



APEC Building Codes, Regulations, and Standards

Minimum, Mandatory and Green

**APEC Sub-committee on Standards and Conformance
APEC Committee on Trade and Investment**

August 2013

APEC Project M CTI 02/2012A - SCSC



This publication was produced by Nathan Associates Inc. for review by the United States Agency for International Development (USAID).

Produced For
Asia Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 68919 600
Fax: (65) 68919 690
Email: info@apec.org
Website: www.apec.org

© 2013 APEC Secretariat

APEC#213-CT-01.8

APEC Building Codes, Regulations, and Standards

Minimum, Mandatory, and Green

DISCLAIMER

This document is made possible by the support of the American people through the United States Agency for International Development (USAID). Its contents are the sole responsibility of the author or authors and do not necessarily reflect the views of USAID or the United States government.

Acknowledgements

The author of this report is Dr. Oswald Chong with contributions by Sylvana Ricciarini. The report was prepared for the Asia-Pacific Economic Cooperation (APEC) organization as part of the APEC Technical Assistance and Training Facility (TATF) program. APEC TATF is managed by USAID, with funding and strategic direction provided by the U.S. State Department Bureau of East Asian and Pacific Affairs, Office of Economic Policy. For further information, please contact Ms. Victoria Waite, Chief of Party, vwaite@nathaninc.com.

TECHNICAL ADVISORY BOARD FOR THE STUDY

The following experts helped to shape this study:

- Alberto Herrera, International Code Council
- Cary Bloyd, Pacific Northwest National Laboratory
- Derek Greenauer, Underwriters Laboratories
- Guiliana Orrezoli Alvarez, Direccion Nacional de Construccion, Peru
- James Olshefsky, ASTM International
- Jessica Roop, American National Standards Institute
- Joanne Littlefair, U.S. Department of Commerce International Trade Administration
- Len Swatkowski, Plumbing Manufacturers International
- Maggie Comstock, US Green Building Council
- Maureen Guttman, Alliance to Save Energy
- Nancy McNabb, National Institute of Standards and Technology
- Pete DeMarco, IAPMO
- Renee Hancher, U.S. Department of Commerce, International Trade Administration
- Ryan Colker, National Institute of Building Sciences
- Shelley Pursell, Air-Conditioning, Heating and Refrigeration Institute
- Sylvana Ricciarini, Civil Engineer, MSCE, Codes and Conformity Assessment Expert

Contents

Executive Summary	1
Table 1A/B. APEC Economies' Minimum and/or Mandatory Codes	8
Table 2. Status of Green Building Codes in APEC Economies	16
Table 3. Status of Mandatory Building Codes in APEC Economies	19
Table 4. Regulatory Frameworks in APEC Economies	27
APEC Economy Reports	33
Australia	35
Brunei Darussalam	43
Canada	49
Chile	57
People's Republic of China	65
Hong Kong China	75
Indonesia	85
Japan	95
Republic of Korea	101
Malaysia	109
Mexico	117
New Zealand	129
Peru	137
Philippines	147
Singapore	153
Chinese Taipei	165
Thailand	171
United States	179
Vietnam	179
Bibliography	203

Executive Summary

OBJECTIVES

This study was developed for the purpose of understanding how APEC member economies utilized building codes to increase building performance, aligning with the “green” goals of resource conservation and waste reduction. Building codes historically have been important policy tools for managing the safety, security, health, environment, and economy of the building sector. They also are regulatory tools for improving the performance of buildings and building professionals. Because buildings are responsible for a high percentage of materials consumption; greenhouse gas; and other emissions, regulation of the building sector offers a prime opportunity for economies to pursue resource conservation and waste reduction objectives. Building codes also provide policymakers with an important tool to encourage economic growth and conduct risk management.

This study is organized with a chapter devoted to each APEC member economy, which seeks to detail:

- *The approach to developing, adopting, administering and enforcing building codes.*
This includes, for non-residential buildings, the existing minimum building codes, including the types of buildings covered, adoption and evolution, key actors and processes, points of accountability, enforcement mechanisms, and main expression of criteria.
- *How existing codes establish minimums for key elements.*
Such elements include electrical, energy, water, sanitation, structural, mechanical, indoor air quality, security, safety, siting, and others.
- *Any existing “green” building codes.*
This includes elements of the minimum code that already are stringent and may be considered “green,” as well as any stand-alone green building code.
- *Protocols and mechanisms in place for monitoring, review, and assessment.*

RESEARCH BASIS

Terminology related to building regulation differs among the APEC member economies. For the purposes of this study, “building code” refers a set of rules that specify a minimum level of requirements for non-residential building construction and occupancy/operation and which meet the following criteria: (i) requirements are adopted and/or enforced by, or on behalf of, a government entity; (ii) criteria are written in mandatory language; (iii) the minimum criteria are mandatory, while requirements above the minimum may be voluntary, mandatory for certain recognitions, or mandatory for a specific population of buildings; and (iv) there is use of referenced standards.

In completing this study, the author conducted independent research to develop information responsive to the objectives. Each APEC member economy was then provided with a draft of the economy-specific chapter and requested to provide comment or clarification. The final study reflects all feedback provided to the author during that comment period. The study also reflects expertise provided by APEC member economy representatives and building industry professionals who participated in the March 5-7, 2013 workshop, *Sharing Experiences in the Design and Implementation of Green Building Codes*, a joint APEC-ASEAN workshop hosted by Peru in Lima, Peru.

KEY FINDINGS AND RECOMMENDATIONS

This Executive Summary expands upon four key findings, which are further elaborated in the economy-specific chapters.

- Multiple pathways support greener building code development in APEC economies.
- Economies have successfully evolved greener codes to increase building performance utilizing different approaches that fit the economy’s specific approach to regulation and engagement of non-governmental entities.
- There are strong commonalities in target areas for greening.
- Common building elements targeted for performance improvement through building codes include energy efficiency, water efficiency, indoor air quality, light pollution, land use, environmental protection, and storm water management.
- Relevant international reference standards exist, supporting all code approaches.
- Regardless of the pathway chosen, international reference standards already exist for many green elements. Such standards can be important mechanisms for efficiently establishing greener code requirements that reflect consensus technical and procedural solutions to common challenges. Use of existing, relevant international standards can also reduce unnecessary obstacles to trade in building products.
- Embracing established best practices in building codes becomes increasingly important.
- As economies move to make codes greener, new and rapidly changing technologies and processes present new complexities and challenges. Specific best practices are detailed on pages 6-7.

APPROACHES TO BUILDING CODES

APEC member economies rely on three fundamental approaches to developing, adopting, administering and enforcing building codes.

Approach	Details
<i>Model Code Developed Separate from Building Regulations</i>	<p>This approach utilizes model codes developed and administered by private organizations and quasi-governmental agencies. Jurisdictions have independent responsibility for developing and adopting building codes, and model codes offer an efficient way of doing so. The jurisdictions also manage building code enforcement, including inspection and permit issuance.</p> <p>In such a system, code enforcement officials, building sector</p>

	<p>professionals affected by the codes, academics and others participate in code development. Model codes are updated every three to five years. Reference standards are developed by separate organizations.</p> <p>Australia, Canada, and the United States follow this system.</p>
<p><i>Model Code Developed Alongside Building Regulations by the Government.</i></p>	<p>A national regulatory system is the most common among APEC economies, with variations coming in the degree of freedom regional (local) governments have in modifying, adopting, and enforcing regulations.</p> <p>In China and Indonesia, the central government develops regulations and codes and local governments may freely adopt or reject the codes and regulations.</p> <p>In Chile, Chinese Taipei, Japan, Korea, Peru, and Vietnam, local governments have little to no authority to modify codes and regulations.</p>
<p><i>Regulations Specify Use of Best Practices and Standards But Allow Equivalent.</i></p>	<p>Under this approach, building regulations are developed and enforced by the government.</p> <p>This approach is utilized in Brunei Darussalam, Hong Kong, China, and Singapore. The regulations allow the use of nonlocal codes, standards, and best practices in place of local ones.</p> <p>In Malaysia, local jurisdictions may develop and enforce their own standards.</p>

REFERENCE STANDARD DEVELOPMENT AND UTILIZATION

All building codes rely on reference standards. In terms of developing standards for various building elements, all APEC member economies rely on committees of industry experts, academics, government officials, and other stakeholders to arrive at a standard. The difference among the economies relates to whether the committees are managed by the government or are private sector-led. In terms of the types of standards cited by reference by the APEC economies in their building codes, the following chart summarizes the study findings.

9 Economies	8 Economies	4 Economies
Strong use of local standards and reference international	Strong use of international standards from multiple	Local standards and international standards are

standards from selective sources.		sources.		used at the same time.
-----------------------------------	--	----------	--	------------------------

MINIMUMS

To begin determining pathways utilized to develop greener building codes, or stand-alone green building codes, the study first examined how economies approached minimum requirements for a set of core building elements. The following chart summarizes the study findings with respect to the approach to these elements in each economy’s code. Some elements of minimum code requirements also contribute to energy or other resource savings, and may be considered natural potential pathways to greening.

Building Code Element	Status	APEC Economies
Fire, Structural, and Electrical	Mandatory	All
Energy & Energy Efficiency	Mandatory	13
	Minimum	4
	Planning	1
	None	1
	No reporting	2
Water Quality & Sewage	Mandatory	Most reporting
	Minimum	3
	Other	Via environmental laws
Location, Siting, Zoning & Environmental Protection	Mandatory and enforced via regulation	All reporting
Indoor Air Quality	Mandatory	7
	Minimum	5
	Not addressed	9
Lighting	Mandatory	All but 3 reporting
Light Pollution	Mandatory	1
	Recommended	3
	Not addressed	17

PATHWAYS TO GREEN

APEC economies have relied on three fundamental approaches to make buildings greener and increase building performance:

Approach	Details
<i>Integrate Green Elements into Existing Building Codes</i>	<p>Most APEC member economies integrate certain green elements into mandatory building codes and building regulations.</p> <ul style="list-style-type: none"> Most APEC economies have incorporated energy efficiency requirements into mandatory codes.

	<ul style="list-style-type: none"> ▪ Building, plumbing and mechanical codes are common areas for introduction of green elements. ▪ Green elements that have been incorporated by some APEC member economies also include indoor air quality, lighting, light pollution, water efficiency, waste recycling and reuse, environmental and land use, and hazardous materials. Please refer to the chart on the following page.
<i>Develop a Separate Green Building Code</i>	<p>This approach involves developing a building code that combines all green elements into one enforceable code.</p> <ul style="list-style-type: none"> ▪ Examples include the International Code Council’s International Green Construction Code (IgCC) and codes developed in China. ▪ In some economies, building regulations mandate the utilization of certain green building rating systems. The combination of the building regulatory mandate and the building rating system becomes, in effect, the green building code. Singapore and Korea are examples of this approach.
<i>Develop Separate Regulations for Green Features</i>	<p>This approach utilizes regulation <u>other than building codes</u> to mandate compliance in green areas throughout the economy.</p> <ul style="list-style-type: none"> ▪ For example, an economy may establish regulations for toxic or hazardous materials use and disposal, land use, zoning, storm water and water quality, or light pollution, among other green features. ▪ Such regulations are typically managed by government entities with enforcement authority, removing the need to re-state the requirements in the building code specifically.

GREEN ELEMENTS

As noted above, APEC economies have almost universally embraced energy efficiency requirements. The following table summarizes the study findings with respect to economies’ adoption of other elements that are specifically considered to be green elements.

19 Economies	17 Economies	16 Economies	12 Economies	2 Economies
Environmental and zoning requirements	Energy and energy efficiency	Water quality and sewage requirements	Indoor air quality requirements	Light pollution requirements

STUDY FINDINGS: SUMMARY TABLES

Tables 1-4 following this executive summary summarize the findings of this study for each APEC member economy, with respect to minimum codes for select building elements, mandatory code requirements, status of green elements within the code or a stand-alone green building code, and the economy’s regulatory framework.

RECOMMENDATIONS

1. *Best practices in basic building code design, adoption, implementation and enforcement become all the more important as economies pursue pathways to greener building.*

With greening come new challenges in rapidly evolving technologies and processes, it is imperative that APEC economies increase the likelihood of success with greener codes by embracing established best practices, including:

Best Practice	Details
<i>Early planning</i>	Plan early and have a vision. With green codes, balance energy, environment, and other societal concerns. Establish indicators for measuring success at the outset.
<i>Early and continuing engagement of all affected stakeholders in development, implementation, and enforcement</i>	<p>Collaboration is important and includes involvement and training of all relevant stakeholders.</p> <p>Consider all affected stakeholders (consumers, labor groups, contractors, building owners). All parties need to understand what the green requirements mean and why they have been incorporated.</p> <p>Cultivate partnerships. Collaboration with standards developers, architects/builders, and rating programs may also be helpful.</p>
<i>Transparency</i>	An open and transparent process for code development will help assure support as the code is implemented.
<i>Reference to international standards reflecting best consensus solutions</i>	To facilitate trade, standards used in codes should be developed using the World Trade Organization Technical Barriers to Trade (WTO TBT) principles for what constitutes an international standard (which include transparency, openness, impartiality and consensus, relevance and effectiveness, coherence, and developing country interests).
<i>A focus on training and outreach</i>	<p>Given that green codes are a new area, a well-trained code staff is essential for effective implementation.</p> <p>Communication and education about green requirements must occur for green codes to succeed. Use of technology, like webinars and online courses, can be good ways to educate relevant stakeholders. Academia can be a resource for education and training.</p>
<i>Clarity and consistency facilitate all stages</i>	<p>Processes should be kept simple. A streamlined permitting process is key.</p> <p>Plan and create tools, such as guides and checklists, so the user knows what to do. Such tools can also help the inspector</p>

	perform his job successfully. Enforcement of green codes depends upon inspection and plan review. Inspection is essential or green codes will not be effective.
<i>Early engagement of policymakers on a broader level to ensure support</i>	

2. *Consensus reference standards exist and may provide efficient options for economies to develop greener building codes.*

International reference standards provide access to up-to-date professional consensus decisions about appropriate technologies and procedures to meet challenges presented by building elements targeted for greening.

3. *Balance is required in an evolving environment.*

The green code system is evolving. It is crucial to maintain building safety while moving forward with greener materials and equipment.

4. *Flexibility exists to meet economy-specific requirements.*

Market tools can be adopted based on specific economies’ social, economic and geographic needs, and establish a proving ground for potential changes in baseline codes.

5. *It is important to recognize post-construction impacts on green performance.*

With regard to assessing green performance, it is important to focus on commissioning, maintenance, and operation of a building to ensure it achieves its potential, as well as the value of developing a common understanding of how to measure and evaluate green building performance.

6. *Additional work is needed on metrics for green measurement.*

Data is needed to measure whether policies are working. There are indicators that can be used, but currently there is no standard way to measure green performance. The effort must begin with benchmarking. Each economy can also use baselines and pilot projects in order to determine their starting point and goals.

7. *Economies may benefit from referring to a wide range of APEC green code resources.*

All speaker presentations provided at the March 5-7, 2013 workshop, *Sharing Experiences in the Design and Implementation of Green Building Codes*, are available at the APEC website. This compendium includes the results of the detailed survey conducted by Peru, in which each of the twenty one APEC member economies was queried on specific actions and experiences to date with regulation to advance green building. The web link for this material is:

<http://mddb.apec.org/Pages/search.aspx?setting=ListMeeting&DateRange=2013/03/01%2C2013/03/01&Name=Workshop%20on%20Sharing%20Experiences%20in%20the%20Design%20and%20Implementation%20of%20Green%20Building%20Codes%202013>

Table 1A

APEC Economies' Minimum and/or Mandatory Codes: Electric, Energy, Water/sanitation, Mechanical, Indoor air, Lighting

Economy	Electrical Code	Energy Code	Water & Sanitation	Mechanical System	Indoor Air Quality	Lighting
Australia	AEMA National Electricity Rules, AS/NZS 3000 & 3017 (mandatory)	GEMS Act & MEPS (mandatory)	Australian National Water Guidelines, NEPC, & NEPM (minimum)	AS/NZS 1668, AS 1691, AS 1731, AS 2665, AS/NZS 2918, AS 3823, AS 4254, ARI 460, ARI 550/ 590, BS 7190 (minimum)	None	NCC, AS/NZS 4847, MEPS, and Californian Code (mandatory)
Brunei Darussalam	Electrical Act 1973, Electricity Act (2011) (mandatory), and DES Guidelines on Proper Installation and Use of Electrical Wirings (minimum)	None	WHO Water Quality Guidelines (minimum)	None	None	None
Canada	CSA C22 (mandatory)	NEC (mandatory)	Legislations from Environment Canada (mandatory)	CAN/CSA-C260-M90, CAN/CSA-B602-05, B52-05 and other Canadian Standards (mandatory)	ASHRAE 62.1 (minimum)	Canadian Federal Energy Efficiency Act 1992, MOL Act on Lighting for workplace (mandatory)
Chile	INN .7.7 Electrical installations of buildings	Program Pais de Eficiencia Energetica (PPEE, Program Energy Efficient Country)	INN F.7.1 Drinking water installations	HVAC INN F.7.5 Heating, artificial ventilation, air conditioning		INN F.7.3 Electricity and artificial lighting
People's Republic of China	GB 50303-2002 (code acceptance of construction quality of electrical installation in building). GBJ 303-88 (building electrical safety inspection national standards), GB 50259-96 (code of acceptance of electrical installations of over 1kv and below), and GB 50259-96 (code of acceptance of electrical installations and lighting during construction), JGJ 16-2008 (commercial building electrical code), JGJ242-2011 (residential building electrical code), GBC63-90 (electrical installations and	GB 50411-2007 (code for acceptance of energy efficient building construction)	CECS 137:2002 (design for steel potable water pipes), GBT19570-2004 (installation of waste water storm water system), GCC-T98-2003 (design and installation of aluminum and copper potable water pipes), GBT 11836-89 (mandatory guideline, design code and standards for concrete and gas delivery pipes), GB50032-2003 (design and installation of external potable water and gas delivery in earthquake zone), DBJ 08-42-95 (design of rainwater disposal systems), Code of Installation and Design Mandatory Guidebook, Code of Design and Installation for Pressure Piping – Industrial Piping, GB3091-2001 (design of soldered pipes), and CECS164-2004 (design and	GBJ 242-82 (design and installation of heating and hygiene engineering), GBJ 302-88 (mandatory quality and inspection control guidelines and standards), GB 50231-88 (installation and inspection of mechanical systems), GB 50243-97 (design and installation of HVAC), GB 50235-97 (mandatory standards for steel piping used for mechanical systems), GBJ 304-88 (mandatory standards for HVAC), GB 50274-98 (design and installation of air quality handling systems for refrigeration of air , GB 50275-98 (design and installation of fan, compressors and boiler systems)	Ministry of Health's Indoor Air Quality Code	Requirements for lighting energy use and lighting installation methods are part of the energy and building system (including fire) codes and mandatory standards. GB 50034-2004 (lighting fesign of buildings) is a mandatory standard as it has been incorporated into many codes. It is administered by the Ministry of Construction.

Economy	Electrical Code	Energy Code	Water & Sanitation	Mechanical System	Indoor Air Quality	Lighting
	distribution), GB 50062 (electrical installation protection and automated system), and GB 50055 (electrical distribution network design system)		installation of underground piping).			
Hong Kong, China	EMSD's Code of Practice for the Electricity (Wiring) Regulations (Mandatory)	EMSD's Building Energy Code (BEC) 2012 (Mandatory)		Various codes from EMSD (mandatory)	Indoor Air Quality Certification Scheme (voluntary)	EMSD's BEC 2012 (covering lighting installations) (Mandatory)
Indonesia	SNI Design Procedures (minimum)	National Energy Policy and Voluntary Commercial Energy Codes 1992 (minimum)	National Plumbing Code Handbook (minimum) WHO Guidelines on Drinking Water (minimum)	IAPMO (minimum)	None	SNI 03-2396-2001 Procedures for Natural Lighting System Design in Building (minimum)
Japan	JIS C 60364-5-55 (mandatory)	JIS Q 50001:2011 (mandatory) JIS Z 9204:1991 (minimum)	JIS B 2312 (mandatory)	JIS B 9908, JIS A 1431 (minimum)	Building Standard Law's (2003) : Emission Control and Installation of Ventilation System (2007) Indoor Air Quality Guidelines, Building Sanitation Law (2002) Housing Quality Assurance Law (2002) (mandatory)	Mandatory: JIS C 0364 (electrical installations of buildings), JIS C 8105 (luminaires in buildings), JIS Z 9120 - 29(indoor workplace, outdoor workplace, sports, tennis court, sport stadiums, swimming pools etc.), ISO 8995 (work place: indoor, security, and outdoor), ISO 30061 (emergency) Minimum: outdoor light pollution guidelines
Republic of Korea	Korean Standard on various electrical engineering and works (mandatory)	Mandatory: Building Design Criteria for Energy Saving (BDCES), Building Certification System Minimum: Energy Audit	Included in Korean Building Code and Korea's Water Quality Standards (both mandatory)	Korean Standards for Mechanical Engineering (mandatory)	Ministry of Environment's IAQ Control in Public Facilities Act (mandatory) Various policies on IAQ (minimum)	Mandatory: Ministry of Environment's Lighting Pollution Prevention Law Based on Artificial Lighting Minimum: Energy Standard and Labeling
Malaysia	MS 1979, Electrical Installations of Buildings – Code of Practice (minimum)	MS 1525, Code of Practice on Energy Efficiency for non-residential Buildings, UNDP Malaysia Building Sector Energy Efficiency Project, National Energy	Water Services Industry Act 2006, National Water Services Commission Act for Peninsula Malaysia (not affecting East Malaysia), Sewerage Act 1994 (Affects both), and Water Forum,	MS 1460, MS 1918, MS IEC 60335 (minimum)	Code of Practice on IAQ, Department of Occupational Safety and Health (minimum)	MS 1038, MS IEC 60364, MS 603, MS ISO 8995, MS 825, MS IEC 60335, MS 947 (minimum)

Economy	Electrical Code	Energy Code	Water & Sanitation	Mechanical System	Indoor Air Quality	Lighting
		Policy (minimum)	Ministry of Energy, Green Technology and Water (mandatory)			
Mexico	NOM-001-SEDE 2012 by the Secretary of Energy – based on international standards, such as National Fire Protection Association (NFPA) 70, National Electrical Code (NEC) 2011, and others referenced in the complementary technical standards (CTN) of the Mexico City Building Code (MCBC)	NOM-018 Thermal insulation for buildings - Energy Agency National Agency for Standardization and Certification of Building and Construction, NOM-003-ENER-2000 Energy Secretary. Thermal Efficiency of Water Heaters There are several NOM and NMX.	NOM-008-CAN 1998 SEMARNAT (minimum and maximum flow in shower heads) There are several NOM and NXM on this subject.	MCBC-CTN and local codes/standards/ordinances	MCBC-CTN and local codes/standards/ordinances	MCBC-CTN and local codes/standards/ordinances
New Zealand	NZ Energy Safety Authority Electrical Codes of Practice (minimum)	Building Code of NZ (in National Code, mandatory)	Ministry of Health Water Quality and Foul Water standards, Resource Management Act, Water Minimization Act, and NZS 9201 (mandatory)	AS/NZS 2537 & 4793 (mandatory)	BRANZ Designing Quality Learning Spaces: Ventilation and Indoor Air Quality Guidelines, Building Code of NZ, NZS 4303 (Mostly mandatory w/ guidelines)	Building Code of NZ (mandatory)
Peru	National Electric Code – Supply (2001), National Electric Code – Use (2006), Modifications to National Electric Code – Use (2008)	47 voluntary energy efficiency standards (Normas Técnicas Peruanas – NTP) up to December 2012. Existence of EE policies and programs.	Title II.3 of the RNE Obras de Saneamiento OS Standards / Sanitation Works and Instalaciones Sanitarias standards / sanitary installations Title III.3 of the RNE	Title III.4 Instalaciones Eléctricas y Mecánicas	None	None
Philippines	Included in National Building Code, National Electrical Code (mandatory)	Some in National Building Code, no separate code (mandatory), Philippines National Energy Efficiency and Conservation Program (minimum)	Clean Water Act, Plumbing Code of the Philippines, National Sanitation Code of the Philippines (mandatory)	Philippines Mechanical Code	National Ambient Air Quality Standards (minimum)	Included in Philippines National Energy Efficiency and Conservation Program (minimum)
Singapore	EMA’s code of practice on lighting for workplace and installations (mandatory)	EMA’s code of practice for energy efficiency in building (mandatory)	PUB Code of practice for water and sewerage, and SS CP 48, PUB ABC Water Design Guidelines (mandatory)	SS 553, BCA Code on ETTV, ASHRAE standards 90.1 and guidelines (mandatory)	SS 554 (minimum)	SS 531 (minimum)

Economy	Electrical Code	Energy Code	Water & Sanitation	Mechanical System	Indoor Air Quality	Lighting
Chinese Taipei	Electrical Act (mandatory)	Energy Management Law, National Energy Conservation and Carbon Reduction Masterplan (mandatory)	Plumbing code in Building Act (mandatory), Sewerage Law and Enforcement Rule for Sewerage Act (mandatory), Sewer Engineering Design Guidelines (minimum)	Enforcement Rules for Common Duct, Common Duct Act (mandatory), Equipment Energy Efficiency Management and Promotion (minimum)	IAQ Act (mandatory)	Various lighting standards (some mandatory, others are not)
Thailand	Included in Building Control Act (mandatory)	Energy Conservation Promotion Act, Building Energy Code (mandatory)	Ministerial Regulation on Mechanical and Sanitary Design, Ministerial Regulation on Waste Water (mandatory), Ministry of Natural Resources and Environment Guidelines (minimum)	Ministerial Regulation on Mechanical and Sanitary Design (mandatory)	Included in Building Energy Code (mandatory)	Included in Building Energy Code (mandatory)
United States	NFPA 70, NEIS (mandatory if implemented)	ASHRAE 90.1, IECC (mandatory if implemented)	USEPA, NPDES, Clean Water Act (mandatory: Federal Law), Guidelines on Water Reuse, SDWA (minimum)	IMCC (mandatory if implemented), ASHRAE Standard 15, various ASTM standards (minimum)	OSHA IAQ Standards, ASHRAE 62.1 (minimum)	Requirements included in ASHRAE 90.1, 189.1, IEC, IBC, IDA, and thus mandatory if implemented IESNA Handbook (minimum) IDA-IES Model Lighting Zone Ordinance (mandatory if implemented)
Vietnam	Code on Electric Facility-Part I: General Regulation, Code on Electric Facility-Part IV: Protection & Automatic National technical codes for operating and maintenance power system facilities National technical regulations on electric safety, on safe work for electric welding & welding jobs (mandatory)	Part of Vietnam Building Code (mandatory)	Code of Internal Water Supply & Drainage Systems, national technical regulation on surface water quality (mandatory)	National technical regulations on safe work of steam boiler and pressure vessel, and on safe work for electric lift	National technical regulations on ambient air quality, and on hazardous substances in ambient air (mandatory)	None

Table 1B

APEC Economies' Minimum and/or Mandatory Codes: Security, Fire, Structural, Location/Siting/Zoning, Environment, Safety

Economy	Security	Fire	Structural	Location, Siting, Zoning	Environment	Safety
Australia	None	NCC (mandatory)	NCC (mandatory)	Legislation from Department of Sustainability, Environment, Water, Population and Communities (mandatory)	Included in Zoning (mandatory)	BCC (mandatory)
Brunei Darussalam	None	Brunei Fire Code, and PBD 12 (mandatory)	Building Control Act (mandatory)	Laws of Brunei's Town and Country Planning (Development Control), and National Land Use Master Plan (mandatory)	Various environmental regulations and policies of the Department of Environment Parks and Recreations (mandatory)	Brunei Standards: Site Safety Audit (8), Guidelines for Safety Organization (12), Site Safety Assessment (11-2), and Guidelines on Safety on Construction Site. (minimum)
Canada	Various government agencies (minimum)	NFC (mandatory)	NBC (mandatory)	Canadian Environmental Protection Act and other government related acts (mandatory)	Included in Zoning (mandatory)	CSA standards and Health Canada's workplace regulation (mandatory)
Chile	INN F.5.2 Safety in execution of works - Personal Protection	INN F.5.1 Fire prevention	F.2.3 Technical Drawing - Project presentations - Technical Specifications		F.4.6 Sustainability	F.5.2 Safety in execution of works - Personal Protection
People's Republic of China	No mandatory code or standards.	There are several fire codes and mandatory standards: GB 50045-95 (design of high rise buildings), GBJ 16-2001(design of buildings), GB 50016-2006 (design of building fire protection and prevention), GB 50067 -97 (design of garage and parking fire protection), GB 50038-2005 (mandatory design specification for civil air defense—including fire protection), GB 50098-2009 (engineering design for fire safety norm for civil air	42 mandatory structural codes 28 mandatory structural standards Codes are divided into loading, concrete, steel, brick and masonry, timber, rolled steel, seismic, foundation, PRC, RC structure for tall buildings, RC structure for shell, mash concrete structure, FRC structure, and RC solid.	Extensive laws are enforced by the Ministry of Planning and Economic Affairs, Department of Development Planning of the Ministry of Science and Technology, and the Ministry of Housing, and Urban-Rural Development.	All environmental laws and regulations are enforced and developed by the Ministry of Environment.	No separate safety code or standard, all are incorporate into other elements.

Economy	Security	Fire	Structural	Location, Siting, Zoning	Environment	Safety
		defense basement), GB 50222-95 (fire prevention design of interior decorations in buildings), GB 50261 (installation of automated fire extinguishing system). Building codes also have fire protection requirements.				
Hong Kong, China	Security Bureau's Manual for Security Personnel Providing Guarding Services in Buildings (minimum)	Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment and Fire Services Department Circular Letters (Mandatory). Buildings Department's various regulations and codes, not as a specific document (Mandatory)	Buildings Department's various regulations and codes, not a specific document (Mandatory)	Town Planning Ordinance and statutory plans and master layout plans for comprehensive development schemes (mandatory)	Environmental ordinances on air, noise and water pollutions, ozone layer, EIA, chemical control, and products. (Mandatory)	OSHC guidelines on workers safety
Indonesia	None	SNI 03-1735-2000, SNI 03-1736-2000, <u>SNI 03-1745-2000</u> , <u>SNI 03-1746-2000</u> (Mandatory)	Included in National Regulation Law 28 of 2002 and Regulation 36 of 2005 (Mandatory)	Zoning Law 26 of 2007 (mandatory)	Regulations published by Environmental Agency (mandatory)	Included in National Regulation Law 28 of 2002 and Regulation 36 of 2005 (mandatory)
Japan	None	Fire Service Law (mandatory)	Building Standards Law (in mandatory Building Code)	City Planning Law, Environmental Laws and Standards (mandatory)	Environmental Laws and Standards (mandatory)	Included in mandatory Building Code
Republic of Korea	None	Included in Building Act (mandatory)	Included in Building Act (mandatory), various standards provided by KCI, KSSC, KRISC, and KATS are also mandatory (even though they're standards)	Most zoning laws are mandatory and managed by the Ministry of Environment (mandatory)	All environmental are laws and mandatory. All laws enforced by the Ministry of Environment (mandatory)	Special Act on the Safety Management of Facility (mandatory)
Malaysia	None (or unclear)	Circular and code in Malay language (mandatory)	ICS D Section, MS 416, MS 977, MS IEC 8124, MS 544, MS 1294, MS 1057, MS 229, MS 1933, MS 1195, MS 1226, MS 1553, MS 1314, MS 1490 etc. (included in Building Code and mandatory)	10th Malaysia Plan, Malaysia Economic Planning Unit, Town and Country Planning Act (mandatory but the enforcement is depends on situation)	Environmental Quality Act 1974-2011, Fisheries Act, Land Conservation Act, Local Government Act, National Forestry Act, National Park Act, Protection of Wildlife Act, Radioactive Substances Act, Water Enactment Act, Sarawak Biodiversity Center	Department of Occupational Safety and Health's guidelines for public safety and health at construction sites, and code of practice for safe working in a confined space.

Economy	Security	Fire	Structural	Location, Siting, Zoning	Environment	Safety
					Ordinance, Sabah Biodiversity Enactment, Sarawak Natural Resources and Environment Ordinance, Sabah Environmental Protection Enactment, Sabah Forest Enactment, Sarawak Forest Ordinance (mandatory)	Occupational Safety and Health Act 1994 (mandatory)
Mexico	MCBC-CTN and local codes/standards ordinances	MCBC-CTN and local codes/standards ordinances	MCBC-CTN and local codes/standards ordinances	MCBC-CTN and local codes/standards ordinances	MCBC-CTN and local codes/standards ordinances	MCBC-CTN and local codes/standards ordinances
New Zealand	None	Building Code of NZ (mandatory)	Building Code of NZ (mandatory)	Urban Design Protocol, Resource Management Act, & Quality Planning Act (mandatory)	Included in Zoning (mandatory)	Building Code of NZ, AS/NZS 4804, Health and Safety in Employment Act 1992, Hazardous Substances and New Organisms Act 1996 (mandatory)
Peru	None	None	Title III.2 of RNE Estructuras (structures) E.010 (wood), E.020 (loads), E.030 (seismic resistant design – being revised), E.040 (glass), E.050 (soil and foundation – being revised), E.060 (reinforced concrete), E.070 (masonry), E.080 (adobe), E.090 (steel structures)	None	N/A	N/A
Philippines	None	National building code (NBC) covers fire resistivity design; National Fire Code (mandatory)	Code in NBC (mandatory)	National Planning Act or similar (mandatory)	Embedded in Pollution Control Decree, and various regulations (mandatory)	None
Singapore	Prescribed guidelines by Singapore Civil Defense Force, Internal Security Dept., Police Force and Building Control Act (BCA) (minimum)	SS CP 2, 10 & 19 (in BCA) (mandatory)	BCA (mandatory)	URA Master Plan (mandatory)	NEA codes of practice: environmental health, pollution control, legionella bacteria, & piped drinking water sample (mandatory)	SS CP 20, 45, & 79, 98, 473, 506, 508, 510, 531, 536, & 537, MOM code of practice on heights, risk management (minimum)
Chinese	None	Included in Building Act	Building Act, and Seismic Design	National Park Law, Urban Renewal Act, Urban Road Act, New Town	Environmental laws are also integrated into zoning, like	In Building Codes

Economy	Security	Fire	Structural	Location, Siting, Zoning	Environment	Safety
Taipei		(mandatory)	Standards (mandatory)	Development Act, Regulation on Land Use Control and Buildings in New Towns, Regional Planning Act (mandatory)	waste water, waste disposal, carbon emissions, air pollution etc. All are managed by Environmental Department (mandatory)	(mandatory)
Thailand	Unsure	Fire requirement included in Building Control Act, and Ministerial Regulation on Structural Design (mandatory)	Ministerial Regulation on Structural Design, Building Control Act (1979), Engineering Institute of Thailand Standards, IBC, and ACI 318 – Building Code Requirements (All in Thai except ACI 381) (mandatory)	Ministerial regulation on open space, boundary and building interval (mandatory)	Environment Quality Promotion and Preservation Act (mandatory)	None
United States	Codes by GSA and DOD (Only for Federal)	IFC, NFPA 1 (mandatory if implemented)	IBC, NFPA 5000 (mandatory if implemented), ACI, ASI (minimum)	IZC, IWUIC, EPA Brownfield Recovery Act, EPA Smart Growth, NPDES, Dredge and Fill Activities, SuperFund, and various EPA regulations (mandatory); zoning is generally the responsibility of jurisdictions	Analyzed with zoning as EPA environmental regulations affect zoning (EPA regulations mostly mandatory)	Included in fire and security (mandatory)
Vietnam	None	Part of Vietnam Building Code (mandatory)	Part of Vietnam Building Code (mandatory)	Vietnam Building Code. Regional and Urban Planning and Rural Residential Planning (mandatory)	National technical regulations on effluents of natural rubber processing industry, on emission of health care solid waste incinerators, on the allowable limits of heavy metals in the soils, on the effluents of aquatic products processing industry, on pesticide residue in soils on hazardous waste thresholds, on industrial emissions of inorganic substances and dusts, on emission of thermal power industry	Dwellings and Public Buildings - Occupational Health and Safety, National Technical Regulation on Noise, National Technical Regulation on Vibration (mandatory)

Table 2*Status of Green Building Codes in APEC Economies*

Economy	Green Code/Rating System	Green Features in Mandatory Code	Implementation Status	Evolution	Code is Part of National Building Code System
Australia	No code. Green Star is the rating system.	No	Voluntary	Green Building Council of Australia administers Green Star. Inputs and suggestions from stakeholders and general public are administered by Green Star Review Committee. Standards are adopted from various Australian and Australia/New Zealand Standards, and the environmental acts and regulations of the Department of Sustainability, Environment, Water, Population and Communities.	No
Brunei Darussalam	Green Building Initiative	Per website, may become national code	Still at implementation stage	Just started; no details provided.	No
Canada	No code. BOMA BEST, BREEAM, CSA, LEED, EnerGuide, GreenGlobe are rating systems.	No	Mostly voluntary, however, NBC has included similar standards in NBC	LEED and BOMA BEST managed by their respective non-profit organizations.	Separate green building code not on the radar but code has many of green features.
Chile	No code.	No	N/A	Development of different standards addressing sustainability issues in the built environment is notes. Important efforts on EE.	No.
People's Republic of China	JGJ/T229-2010 (green design for civil buildings)	Green features are in hundreds of codes.	Mandatory.	Not sure.	Yes.
Hong Kong, China	No code. CEPAS and BEAM Plus are rating systems.	No	Voluntary at this time. CEPAS is maintained by the Buildings Department and BEAM is private and nonprofit	CEPAS is maintained and managed by the Buildings Department. It does not set a timeline for updates and is generally not enforced. BEAM Plus is maintained by the Green Building Council of Hong Kong. BEAM follows the concept of BREEAM closely but is implemented like LEED.	No
Indonesia	No code. GREENSHIP is rating system.	No	Voluntary and run by private sector	Developed by private sector entirely. administered by Green Building Council of Indonesia.	No
Japan	No code. CASEBEE is nationally accepted rating system.	No	Voluntary and run by private sector.	Developed and administered by Japan Green Building Council.	No
Republic of Korea	No code. Green Building Certification System (GBCS) is mandatory and enforced. It is a rating system.	Most green standards and features are in the Building Act. The GBCS rating system somehow enforces features in the Act. The minimum rating is considered mandatory.	Enforced. Standards are part of the national building code.	Enforced by the Building Act, and thus the Building Planning Division enforces the Act and GBCS. The Korean Agency for Technology and Standards maintains and updates the GBCS standards (they are also involved in NBC too).	Green standards are but GBCS is not.

Economy	Green Code/Rating System	Green Features in Mandatory Code	Implementation Status	Evolution	Code is Part of National Building Code System
Malaysia	No code, Currently exist 1 rating systems, the Green Building Index non-government);The government under Ministry of Works (MOW) is in the midst of developing another green building assessment system.	Incentives provided by Green Technology Initiatives	GBI: Initial document checks and followed by on-site verification; Green Technology Initiatives:	GBI: Committee with members from industry, academia and government. GBI is maintained by Malaysian Green Building Confederation (MGBC)	Partially
Mexico	No code. Standards and standards address sustainability in the built environment.	The complementary technical standards of the Mexico City Building Code address aspects of sustainability (water and energy efficiency).	A national green code may be developed.	N.A	Not at this time.
New Zealand	No code. Green Star of New Zealand is the rating system	No	Voluntary	Green Star is administered by Green Building Council of New Zealand.	No
Peru	No code or rating system.	No	N/A	N/A	N/A
Philippines	No code, but government has plans to develop one. No rating system.	No	N.A.	N.A.	N.A.
Singapore	The Green Mark rating system is administered like a code. Some aspects of the system are enforced.	Part of the rating system is mandatory, even though Green Mark is not a code.	Enforced at minimum level with incentives.	Green Mark is administered by the Building and Construction Authority of Singapore. It has a separate department that maintains and updates the requirements in the rating system. The same department also enforces the rating system on all buildings in the economy (i.e. its enforced like a code, even though it's a rating system).	No
Chinese Taipei	No mandatory code. The Green Building Promotion program promotes Green Building Labels.	No	Developed by the Ministry of Interior, and Building Research Institute	Building Promotion program provides the education and workshop on how to implement green building standards (includes Green Building Label), while the Ministry of Interior's Building Department implements the Label. Building Research Institute updates and maintains the standards.	No

Economy	Green Code/Rating System	Green Features in Mandatory Code	Implementation Status	Evolution	Code is Part of National Building Code System
Thailand	No mandatory code. Rating system is the Thai Rating of Energy and Environmental Sustainability	No.	Launched in December 2012.	Maintained by private sector, the Thai Rating of Energy and Environmental Sustainability	No.
United States	IgCC and ASHRAE 189.1	Some green features are also in model codes (energy and water efficiency)	5 states have adopted the IgCC statewide as a compliance pathway for their green requirements, 3 other states have jurisdictions that have adopted parts or all of the IgCC as their green code or compliance path DoD uses parts of ASHRAE 189.1, but not all.	IgCC administered by International Code Council while ASHRAE 189.1 administered by the American Society for Heating, Refrigeration, and Air-conditioning Engineers.	Some green building features are in model codes.
Vietnam	No code. Rating system is LOTUS, administered privately by Vietnam Green Building Council.	No, even though energy conservation and indoor air quality might be in the national code.	Not yet released but will be this year.	Privately developed by the Vietnam Green Building Council. Yet to be launched.	No.

Table 3*Status of Mandatory Building Codes in APEC Economies*

Economy	Code	Buildings Covered	Reference Standards	Green Features			Adoption, Evolution, Enforcement (Details in Table 4)
				Coverage	Actors	Development Timeline	
Australia	National Construction Code (NCC), and comprising the Building Code of Australia (Volumes 1 and 2), and the Plumbing Code of Australia (Volume 3)	Four levels: Objectives and Functional Statements providing guidance; and Performance Requirements and Buildings Solutions (deemed-to-satisfy solutions and alternative solutions) for compliance.	Mainly AS, AS/NZS and ISO, selective European, American and British Standards	<p>Energy efficiency; Health and Amenity</p> <p>Water and energy efficiency relating to plumbing work and new building work are included in the NCC.</p> <p>Green Building Council of Australia has taken on the task to develop green building rating system in Australia</p>	Building Code of Australia is involved for all national code. Australian National Standards develops standards for green buildings. Green Building Council develops green building rating system.	Water and energy efficiency are the only green features included in the NCC.	<p>NCC is developed as a model code by the Australian Building Code Board (ABCB), Standards are developed and administered predominantly by Standards Australia, Building Regulatory and Enforcement Power is a State and Territory responsibility, technical committee.</p> <p>Members are mainly from various trade associations, professional organizations, government, and scientific/research agencies.</p>
Brunei Darussalam	Town and Country Planning (Development Control) Building Control Act	All except low-rise	Brunei Standards, ISO/IEC Standards, and PBD	None	Green Building Initiative is launched by the government and the BCD seems to be an extremely important authority to implement green features and green codes.	None at this time.	The Construction Planning and Research Unit of the Ministry of Development is the main developer and enforcer. The unit also conducts inspections alongside a private sector “Qualified Person” and issues permits. No timeline to update codes.
Canada	National Building Codes	Loading and strength requirements, plus house, small buildings, large buildings, complex buildings, and onsite sewerage systems	Standards from Canada and USA mainly: Such as CSA, UL, Canadian Wood Council etc.	Indoor air quality, noise reduction, hazardous materials containment, view of the outdoors, water and sewerage protection of buildings, conservation of resources, water, and energy, and environmental integrity	<p>Codes involving the CCC and Commission on Building and Fire Codes must include the features. For privately developed codes, the codes and standards organizations have to include themselves. Provincial and territorial governments may include green features in their codes.</p> <p>Canada has many privately developed green building rating systems (these are not codes).</p>	Most green features have been in most mandatory codes since 2000. More will be included in future editions.	The Canadian Codes Center of the National Research Council of Canada publishes and maintains six national model construction codes on behalf of the Canadian Commission on Building and Fire Codes. The four codes relevant to this project include the National Building Code, the National Fire Code, the National Plumbing Code, and the National Energy Code. The Canadian Commission on Building and Fire Codes is responsible for accepting, reviewing, amending and rejecting requests for code change.

Economy	Code	Buildings Covered	Reference Standards	Green Features			Adoption, Evolution, Enforcement (Details in Table 4)
				Coverage	Actors	Development Timeline	
Chile	National building code- General Law of Urban Planning and Construction	Housing and commercial	Mainly Normas Chilenas INN	Standards addressing aspects of sustainability (energy efficiency)	Energy efficiency and other sustainable aspects in the built environment are incorporated in the technical standards.	N/A	Code adoption is local through regional secretariat ministries. The Ministry of Housing and Urban Development supervises laws, regulations, administrative and technical requirements for construction and urbanization and interprets provisions of land zoning tools.
People's Republic of China	National Construction Law leading to development of many codes (45 for structures and hundreds of building codes)	Building uses, height etc.	Standards are not referenced but incorporated directly into the documents	Energy efficiency, water efficiency, waste management, lighting, light pollution have been integrated into existing codes.	Centrally by the Ministry.	N.A.	See Table 4.
Hong Kong, China	Building Ordinance and Buildings Dept.'s codes of practice	Building use	BS, AS/NZS, JIS, American Standards, EU standards, Chinese standards	None	Mostly government, but private sector and professional orgs have been developing and promoting rating systems. One of the few economies where a government green rating system runs hand in hand with a privately run rating system.	Government green building rating has existed since 2004, and the private rating system since 2008.	Enforced and administered by the Buildings Department. There are only four divisions in the department.
Indonesia	Law 28, Law 29, Regulation 36, Regulation 76, Land and building control are integrated (mandatory)	Building use	National Standards Institute	Environmental protection and requirements are integrated into Law 29 (land planning) and thus are part of the building regulatory control system	At this time, no government effort to develop green codes and standards. Private sector (Green Building Institute of Indonesia) has a rating system called GREENSHIP.	N.A.	Laws by the central government are passed by the parliament, and enforced in all central government jurisdictions. The central government also passes laws for regional governments, and assists them in developing codes, even though regional and local governments tend to develop their own codes. Regional and local codes mostly contain punishment and payment information, rarely technical information. The authority handling the law is the Building Department.

Economy	Code	Buildings Covered	Reference Standards	Green Features			Adoption, Evolution, Enforcement (Details in Table 4)
				Coverage	Actors	Development Timeline	
Japan	Building Standard Law	All buildings except low-rise residential	AIJ standards, guidelines, and specifications, and JCI guidelines, specifications and manuals	Indoor air quality	The government introduces indoor air quality law and energy efficiency into code. Light pollution and environmental impacts are enforced by other ministries. CASEBEE is maintained and administered by the private sector.	See CASEBEE history.	Building Standard Law Enforcement Order by the Minister of Land, Infrastructure, and transport, and ordinances of municipal governments. Both laws are applicable throughout Japan. The Japan Housing Loan Corporation and building officials designated by the Building Standard Law enforce the law. Building engineers are also obligated to ensure code compliance.
Republic of Korea	Building Act Enforcement Decree of the Framework Act on the Construction Industry Enforcement Decree of the Building Act	By building use	Korean Standards	Energy efficiency, energy saving, treatment of rainwater, protection of water quality, waste reuse and recycling, and indoor air quality. With Canada has the most green features in regulations and codes. The only other economy with a government green rating system that includes all green features in regulations.	By the Ministry of Land, Transport and Maritime’s task force or committee. The Building Planning Division (BPD) will develop regulations. Most green features are in building regulations. BPD also runs a green rating system. Some mandatory green features in codes are also in the rating system.	Green features have been included in the codes since 2008 . They were introduced by BPD through research projects (mainly through universities).	The Building Act and amendments thereto are passed by the Congress and Senate for approval by the President. The Ministry of Land, Transport, and Maritime Affairs Building Planning Division makes the Act implementable and establishes enforcement decrees. The Division also manages, updates, and enforces the Act throughout the entire economy. Each local government is required to enforce the code and to ensure that local ordinances conform to the Act.

Economy	Code	Buildings Covered	Reference Standards	Green Features			Adoption, Evolution, Enforcement (Details in Table 4)
				Coverage	Actors	Development Timeline	
Malaysia	Street, Drainage and Building Act (1974); Uniform Building Bylaws (1984); Building (Federal Territory of Kuala Lumpur) Bylaws 1985 (mandatory), Occupational Safety and Health Act (1994), Solid Waste and Public Cleansing Management Act 2007(Act 672) Dept. of Standards Malaysia through Industry Standards Committee on Building, Construction and Civil Engineering, ISC D has develops 357 MS where 20 MS has been made mandatory and referred in the acts.	Building use (excludes low-rise up to three stories)	Malaysian Standards (MS), and other standards that adopted from USA, Australia, Canada, Singapore, and Japan.	Part of Malaysian Standards (MS) but excluded from ISC D., the Ministry of Works, CIDB Green Technology Initiatives	Code is controlled by governments and green features have to be introduced by government. Rating system is privately run by the Malaysian Green Building Confederation. Malaysia Standards (MS) recently developed a lot of green standards such as energy efficiency.	Green Building tool first developed in Malaysia in 2009 through engagement with key stakeholders in the industry.	Malaysian Standard (MS) are developed by Dept. of Standards Malaysia but enforced by relevant departments under respective ministries e.g. Department of Local Government and Housing, Department of Environment under MOSTI, Energy Commission under KeTTHA and Construction Industry Development Board (CIDB) of the Ministry of Works. Standards are updated by Industry Standards Committees (ISCs) and relevant ministries.

Economy	Code	Buildings Covered	Reference Standards	Green Features			Adoption, Evolution, Enforcement (Details in Table 4)
				Coverage	Actors	Development Timeline	
Mexico	Most code development is for Mexico City, the capital and largest city. Cities and municipalities of different sizes and in regions with distinct hazards have codes but usually just adapt or simply copy the Mexico City building code (2004).	All building types	Mandatory <i>normas oficiales Mexicanas</i> (NOM) and <i>normas Meicanas</i> (NXM) which are available for voluntary adoption.	Green aspects are addressed through the standards and standards available in the MCBC's complementary technical standards.	A green code may be developed. Various standards and standards address aspects of sustainability, especially energy efficiency.	N.A	Jurisdictional authorities enforce building code provisions. There are local systems for the enforcement of general building codes in place, with some third party involvement through auxiliary, nongovernmental entities that confirm compliance with building codes.
New Zealand	Building Code of NZ	Building use (excludes low-rise residential)	Mostly AS and AS/NZS, with some European, American and British Standards	Energy efficiency, hazardous wastes, waste treatment, indoor air quality, and noise pollution	The building code has provisions for energy efficiency, hazardous wastes, waste treatment, indoor air quality, and noise pollution. These are inserted into the codes by the Building and Housing Department. Green Star New Zealand, a building rating system, is maintained by the private Green Building Council.	Green features have been in the codes since 2005 through various acts by the central government. These features are continuously updated by the Building and Housing Department.	Department of Building and Housing develops and enforces the code that is translated from Building Control Act passed by the parliament. The BCA scheme requires that any territorial authority or regional authority/council that carries out building consent, inspection and approval work be accredited (International Accreditation New Zealand) against the standards and criteria in the Building (Accreditation of Building Consent Authorities) Regulations 2006. The council must then be registered by the Department of Building and Housing against the standards and criteria in the Building (Registration of Building Consent Authorities) Regulations 2007.

Economy	Code	Buildings Covered	Reference Standards	Green Features			Adoption, Evolution, Enforcement (Details in Table 4)
				Coverage	Actors	Development Timeline	
Peru	National Construction Code (<i>Reglamento Nacional de Edificaciones</i>) (RNE)	Residential and commercial	Technical standards in the RNE are developed and/or updated by the vice ministries of housing and urbanization and of construction and sanitation. Voluntary standards are developed by Peru's national institute for the defense of competition and the protection of intellectual property (INDECOPI)	Standards addressing aspects of sustainability, such as energy efficiency.	N/A	Energy efficiency is an important element of green features in the Building Code. There are plans to include more sustainable features in National Code.	The Ministry of Housing, Construction and Sanitation approves and issues the RNE. As the national governing body, the Ministry is in charge of designing, regulating and implementing policy for national housing, urban planning, construction and sanitation. Municipalities are responsible for enforcement and use municipal technical inspectors.
Philippines	National Building Code of Philippines	All building types but low-rise.	ASTM International for Concrete, ACI Standards for Concrete, Philippines National Standards (PNS)	APEC document states that energy efficiency is included but it is not found in actual code	Government is planning to introduce green building code. Some local governments have ordinances requiring green features in homes. Codes are not yet green.	Bills still in Senate for debate.	The code is converted from act (passed by the Senate and House) and enforced by the Department of Public Works, Transportation and Communication. All municipalities with an income of more than Peso 2.99 million must comply with the code. Enforcement is conducted by local municipalities, with low income municipalities assisted by the government.
Singapore	Building Control Act	Building use (residential low-rise, private residential high-rise, public residential (all high-rise), commercial, industrial, and others	BS, AS/NZS, JIS, American Standards, EU standards, Chinese standards	Most green building features if you consider the use of green building rating system is now mandatory.	Ministry of National Development will be responsible for green plans, and the BCA for regulations and standards. BCA may also opt to use Singapore Standards. BCA administers Green Mark, the rating system.	Green Mark has been around since 2004, and has been updated five times. It is a quasi-regulation, since it is mandated at the minimum rating, but higher rating is not required.,	Building Control Act passed by parliament is passed to Ministry of National Development and made implementable by the Building and Construction Authority (BCA). Only the BCA drafts and enforces the law.

Economy	Code	Buildings Covered	Reference Standards	Green Features			Adoption, Evolution, Enforcement (Details in Table 4)
				Coverage	Actors	Development Timeline	
Chinese Taipei	Building Act Construction Industry Act	By building use	Chinese National Standards	Building energy efficiency, green outdoor space, pollution reduction, and use of environmentally friendly products	The Ministry of the Interior and CPA decide to include green features in code. Only energy efficiency has been included in the regulations. The green rating system is owned and operated by the Ministry of the Interior through the Building Research Institute.	N.A.	Acts are passed by Congress and Senate for approval by the President. to The Construction and Planning Agency of the Ministry of Interior then makes it implementable. The agency also manages, updates, and enforces the Act. Municipalities enforce the Central Administration Act.
Thailand	Building Control Act Building Inspection Regulation Energy Promotion Act	Building use and size	Thailand Standards Institute and relevant standards of ASTM International, Uniform Building Code, American Concrete Institute, and standard institutions around the world.	Energy efficiency	Energy efficiency is mandatory and part there is a mandatory energy efficiency code. Regulations are the sole responsibility of the Department of Public Works, the City Planning Building Control Bureau. Thus any green features must be introduced by the government. Thai Green Building Institute (private), launched Thai Rating of Energy and Environmental Sustainability (TREE) in 2012.	Not much information available at this time.	Acts of the Federal government are passed to ministries, which make them implementable. The Building Control Act (1979) and the Building Inspection Regulation are administered by the Ministry of Interiors' Department of Public Works and by the Town and City Planning's Building Control Bureau. The Act is only enforced in the Bangkok Metropolitan Area and districts under the Thailand Provisional Authority. Other provinces implement and enforce their own codes.
United States	IBCC or any local codes	Building use	Over 200 codes and standards developing organizations	Energy efficiency	Codes and standards developing organization, and jurisdictions that enforce codes.	Depends on the codes and standards developing organization.	There is no national building code. Responsibility for development, management, and enforcement of building codes resides with authorities in individual jurisdictions, including states, counties, and cities. In each jurisdiction, a building code becomes mandatory only when formally enacted by authorities, via laws, ordinances, regulations, or administrative orders. Building code adoption and enactment processes vary widely among jurisdictions.

Economy	Code	Buildings Covered	Reference Standards	Green Features			Adoption, Evolution, Enforcement (Details in Table 4)
				Coverage	Actors	Development Timeline	
Vietnam	Vietnam Building Code	Building use	Vietnam Standards, and national/local technical standards are issued by the Vietnam Standards and Quality Institute (Directorate for Standards, Metrology and Quality (STAMEQ). International Standards and codes are also referenced.	Energy efficiency	Government as the only green building rating system will be introduced by the government. Most decisions are by the MOC and other ministries.	Green building rating system is relatively new and has not gone online.	The Central Government develops regulations through the Ministry of Construction using construction control decrees. The Ministry works with other ministries as permits also require compliance with the regulations of those ministries. Provincial People's Committees enforce regulations. The committees engage building officials, issue building permits, and develop regional technical regulations.

Table 4

Regulatory Frameworks in APEC Economies

National Code Development	Enforcement of National Codes	Status of Criteria	Roles of Public/Private Sector	Actors in Development	Comments
Australia					
<p>NCC Series (NCC), comprising the Building Code of Australia and the Plumbing Code of Australia, is developed and maintained by Australian Building Codes Board (ABCB) on behalf of Australian Government and State and Territorial Governments—the Building Ministers’ Forum (BMF). The NCC is updated every year.</p>	<p>States and Territory Governments have constitutional authority to regulate for buildings and have the capacity to introduce variations to the NCC. The NCC, as model code, is referenced in State/Territory building law.</p> <p>NCC compliance is a State and Territory Government responsibility and is outside the remit of the ABCB and NCC. Ministerial oversight of the ABCB and NCC is by the BMF via a non-binding Intergovernmental Agreement (IGA). The IGA provides the strategic and operational framework under which the ABCB manages development of the NCC.</p>	<p>Performance –based code, which references standards as ‘deemed-to-satisfy’ building solutions.</p>	<p>All 3 levels of government and industry are represented on the Board of the ABCB. The private sector also contributes to the development by participating in technical committees and through public consultation processes. Standards Australia (SA), a private entity, develops and maintains standards; however, the NCC makes provision for referencing non-SA referenced standards.</p>	<p>Commonwealth, State and Territory Governments, industry and special interest stakeholder groups.</p>	
Brunei Darussalam					
<p>Parliament passed Building Control Act, while Building Control Division (BCD) converts it into implementable document, and enforces it. The code is solely the responsibility of the Building Control Division.</p>	<p>BCD, through a “Qualified Person” (an architect or engineer). Centrally managed by BCD, with one section updating Act and the other enforcing it.</p>	<p>Mostly prescriptive, but some cited standards (structural and fire) are performance. Outcome base are also included in the Act for fire and structural.</p>	<p>BCD develops and coordinates most development works. Private sector participates in development of act and standards. Brunei Standards is a government agency, and the private sector is involved in developing standards.</p>	<p>BCD and private sector.</p> <p>A very small economy so everything is centrally planned. Constitutional monarchy means the role of government is significant.</p>	
Canada					
<p>Canada’s constitution states that fire safety and plumbing regulations are the responsibility of provincial and territorial governments. Canadian Codes Center (CCC) (government) maintains six national construction codes. Canadian Commission on Building and Fire codes is also responsible for</p>	<p>Provincial governments enforce code, and though not required to adopt the national codes, most do.</p>	<p>Mostly prescriptive, but some cited standards make the codes performance and outcome-based (especially structural).</p>	<p>Mandatory codes are maintained by CCC and Commission on Building and Fire Codes; the private sector is involved in updating. These codes reference standards from 200+ codes and standards agencies in Canada, United States, Europe and Japan. These standards are mostly developed by private</p>	<p>Commission on Building and Fire codes, and CCC. Federal government passes bills and these agencies convert bills into codes.</p>	

National Code Development	Enforcement of National Codes	Status of Criteria	Roles of Public/Private Sector	Actors in Development	Comments
updating codes.			organizations.		
Chile					
Through the General Law of Urban Planning and Construction	Administered and Enforced by the Ministry of Housing and Urban Development , and Local level. Directions of Municipal Works.	Mostly prescriptive	The Ministry of Housing and Urban Development approves technical standard developed by the National Institute of Standardization, and the regulation of potable water, sewerage and paving installation. It can also prepare technical standards.	Private and public sectors	
People’s Republic of China					
Laws are developed by the National People’s Congress, and codes, design guidelines, and some standards are developed by the ministries, and standards by one of the five agencies under the Standardization Administration	Enforced at the province and municipal levels.	Prescriptive at the law level, and standards define things very clearly, and specifications detailing what designers etc need to do. In short, everything is included and all are mandatory.	See first column.	All ministries, administrations, and agencies. Academics and private sector are heavily involved, especially nationally owned companies.	N.A.
Hong Kong, China					
Various codes relating to building safety, fire safety, electrical & mechanical safety and energy efficiency are developed, promulgated, updated and enforced by various responsible government departments. The codes contain technical standards and requirements.	Buildings Department is responsible for enforcing the code on building safety throughout Hong Kong. Housing Department conducts their own site inspection but follows the same protocol of the Buildings Department. Electrical and Mechanical Services Department is responsible for enforcing codes on electrical & mechanical safety and energy efficiency. Fire Services Department is responsible for enforcing codes on fire service requirements.	N.A.	All the codes are administered and developed by the Buildings Department, however, other government agencies may also develop their own codes and standards. Hong Kong government is responsible to develop Hong Kong standards, however, most of the standards used in building are adopted from various responsible government departments with reference to standards from other sources and in consultation with the relevant stakeholders (including the relevant private sectors).	All relevant government departments/bureaus, special interest groups, professional organizations, trade associations, academia and private sector, etc..	N.A.
Indonesia					
Central government develops most building codes, but 70% of	Public Works Department develops and enforces codes in the jurisdiction	N.A. (Berhasan Indonesian)	Government administers codes and standards. Indonesian	The Ministry of Industry, Ministry of Public Works, and	N.A.

National Code Development	Enforcement of National Codes	Status of Criteria	Roles of Public/Private Sector	Actors in Development	Comments
<p>municipalities develop their own as well. Most municipal codes focus on financial information (fees). The Ministry of Industry, Ministry of Public Works, and Transportation develop codes for buildings and infrastructure.</p>	<p>of the central government. Municipalities enforce their own codes. Acts are enforced by Ministry of Industry, Ministry of Public Works, and Transportation through the Public Works Departments, and municipalities enforce their own codes.</p>		<p>Standards (SNI) are maintained by a government agency, the National Standards Institute. Very little information on whether standards development involves the private sector.</p>	<p>Transportation, Public Works Department, and municipalities.</p>	
Japan					
<p>Minister of Land, Infrastructure, and Transport develops and enforce laws. Ordinances of municipal governments are required to conform with the central government laws.</p>	<p>Laws are enforced by municipal governments.</p>	<p>Cannot comment as many are in Japanese.</p>	<p>Ministry of Land, Infrastructure and Transport (through building and infrastructure control department) develops and administers codes, Quasi-government standards agencies AIJ and JCI rely on the private sector to develop standards.</p>	<p>Ministry of Land, Infrastructure and Transport, the government, and private sectors.</p>	<p>N.A.</p>
Republic of Korea					
<p>The Building Planning Division (BPD) develops and administers regulations.</p>	<p>BPD requires municipal governments to align local regulations with national ones. Municipal and local governments enforce codes. All codes are similar.</p>	<p>Mostly prescriptive; structural, energy, and fire are performance and outcome based.</p>	<p>BPD is the only authority to develop national regulations. Korean Standards are developed by the Korean Agency for Technology and Standards, a government agency. All applicable foreign standards are converted into Korean Standards.</p>	<p>BPD and the private sector. Universities are also heavily involved, perhaps the most involved of all the APEC economies.</p>	
Malaysia					
<p>The Department of Local Government under Ministry of Housing and Local Government develop and administer building laws and/or regulations but are enforced by the respective local councils or municipals at the state levels, except Sabah and Sarawak.</p>	<p>Federal government enforces regulations in its own territory. States and territories enforce their own regulations. Local municipals may also develop and enforce their own regulations.</p>	<p>Mostly prescriptive, while structural and other standards are performance and outcome based.</p>	<p>.Each state, territory, or municipality enforces its own regulations. Malaysian Standards is administered by a quasi-government agency., Malaysia relies on relevant standards developed outside of Malaysia.</p>	<p>Federal government; state government and local Authority.</p>	
Mexico					
<p>Most code in Mexico was made for Mexico City. Cities and municipalities simply adapt or</p>	<p>Enforcement is local. States and jurisdictions enforce own regulations. They may also develop their own</p>	<p>Language is evolving to be performance based.</p>	<p>Government, academia, private sector and other stakeholders work together to develop</p>	<p>Process coordinated by academics and practitioners aimed directly at</p>	<p>Ministry of Social Development</p>

National Code Development	Enforcement of National Codes	Status of Criteria	Roles of Public/Private Sector	Actors in Development	Comments
just copy the Mexico City Building Code (MCBC).	regulations. A private sector/third party helps ensure compliance.		standards and standards.	updating the code.	has tried to coordinate model codes. Progress has been limited.
New Zealand					
Building and Housing Department maintains and administers NZ national building code. Code closely follows the Building Act.	Building Control Authority (BCA) accredits and registers enforcers of building codes. Enforcers can either be a building control department of a municipal government or a private company appointed by the same. Code is enforced by local government. The building control department and personnel enforcing the code has to be accredited by BCA.	Mostly prescriptive, while structural and other standards are performance and outcome based.	Central government is to develop the Act, and the Building and Housing Department converts it into code. New Zealand Standards are administered by a quasi-government org. Also relies heavily on standards from Australia and Britain. Private sector is heavily involved in the standards development and updating.	Building and Housing Department.	Very close relationship between New Zealand and Australia, but NZ is ahead of Australia in integrating green features into codes.
Peru					
The Ministry of Housing, Construction and Sanitation approves and issues the Reglamento Nacional de Edificaciones (RNE). It designs, regulates and implements policy for national housing, urban planning, construction and sanitation.	The Ministry of Housing and Sanitation is responsible for code administration, which is enforced through municipalities. Municipalities enforce code.	Mainly prescriptive.	Government is involved throughout code development and enforcement. Private sector contributes to development through standards development committees (voluntary or mandatory).	Public sector (ministries, regulatory organizations, municipalities, etc). Private sector (construction companies, manufacturers, etc) as well as the academia, and the Professional schools (e.g., School of Engineers and School of Architects).	
Philippines					
Department of Public Works, Transportation and Communication develops, maintains, reviews, and updates codes.	Municipalities enforce codes. The Department of Public Works, Transportation and Communication assists low income municipalities with enforcement. Wealthier municipalities must adopt the codes, while poor ones may not.	Mainly prescriptive; standards are performance based, and guidelines outcome based.	Government, through the Department of Public Works, maintains codes. Philippines National Standards (PNS) is maintained by the government. The private sector is involved in PNS development and revision.	Department of Public Works, municipalities' building control departments, and private sectors.	
Singapore					
The Building and Construction Authority (BCA) maintains the	BCA enforces the Act.	Mostly prescriptive with structural, energy, and fire are performance and	BCA develops regulations and	BCA, with assistance from the two local universities and external	

National Code Development	Enforcement of National Codes	Status of Criteria	Roles of Public/Private Sector	Actors in Development	Comments
Building Control Act.		outcome based.	acts. Spring Singapore, maintains Singapore Standards. Private sector is heavily involved in developing standards. BCA also develops standards and guidelines while Singapore relies on relevant standards from other sources.	consultants.	
Chinese Taipei					
The Construction and Planning Agency (CPA) of the Ministry of the Interior develops and administers the Building Act.	Municipal and local governments are required to enforce the Act. CPA is not an enforcement agency for the Act but for municipal and local governments.	Mostly prescriptive with structural, energy, and fire are performance and outcome based.	CPA develops all acts. Private sector is very involved as are the universities. National standards are administered by the Bureau of Standards, Metrology, and Inspection. Private sector involvement is prominent.	CPA and the Bureau of Standards, Metrology, and Inspection. Private sector and universities are heavily involved.	
Thailand					
The Ministry of Interior's Department of Public Works, and the City Planning Building Control Bureau develop and administer the Building Control Act. Several ministries are also involved in drafting and development.	Mandatory regulations are only enforced in Metropolitan Municipality, and the districts under the Thailand Provisional Authority. Municipal governments may develop regulations and acts, but most adopt the mandatory regulations of the Department of Public Works.	Mostly prescriptive with structural, energy, and fire being performance and outcome based.	See first column. Thailand Standards Institute is a government agency that develops and maintains Thai Standards. Private sector is involved.	See first column.	
United States					
Private sector codes and standards developing orgs develop code. Enforceable codes by local jurisdictions, GSA, and DoD.	Local jurisdictions enforce local codes. GSA and DoD enforce their codes.	Prescriptive mainly, with performance and outcome basis for standards.	The US "bottom up" approach provides local jurisdictions mechanisms to develop codes for enactment. This approach requires engaging stakeholders in developing model codes and voluntary standards for standards referenced in model codes.	Private and public sector codes and standards developing organizations, local building control/dept. officials, and private sector professionals.	
Vietnam					
Ministry of Construction (MOC)	MOC ensures that codes are applied	Mainly prescriptive, and cite	Central government enacts laws;	MOC and other ministries and the	

National Code Development	Enforcement of National Codes	Status of Criteria	Roles of Public/Private Sector	Actors in Development	Comments
administers development of building codes.	uniformly. Provincial People’s Committees enforce code and develop local national technical regulations. Local jurisdictions enforce code	international codes and standards.	MOC develops Acts, regulations and codes, and make sure they are uniformly enforced. Provincial People’s Committees develop local codes, conduct inspections, and issue permits.	Provincial People’s Committee (for local codes).	

APEC Economy Reports

Australia

1. Synopsis

CODE ADMINISTRATION AND ENFORCEMENT

Australia takes a centralized approach to building code administration. The Australian Building Codes Board (ABCB) develops, maintains, and administers the National Construction Code (NCC) on behalf of the Commonwealth and state and territory governments. While state and territorial governments have some control over certain codes and regulations, under the Inter-Governmental Agreement the NCC is mandatory for all of Australia and will prevail over any conflicting codes and regulations that do not pertain to resource management.

The state and territorial governments are responsible for enforcing the mandatory codes. They maintain authority to issue building permits and commissioning certificates, but the governments and local councils often have private sector investigators conduct building inspections and commissioning on behalf of the government. The Commonwealth and state governments are responsible for incorporating the private sectors into the inspection process to enhance the productivity of building inspection. The issuance of permits and certificates is often the responsibility of the states and territorial governments while city councils engage inspectors and certify projects. Even though NCC can be treated like model codes (like Canada and the United States), the Australian Commonwealth Government's approach to the administration and enforcement is more similar to the style of economies in the Pacific Rim. While states and territorial governments are responsible for introducing codes and regulations that the NCC does not cover, they are required to use the NCC.

REFERENCE STANDARDS

The NCC references mostly the Australian and Australian/New Zealand standards and selective U.S., Canadian, and European standards. The ABCB is responsible for identifying and incorporating these standards into the NCC.

PATHWAYS TO GREEN THROUGH NCC

The Commonwealth and state governments are mainly responsible for introducing green features into the NCC. These features make their way into the NCC through legislations introduced by the Commonwealth and state governments. The Commonwealth's Greenhouse and Energy Minimum Standards (GEMS) Act, Environment Australia's Water Act 2007, Water Amendment Act 2008, Water Amendment Regulations 2010, and Water Efficiency Labeling and Standards Act 2005 are some of the green legislation incorporated into the NCC. State and territorial governments have also introduced green legislations and

programs for their states and territories, such as Victoria’s Energy Save Initiative Program, and the South Australia’s energy efficiency target for government buildings.

2. Code Development, Administration, and Enforcement

DEVELOPMENT AND ADMINISTRATION

Key Actors and Administration Agency. The Australian Building Codes Board (ABCB) develops and maintains the National Construction Code (NCC) on behalf of the Commonwealth, state and territory governments. NCC consists of three volumes. Volumes 1 and 2 are the Building Code of Australia (BCA), and Volume 3 focuses on plumbing and drainage codes. These are also known as the Plumbing Code of Australia, or PCA. Volume 1 is applicable to all buildings except housing; Volume 2 is applicable only to housing.

Application of Codes. The NCC is applicable to all Australian states and territories. It ensures the consistency and uniformity of codes and sets minimum standards pertaining to the health, safety, amenity, and sustainability of buildings throughout Australia. The BCA is a uniform set of technical provisions for the design and construction of buildings and other structures that allows for variations in climate and geological or geographic conditions in Australia.

Process of Code Adoption. The NCC is given legal effect by the Australian government, and is enforceable in all states and territories. An Australian government’s legislation also prescribes the NCC as the mandatory and minimum requirements throughout Australia. The legislation consists of an Act of Parliament and subordinate legislation that empowers the regulation of certain aspects of buildings and structures, and contains the administrative provisions necessary to give effect to the legislation.

Regional versus Commonwealth Codes. NCC requirements will overwrite other standards stated in the state or territorial codes. Proposals to change the BCA are subject, as applicable, to a regulatory impact assessment . The BCA contains the technical provisions for the design and construction of buildings and other structures, covering such matters as structure, fire resistance, access and egress, services and equipment, and energy efficiency as well as certain aspects of health and amenity.

Regional Requirements in NCC. NCC has provisions specific to the states and territories. These provisions can be found in the appendices. State governments have also developed regulations and codes to supplement additional requirements for other building control elements and energy efficiency in their states.

Zoning and Environmental Codes. Zoning and environmental regulations are enforced and administered by Environment Australia. They are separated from the NCC and other regulations. These regulations are administered by separate committees.

Time Period for Code Revision. There is no required time period to revise or renew the codes, although new versions are published about five to six years from the previous versions.

Approval of and Public Comments on Codes. The codes are approved by majority consensus of the committee members, and the code documents are open to the public for comments regularly.

REFERENCE STANDARDS

There are two types of national standards in Australia, the Australian Standards (AS) and the Australia/New Zealand Standards (AS/NZS). Both are developed by Standards Australia, an agency affiliated to the Australian government. AS/NZS is jointly developed by Standards Australia and Standards New Zealand. AS/NZS are common standards adopted by both economies. NCC also references standards from the United States and Europe, such as the standards from the American Institute of Steel Construction (AISC), ASTM International, American Refrigerant Institute (ARI), International Organization for Standardization (ISO,) and the British Standards Institute (BSI).

GREEN FEATURES OF THE MANDATORY LAWS

BCA has requirements pertaining to building energy efficiency design and construction. The requirements cover energy efficiency of mechanical systems and equipment, façade design, energy modeling, ventilation, air-conditioning, and energy systems. The PCA also has water efficiency requirements.

TYPES OF BUILDINGS

NCC divides buildings into four types, by level of importance:

1. Buildings or structures presenting a low degree of hazard to life and other properties in case of failure
2. Buildings or structures not covered by the descriptions for 1, 3, and 4.
3. Buildings or structures designed to contain a large number of people.
4. Buildings or structures essential to post-disaster recovery or associated with hazardous facilities.

ADOPTION AND EVOLUTION OF NCC

A Council of the Australian Government (COAG), the Australian Building Codes Board (ABCB) is standards writing body that administers the NCC. As mentioned, the NCC comprises the BCA and the PCA, which also covers requirements for sanitation. The Board reports to the Australian Government Minister and state and territory ministers responsible for building regulatory matters (known as the Building Ministers' Forum). It provides a vital link for industry between building and plumbing practice, and government building and plumbing regulatory policy. Under the Inter-Government Agreement (IGA), the objectives of the Board are to develop and establish codes and standards; align needs for codes and standards of each region in Australia; ensure that NCC is performance-based, verifiable, based on appropriate international standards, and expressed in plain English; and to increase awareness of the codes and standards.

ABCB is a joint initiative between all three levels of the government (Commonwealth, state and territorial). NCC was established by an IGA signed by the Commonwealth, states and territories in 1994. The latest IGA was signed by several ministers in 2012. The work of the Board is supported by a professional, technical, and administrative unit, and the ABCB office. The ABCB has two primary technical advisory committees, the Building Codes Committee (BCC) and the Plumbing Code Committee (PCC). These provide a national forum for regulatory authorities and industry to consider technical matters relevant to building and plumbing regulation reform and are active in assisting the Board in meeting its obligations.

The BCC is the ABCB's highest level technical advisory body. The BCC is a national forum for regulatory authorities and industry to consider technical matters relevant to building regulation reform and assists the Board in meeting its obligations under the COAG Guidelines and the IGA. BCC members are designated representatives of the following organizations:

- ABCB Office (Chair)
- A representative of the Australian Government
- A representative of each of the state and territory governments
- A representative of local government
- Australasian Fire Authorities Council
- Australian Institute of Architects
- Australian Institute of Building
- Australian Institute of Building Surveyors
- Building Designers Association
- Building Products Innovation Council
- Commonwealth Scientific and Industrial Research Organisation
- Consult Australia (formerly ACEA)
- Engineers Australia
- Housing Industry Association
- Master Builders Australia
- Property Council of Australia
- Royal Institute of Chartered Surveyors
- Standards Australia
- New Zealand Ministry of Business Innovation and Employment (Formerly Department of Building and Housing) - (Observer)
- Building Research New Zealand Inc - (Observer)

The PCC is the ABCB's peak plumbing technical advisory body. It provides a national forum for regulatory authorities and industry to consider technical matters relevant to plumbing regulation reform and assists the Board in meeting its obligations under COAG Guidelines and the IGA. PCC members are designated representatives of the following organizations:

- A senior representative of the ABCB (Chair)
- A representative of the Australian Government
- A representative of each of the state and territory governments
- Air Conditioning and Mechanical Contractors Association
- Association of Hydraulic Services Consultants Australia

- Australasian Fire and Emergency Service Authorities Council
- Australian Institute of Refrigeration Air-conditioning and Heating
- Engineers Australia
- Housing Industry Association
- Master Builders Australia
- Master Plumbers Australia
- Plumbing Products Industry Group
- Property Council of Australia
- Standards Australia

Approval of and Public Comments on Codes. The codes are approved by majority consensus of the committee members, and the code documents are open to the public for comments regularly.

ENFORCEMENT

The states and territories are expected to adopt NCC, even though some make minor additions to NCC to suit local conditions. No changes can be made to the NCC. States and territories enforce the building codes in their own jurisdictions. Building permits and commissioning of buildings are carried out by departments appointed by the state or territorial government. For example, permitting and commissioning in Western Australia is administered by the Building Commissioner of Western Australia, while permitting and commissioning in South Australia is administered by several departments (the Fire Department, the Housing Department and the Attorney-General Office).

Building inspection and certification is carried by private companies instead of public sector employees. The privatization of building inspection and certification began in the early 1990s in the states of Victoria and South Australia. The Commonwealth Government played a critical role in pushing the privatization of inspection and certification. The push for privatization was a reaction towards local councils' non-proactive and monopolistic approach to inspection and certification. The level of authority given to the private sector inspector differs in the states and Territories (van der Heijden 2009). Public employees of the designated "building control" departments are still required to issue certificates and to commission buildings.

3. Code Details

MINIMUM CODES

Electrical. BCA contains requirements pertinent to electrical installations in buildings. In addition, the Australian Energy Market Commission administers some of the electrical requirements relevant to building design and construction. Energy supply to buildings is governed by the National Electricity Rules (NER) (Australian Energy Market Commission, 2011). The NER governs the installation of electricity distribution inside a building.

Both BCA and NER mandate AS/NZS 3000:2007 Electrical Installations/Australian Wiring Rules, and AS/NZS3017:2007 ‘Electrical installations - Verification guidelines’. AS/NZS 3000:2007 is the minimum for electrical installation and works, and AS/NZS3017:2007 sets out the inspection and testing for a low voltage, multiple earthed neutral electrical installations. These standards also comply with the safety requirements for the prevention of fire, or a person or livestock from sustaining an electric shock that can be found in the building fire codes and requirements (also part of the BCA).

Local jurisdictions also enact their own regulations and enforce their own codes of practice. The Queensland Government’s other mandatory requirements include the Electrical Safety Act of 2002 and the Electrical Code of Safety (Government of Queensland 2012, Electrical Safety Office of Queensland 2010), while the South Australia Government enforces the Energy Product (Safety and Efficiency) Act 2000 (Attorney's General Office of South Australia 2002).

Energy. Building energy efficiency code and requirements are in the NCC/BCA. The BCA contains requirements for energy efficiency building design, and standards for heating, ventilation and air-conditioning (HVAC) equipment. In addition, the Commonwealth and state governments have established minimum energy efficiency standards that affect equipment used in buildings (including HVAC equipment).

The Commonwealth Government’s Greenhouse and Energy Minimum Standards (GEMS) Act 2012 regulates the energy efficiency of equipment and appliances used in buildings, such as lighting products, refrigerators, washers, dryers, televisions, compact fluorescent lamps, industrial motors, and air-conditioning equipment. Suppliers of these products must register products with one of the E3 Regulators (Energy Rating of Australia 2012) before products may lawfully be sold in either Australia or New Zealand. This registration constitutes the formal declaration by the supplier that the product complies with Energy Rating of Australia’s Minimum Energy Performance Standards (MEPS) and the Energy Rating Labels (ERL) requirements (Australian Government 2012)

The MEPS and ERL programs are mandatory in Australia and New Zealand, enforced as a regulation by the Commonwealth and all state governments in Australia, and are included in several national regulations in New Zealand. The technical requirements for MEPS are set out in the respective appliance standards and referenced in the state governments’ and New Zealand government’s regulations. In Australia, state government legislation is necessary to enforce the Commonwealth Government’s regulations because the constitution gives the states and territorial governments the responsibility of managing resources, including energy.

Water and Sanitation. Building codes and requirements pertaining to plumbing and sanitation can be found in NCC Volume 3, or Plumbing Code of Australia (PCA). In addition to the above codes, the Commonwealth Government establishes regulations and guidelines pertaining to drinking water and sanitation water treatment.

Environment Australia’s Water Act 2007, Water Amendment Act 2008, Water Amendment Regulations 2010, Water Efficiency Labeling and Standards Act 2005 establish the water efficiency and use, and quality standards in buildings, including energy efficiency of faucets and water-consuming fixtures used in buildings (Environment Australia, 2012).

Mechanical Systems. The BCA, GEMS Act 2012, MEPS, and ERL regulate the design and energy efficiency of mechanical systems. The BCA has incorporated the following mechanical system design standards:

- AS/NZS 1668 (use of ventilation and air-conditioning in buildings)
- AS 1668 (use of mechanical ventilation and air-conditioning in buildings)
- AS 1691 (domestic oil-fired appliances installation)
- AS 1735 (lifts, escalators and moving walks)
- AS 2665 (smoke/heat venting systems)
- AS/NZS 2918 (domestic solid fuel burning appliances)
- AS/NZS 3500 (national plumbing and drainage)
- AS 3823 (performance of electrical appliances – air-conditioners and heat pumps)
- AS 4254 (ductwork for air-handling systems in buildings)
- ARI 460 (remote mechanical-draft air-cooled refrigerant condensers)
- ARI 550/590 (water chilling packages using the vapor compression cycle)
- BS 7190 (assessing thermal performance of low-temperature hot water boilers using test rig).

Indoor Air Quality. There is currently no established minimum standard in Australia, but indoor air quality has been studied extensively in Australia and Environment Australia published “Air Toxics and Indoor Air Quality in Australia – State of Knowledge Report” in 2001 to set the tone in Australia.

Lighting. The BCA specifies minimum lighting standards. BCA incorporates lighting standards from AS, AS/NZS and the British Building Regulation 2006. These standards include the AS/NZS 1680 (interior lighting), AS 2293 (emergency escape lighting and exit signs for buildings), AS/NZS 4847.2 (self-ballasted lamps for general lighting services Part 2: Minimum Energy Performance Standards (MEPS) Requirements), the California Energy Code, and the British Building Regulation 2006 Edition on the Conservation of fuel and power. In addition, MEPS and ERL are both mandatory for all lighting fixtures in Australia.

Security. There is no code or requirements for building security in Australia.

Fire. The BCA has fire codes and requirements for buildings. The requirements include the testing of fire resistance of materials (AS/NZS 1530), fire protection methods against fire hazards (AS 1670 and 1905), fire protection systems (AS 2118, 2419, 2441, 2665, 2444, and 2665, and AS/NZS 2918 and 3837), fire prevention methods (AS 3837, 3959, 4072, 4428, and 9705), and fire prevention inspection methods (AISC 1987).

Structural. Code and requirements pertaining to structural components are in the BCA. These codes cover design loads, use of materials, design methods, material testing methods, structural design software, and loading resistance.

Location/Siting/Zoning and Environment. Codes and regulations pertaining to zoning, siting, and the environment are administered and enforced by the Department of Sustainability, Environment, Water, Population and Communities of the Commonwealth Government of Australia (also known as Environment Australia). The department is responsible for environment protection, conservation of biodiversity, monitoring air quality, national fuel quality standards, enforcement of land contamination

laws, meteorology, administration of the Australian Antarctic Territory, and the Territory of Heard Island and McDonald Islands, natural, built and cultural heritage, environmental research, water policy and resources, ionospheric prediction, coordination of sustainable communities policy, develop population policy, and planning of the urban environment. The Department also establishes rules for land use in Australia and various territories, and states develop their land use planning following these rules. More information can be found on the Department website (Environment Australia 2011).

Samples of such regulations that pertain to green buildings include the Wetland Regulations, the National Environment Protection Measure administered by the National Environment Protection Council. Environment Australia also administers resources efficiency and use throughout Australia. As mentioned, the constitution assigns responsibility for resource administration to individual states and territories and thus the Commonwealth Government can only encourage states and territories to adopt regulations and codes. All states have adopted these regulations.

Safety. There is no minimum or mandatory code or requirement on safety in Australia.

GREEN BUILDING CODES

Regulations Pertaining to Green Buildings

There is no mandatory green building code in Australia. However, regulations pertaining to energy efficiency and water efficiency are incorporated in the NCC and thus are already enforced. In addition, all states have adopted environmental protection regulations and many state have developed additional ones to supplement those of the Commonwealth Government. Lighting requirements have also been incorporated into the BCA and are part of the MEPS and ERL regulations. The Commonwealth Government has also developed plans to regulate carbon emission and future NCC will include carbon emission. Thus, Australia does not require a separate set of green building codes. Being part of NCC, these green features are also enforced.

Green Building Rating System

Green Star is Australia's voluntary green building rating system neither required by nor endorsed by the government. It was launched in 2003 by the Green Building Council of Australia (Green Star of Australia 2012). The rating system covers a range of practices for reducing the environmental impact of buildings and showcases innovation in sustainable building, while considering occupant health and productivity and cost savings. It scores buildings in nine categories: management, indoor environment quality, energy, transport, water, materials, land use and ecology, emissions, innovation. The scores translate into "Green Stars" as follows:

- 45-59 is a four-star score signifying "best practice" in environmentally sustainable design and/or construction
- 60-74 is five-star score signifying "Australian Excellence"
- 75-100 is a six-star score signifying "World Leadership."

The rating system covers building in the following categories: education, healthcare, industrial, multi unit residential, office, office interior, retail center, office design, office as built, interiors, communities, public building, convention center design, and performance.

Brunei Darussalam

1. Synopsis

Brunei Darussalam (Brunei) is one of several APEC economies that uses building regulations instead of building codes. Because of the size of its population, Brunei has one central government. Like other economies of similar size, it enforces only one set of regulations. The regulations pertaining to building control contain language on penalties and enforcement authorities and cite standards from different sources. Even though the standards adopted by the regulations are mandatory, they can be replaced by equivalent standards. For example, if a company is more familiar with the U.S. standards, it can replace the referenced standards with equivalent U.S. standards.

REFERENCED STANDARDS

The Building Control Act and the Town and Country Planning Development Control Act adopt Brunei Standards, and various international standards. As mentioned, standards referenced by the regulations can be replaced by equivalents not referenced by the regulations.

CODE ADMINISTRATION AND ENFORCEMENT

The respective ministries, through the appointed departments and sections, administer and enforce the regulations. The Ministry of Development's Construction Planning and Research Unit adopts or develops standards pertaining to building design and construction. The Unit evaluates different standards and studies various aspects of standards application and enforcement. It recommends the adoption or develops standards for various building regulations in Brunei. There is no fixed time period to review or revise the regulations, and development and revision are often carried out by special committees appointed by the government. Actual inspection, checking, and enforcement of regulations is carried out by a private sector inspector called the Qualified Person (QP) and permits and certificates are issued by the Building Control Division.

In addition to local regulations, Brunei also follows international codes such as the ICC's International Fire Code, and the World Health Organization's water quality and plumbing guidelines and standards. The codes adopted from outside are enforced by the ministries handling the scope. The ICC fire code, for example, is enforced by the Department of Fire and Emergency, and the Ministry of the Environment enforces WHO's water quality and plumbing guidelines and standards. Adoption of these codes is determined by the respective ministries.

PATHWAYS TO GREEN: GOVERNMENT DRIVEN EFFORT

There is no green building code in Brunei and no green features are included in the regulations. However, the Government of Brunei developed the Energy Efficiency and Conservation (EE&C) Guideline and a green building rating system. These efforts could lead to the greening of Brunei building regulations in the future.

2. Code Development, Administration, and Enforcement

MINIMUM AND MANDATORY CODES

Brunei's Town and Country Planning Act, Town and Country Planning Development Control Act, the Master Plan Act, and the Building Control Act are mandatory regulations governing building design and construction. All are published in Malay.

The Town and Country Planning Act, Town and Country Planning Development Control Act, and the Master Plan Act are accompanied by planning guidelines and standards for commercial development, guidelines for planning permission application of land and buildings, and planning guidelines and standards for earthwork development. The documents provide extensive guidelines and standards on building design, development planning and construction standards in Brunei.

ENFORCEMENT OF BUILDING CONTROL ACT

The Building Control Act regulates construction activities and detail design of buildings. The Act requires a Qualified Person (QP) to inspect building drawings and documents, and to enforce standards pertaining to construction. A QP is a qualified architect or engineer who has experience in building design and construction, who is registered with the Building Control Division of the Ministry of Development, and who is not affiliated with the Division or the Ministry. The Division enforces the act, and issues building permits. Permits are issued pending QP approvals of various drawings, documents and plans, and construction. The QP is fully responsible for any building failures. The Ministry's Construction Planning and Research Unit adopts or develops standards pertaining to building design and construction. It evaluates standards, studies aspects of standards application and enforcement, and recommends the adoption of or develops standards for various building regulations in Brunei.

REFERENCE STANDARDS

Brunei has a flexible approach which allows the use of relevant, regardless of source. These standards include the following:

- Brunei Standards
 - Materials standards for testing, installation and guidelines of building, materials (steel, concrete, timber, piles, waters, weld, bricks) and building elements

- Safety standards for roadway, traffic, timber scaffold, development, quality, safety audit, safety organization, design guidelines, traffic signboards, joints and connections, formwork and falsework, drainage work, and earthwork.
- ISO/IEC/PBD Standards: 820, 1098, 1324, 2036, 2426, 2457, 3397, 5320, 5334, 6891, 8969, 8970, 9000, 9001, 9002, 9003, 9004, 17025, 9087, 17025, 17046, 60081, 60335, 60884, 60901, 60921, 60929, 61347. These focus on fluorescent lamps, household electrical appliances, wood flooring, plywood, wood panels, particle boards, timber structures, quality management system, quality requirements, quality of inspection, and quality assurance.

In addition, the Act also provides guidelines for slope protection, site safety assessment, quality of workmanship, safety on construction sites, audits methods for laboratory, testing methods for materials, and building requirements.

GREEN FEATURES OF THE MANDATORY LAWS

There is currently no green feature.

TYPES OF BUILDINGS

The acts are applicable to all buildings except for low-rise residential.

CODE ADOPTION AND EVOLUTION

The administration of the Building Control Act is the responsibility of the Building Control Division. The administration of the Town and Country Planning Act, Town and Country Planning Development Control Act, and the Master Plan Act are the responsibility of the Ministry of Development.

Special committees are established to develop and modify the regulations, with committee members selected by the ministries. The drafts are then handed over to the ministries to be rewritten into Acts and the Acts have to be passed by majority in the Parliament. Once the parliament approves the Acts, they are endorsed by the Sultan of Brunei and handed over the relevant division or department (via the Ministry) to be converted into regulations.

Time Period for Revisions. There is no fixed time period for the updating of the regulations. It takes time to draft regulations and for Parliament to pass them. The Building Control Act was last revised in 2002.

3. Code Details

MINIMUM CODES

Electrical. Mandatory regulations include the Electrical Act 1973, Electrical Act (Amendment Order) 2002, and Electricity Act (2011) (Department of Electrical Services 1973; Law of Brunei 2011). These focus on the punishment and enforcement authority rather than the standards to be adopted by the economy. The required standard in Brunei is the Department of Electrical Services' (DES) Guidelines on Proper Installation and Use of Electrical Wirings (Hab 2011). The guidelines are based on IEE Wiring Regulations (BS 7671:2001) and incorporate amendments No. 1 & 2 for BS 7671.

Energy. According to a recent APEC study, there is no energy efficiency standard and mandatory energy efficiency labeling in Brunei. According to a previous APEC report (Compendium of Energy Efficiency Policies of APEC Economies), Brunei has started to work on an energy efficiency and conservation guideline (APEC 2010). The goals of the guidelines are as follows:

- Promote public awareness and encourage the adoption of energy-efficient technologies and best practices;
- Establish and develop energy efficiency and conservation regulations and guidelines to encourage energy efficiency and conservation practices;
- Improve energy efficiency in the supply, transportation and utilization of energy; and
- Develop energy efficiency labeling and standards to encourage procurement of energy-efficient appliances.

In addition, the Prime Minister's Office also published the nonmandatory Energy Management Guide, Basic Guide of Energy Audit for Building, and developed the Energy Labeling for Air Conditioners (The Energy Conservation Center of Japan 2010).

Water and Sanitation. There is no mandatory plumbing standard/code in Brunei. Brunei follows WHO guidelines, so WHO's Code of Practices for Plumbing is mandatory (World Health Organization 2012). The Public Works Department (PWD) administers water quality and sanitation standards. Its Water Services Section administers water quality in accordance with WHO Drinking Water Quality Guidelines (1993) (Water Department of Brunei 2012). Drainage and Sewerage Services (also part of PWD) manages the drainage and sewerage including sanitation standards in Brunei. Water facilities and drainage/sewerage are government operated and no private company is involved.

Mechanical Systems. There is no mandatory code for mechanical systems in Brunei.

Indoor Air Quality. There is no mandatory code for this in Brunei.

Lighting. There is no mandatory code on lighting in Brunei. EE&C (see Energy) contains provisions for energy efficient lighting but it is not mandatory.

Security. There is no mandatory security code in Brunei.

Fire. According to ABCi (Building Control Department), Brunei follows the Brunei Internal Fire Code (administered by the Brunei Fire and Rescue Department), and the ICC's International Fire Code. In addition, the PBD 12 of 1994 contains design standards for fire safety and the DES Electrical Installation Guidelines (see Electricity) also contain fire design standards for buildings. PBD 12 and DES are not mandatory.

Structural. Structural codes and standards are in the Building Control Act. Structural design and construction codes pertaining to excavation and soil are in the Town and Country Planning Development Control Act.

Location, Siting, and Zoning and the Environment. Location, siting, and zoning are governed by the Town and Country Planning Act (Development Control) and the National Land Use Master Plan (Tahan Government 2010). These have incorporated various environmental protection and economic policies. The Master Plan provides the overall development plan; detailed plans include district, local, and regional plans. The plans dictate land use. The Development Control Act contains structural codes and requirements for buildings (as mentioned before).

Environmental regulations are administered by the Department of Environment, Parks and Recreation. The Environmental Order is an act and regulation that aims to minimize the environmental impact of human activities. It has provisions for (1) operational control of the activities listed in the scheduled premises (scheduled premises); (2) air pollution control; (3) water pollution control; (4) control of soil pollution; (5) control of noise; (6) control of hazardous substances and hazardous waste as listed (schedule waste); (7) Management and conservation of resources (renewable resources); (8) Control of environmental pollution such as provisions to prepare a report assessing the impact on the environment, implementing its own pollution monitoring (self-monitoring) for selected industries and other; (9) Establishment of the Council on Environmental Quality; (10) preliminary environmental impact assessment. It also lists prescribed activities that are expected to have an impact on the environment and for which environment impact assessments are required. Framework legislation has been circulated for final review by concerned ministries before presentation for approval by the enforcing authorities.

Safety. There is no safety code in Brunei.

GREEN BUILDING CODES

There is currently no green building code in Brunei. There is also no attempt to include green features in the minimum and mandatory codes.

Green Building Rating System

The Ministry of Development launched the Green Building Initiatives (GBI) in March 2012. At the time of this writing, there is neither an active website on this initiative nor any information available from any other sources. On the basis of the government website, one can infer that GBI will likely be administered by the Ministry of Development and will likely adopt standards from Green Mark of Singapore and the USGBC LEED.

Canada

1. Synopsis

GOVERNMENT-LED DEVELOPMENT OF MODEL BUILDING CODES

Canada's national building code is based on six national model construction codes developed by the Canadian Codes Center. The Commission on Building and Fire Codes (CCBFC) administers these codes, accepting, reviewing, amending, and rejecting requests for changes from the public (Government of Canada 2012). Hearings on change requests take place on a regular basis. The committee consists of volunteers from academia, industry, and government.

While the model codes are widely adopted by provincial and territorial governments and by local governments and municipalities, they are not required to enforce them. Local governments and municipalities are also not required to enforce codes adopted by provincial and territorial governments. Provincial and territorial governments draft and implement enforceable codes and may also enforce them. They, along with local governments and municipalities, also issue building permits and certificates. The building inspection program and building inspector's certification are administered by the provincial and territorial governments; local governments and municipalities engage qualified inspectors to carry out the inspections. The inspectors can be public or private employees.

REFERENCE STANDARDS

Standards referenced in codes are developed by the Canadian Standards Agency and various standards organizations in the United States, such as the American Society for Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE,) and ASTM International.

PATHWAYS TO GREEN

The model codes have a number of green features (e.g., indoor air quality, noise reduction, containment of hazardous materials, day lighting and outdoor view, water and sewerage protection of buildings, resource conservation, water conservation, energy conservation, and environmental integrity). The standing committees administered by the CCBFC incorporate these features into the model codes. Some green features were previously regulations of the Federal Government of Canada. Some provincial and territorial governments (e.g. British Columbia and Ontario) have more stringent green codes and standards.

2. Code Development, Adoption, Administration and Enforcement

MANDATORY BUILDING CODES

Canada's model building codes consist of the National Building Code of Canada (NBC), the National Fire Code of Canada, the National Plumbing Code of Canada, and the National Energy Code of Canada. These codes are adopted, modified, and enforced by provincial and territorial governments. Two organizations of the Federal Government—the Canadian Commission on Building and Fire Codes and the Canadian Code Center—administer the model codes.

REFERENCE STANDARDS

References for the national codes are adopted from 30 organizations.¹

GREEN FEATURES OF THE MANDATORY LAWS

The four model codes have extensive green features (e.g., indoor air quality, noise reduction, containment of hazardous materials, daylighting and outdoor view, water and sewerage protection of buildings, resource conservation, water conservation, energy conservation, and environmental integrity). Some provincial governments, such as those of British Columbia and Ontario, mandate the use of energy-efficient design, high-efficiency toilets, solar hot water-ready homes, and renewable energy.

TYPES OF BUILDINGS

Buildings are categorized as follows: house, small buildings, large buildings, complex buildings, and onsite sewerage systems. Each state, however, categorizes buildings quite differently from the national model codes. The government of Ontario categorizes them by size (below and above 600 m²), height (3 or lower), and use.

CODE ADOPTION AND EVOLUTION

Canadian Commission on Building and Fire Codes. The CCBFC was established by the National Research Council of Canada. It develops and maintains the model building, construction, and fire codes; oversees the work of standing committees, special purpose committees, and task groups; approves code documents; and conducts technical revisions. The commission's ten standing committees focus on

¹American Conference of Industrial Hygienists, ANSI, ASHRAE, ASME, American Water Works Association, Canadian Standards Association, American Society of Safety Engineers, ASTM International, American Wood Protection Association, Bureau de normalization du Quebec, Canadian Commission on Building and Fire Codes, Canadian General Standards Board, Canadian Wood Council, DBR, Fédération Internationale de Natation, Hydronic Institute, Heating, Refrigeration and Air conditioning Institute of Canada, U.S. Department of Housing and Development, Home Ventilation Institute, ISO, Ministry of Municipal Affairs, Ministry of Education, NFPA, Natural Resources Canada, NSF International, SMACNA, Twin Cities Aviation, UL and UL Canada.

building and plumbing services, earthquake design, energy efficiency in buildings, environmental separation, fire protection, hazardous materials and activities, housing and small buildings, structural design, use and egress, and technical translation and verification. Each is responsible for a code or sections of a code and related documents, such as user's guides, and advises the CCBFC on technical issues and recommended changes. The committees meet regularly. The membership of each standing committee conforms to a matrix that provides for regulatory, industry, and general interest categories as well as equitable geographical representation. The Technical Translation Verification Committee verifies the technical accuracy of translations of codes into French.

Canadian Code Center. The CCC provides technical and administrative support to the CCBFC and its committees.

Provincial and Territorial Policy Advisory Committee on Codes. CCBFC receives advices from the PTPACC, which consists of representatives from the provincial and territorial ministries that enforce local building, plumbing, and fire safety regulations.

Model Codes Development and Approval. Model codes are developed by consensus among the committee members and are subject to regularly conducted public hearings.

Constitutional Requirements. Canada's constitution specifies that provincial and territorial governments are responsible for fire safety and plumbing regulations. Each government has and enforces its own codes based on the national models. The CCBFC and the CCC update the codes.

Other Nonnational Codes and Standards. Other national standards and guidelines that are not mandatory or national models are maintained and updated by private sector codes and standards organizations. Organizations from Canada referenced in the codes include the Canadian Standards Association (CSA), Bureau de normalization du Quebec, CCBFC, Canadian General Standards Board, Canadian Wood Council, Heating, Refrigeration and Air-conditioning Institute of Canada, Natural Resources Canada, and UL Canada. In developing standards these organizations follow a process that includes analysis, a feasibility study, draft documentation, formation of standards committee (usually industry participants mixed with academia), committee review, correction and revision, public enquiry, vote, second level review, publication, systematic review, and post systematic review.

The **Canadian Standards Association** develops model standards to support various industries and covers standards like basic engineering, building systems, building products, concrete, masonry, structures, wood, welding and structural metals, and plumbing products and materials. CSA also develops standards for electrical work, energy, environment and carbon management, healthcare, information technology and telecommunication, infrastructure and public work, mechanical and industrial equipment, and occupational health and safety.

Bureau de normalization du Quebec operates an extensive certification program for building products, and develops and maintains standards related to the building and construction industry (like CSA).

The **Canadian General Standards Board** is a federal organization that offers client-centered, comprehensive standards development and conformity assessment services in support of the economic,

regulatory, procurement, health, safety and environmental interests of government, industry, and consumers. CGSB also develops standards for the building and construction industry.

The *Canadian Wood Council* represents manufacturers of wood products used in construction and develops standards for Canadian wood products.

The *Heating, Refrigeration and Air-conditioning Institute of Canada* represents more than 1,300 manufacturers, wholesalers and contractors, and provides tools and information necessary to ensure indoor comfort. It sets the standards for heating, refrigeration and air-conditioning in Canada.

The *Department of Natural Resources*, operating under the FIP applied title Natural Resources Canada (NRCan), is responsible for natural resources, energy, minerals and metals, forests, earth sciences, mapping and remote sensing. It sets standards for resource and energy use and conservation. It runs programs related to energy use (e.g., Energy Star, Fuel Consumption Guide, renewable energy, energy policy), mineral mining and production, forest service, groundwater management, climate change, and natural hazards.

CODE ENFORCEMENT

Provincial and territorial governments adopt the model codes, modify them to suit local requirements, and supplement them as needed. The government of British Columbia administers and enforces the building code, plumbing code, fire code, and energy efficient code through its Ministry of Energy, Mines, and Natural Gas's Office of Housing and Construction Standards. The government of Ontario enforces its codes through its Ministry of Municipal Affairs and Housing. It enforces additional codes on energy efficiency and glass in guards. The public may comment on these codes online, using a code change form, and during annual public forums.

Each provincial or territorial government runs its own Building Advisory Council to develop, administer, and modify codes. The council develops and administers codes and reports to the code administration and enforcement agencies of the governments. Those agencies review plans, issue certificates, inspect construction, etc. Building officials in each agency establish policies, enforce the Building Control Act and coordinate and oversee code enforcement and modification. The agencies also appoint inspectors.

Building codes apply province- or territory-wide, but enforcement is discretionary. The government may establish a code, and local government may regulate buildings. Local governments may decide if they want to enforce the code and how to enforce the code. Local governments may use their own building inspectors or subcontract inspection to private companies.

REVIEW CYCLE

The CCBFC has not established a required review or revision period.

3. Code Details

MINIMUM CODES

Electrical. The Canadian Electrical Code, CE code, or CSA C22.1 is a standard published by the Canadian Standards Association. It pertains to the installation and maintenance of electrical equipment. Standards for the code are referenced from CSA, American Petroleum Institute, ASME, IEEE, National Electrical Manufacturers Association, American National Standards Institute, Canadian Electricity Association, International Electrotechnical Commission, Institute of Petroleum, Instrument Society of America, ISO, NFPA, National Research Council Canada, UL, UL Canada, and Natural Resources Canada.

Energy. The National Energy Code for Building sets minimum requirements for building design and construction. The code is very similar to ASHRAE 90.1 and includes building envelop, lighting, heating, ventilation and air-conditioning systems, service water heating, electrical power systems and motors, and building energy performance compliance path. Provincial governments have also developed energy codes. For example, British Columbia has energy efficiency codes for large residential, industrial, commercial and institutional buildings, housing and small buildings, and ventilation.

Water and Sanitation. The National Plumbing Code is the model plumbing code. Each provincial and territorial government modifies the model code, develops additional codes, and develops supplementary standards on plumbing. For example, the government of British Columbia administers high-efficiency toilet design standards, solar hot water-ready home standards, water efficiency code, and code pertaining to the protection of buildings or facilities from water and sewer damage. The government of Ontario has additional water efficiency standards in its plumbing code.

Water Quality. The Federal Government develops guidelines for drinking water quality managed and administered by Health Canada, and Federal Environment Canada manages water rights, quality, pollution, use, sources, and legislation. Environment Canada develops and manages programs, legislation, regulations, and practices pertaining to groundwater contamination, erosion and sedimentation, wastewater treatment, acid rain, and wise water use. These set the minimum requirements for water and sanitation. Each provincial and territorial government also manages and administers its own water quality program and standards.

Mechanical Systems. The national building code has requirements and standards for mechanical systems. It includes various Canadian standards and codes, such as CAN/CSA-C260-M90 (rating for the performance of residential mechanical ventilating equipment), CAN/CSA-B602-05 (mechanical couplings for drain, waste, and vent pipe and sewer pipe), and B52-05 (mechanical refrigeration code). The Energy Efficiency Code also has some mechanical system standards.

Indoor Air Quality. The National Building Code references the ASHRAE Standard 62.1-2007 (ventilation for acceptable indoor air quality) and CSA International Standard Z204-94 (guideline for managing indoor air quality in office buildings), or other acceptable standards.

As mentioned, provincial and territorial governments may not force local governments to enforce the codes, thus, several have developed specific legislation that deals with local governments' reluctance to enforce indoor air quality requirements. In the absence of such legislation, the "general duty clause" applies. This clause, common to all Canadian occupational health and safety legislation, states that an employer must provide a safe and healthy workplace. Thus, making sure the air is of good quality is the employer's duty.

Lighting. Standards and codes for lighting are embedded in different codes and regulations. All lighting in Canada must comply with the Federal Energy Efficiency Act 1992. Canada also recognizes the Energy Policy Act (1992). The Department of Justice enforces the occupational health and safety regulations that address internal lighting in buildings (Department of Justice Canada 2012). The Ministry of Labour administers and enforces Part VI - 928-1-IPG-039 (measurement of lighting levels in the work place) of those regulations.

Security. There is no security code for buildings in Canada, but there are guidelines and standards. These include those of the Secretariat of the Treasury Board of Canada (operational security standard on physical security, personnel security standard, operational security standard on readiness levels for federal government facilities) and of the Public Works and Government Services of Canada (Government Security Policy). (Treasury Board of Canada Secretariat 2009)

Fire. The National Fire Code is the model fire code. It addresses safety, health, and fire and structural protection of buildings. References used in the code are from ANSI, API, ASME, ASTM International, Standards Council of Canada, Compressed Gas Association, Canadian General Standards Board, Canadian Standards Association, National Fire Protection Association, National Research Council of Canada, Natural Resources Canada, Transport Canada, and Underwriters' Laboratories of Canada.

Structural. The Standing Committee on Structural Design (SC-SD) recommends requirements for the national model construction code relating to structural loads and procedures, excavations and foundation design, design requirements for structural materials (wood, masonry, concrete, steel, aluminum, glass), and design requirements for special structures (air-supported structures, parking structures). These provisions are in Part 4 of Division B of the national building code (NBC) and in the code's Structural Commentaries User's Guide. The committee also

- Prepares recommendations for the CCBFC on the technical content of documents in its terms of reference;
- Develops objective versions of the requirements in its terms of reference; and
- Advises the CCBFC on
 - Changes to the scope and application of the NBC and the NFBC and to the SC-SD matrix;
 - The need for documents ancillary to the NBC and the NFBC and for progeny documents for subjects not in the scope of the NBC or the NFBC; and
 - The need for standards to be referenced by the NBC or the NFBC and identifies needed changes to those standards.

Examples of minimum design standards include CSA A23.3-04 (design of concrete structures), CAN/CSA-S16-01 (consolidation limit states design of steel structures), CSA S37-01 (antennas, towers and antenna supporting structures), CSA S304-104 (design of masonry structures), CAN3-S367-M81 (air

supported structures), CSA S413-07 (parking structures), and CSA S478-95 (guideline on durability in buildings).

Location/Siting/Zoning and Environment. Zoning bylaws are not a federal matter in Canada. Such laws are decided at the municipal level and vary from town to town. The Environmental Protection Act 1999 sets the rules for location and siting. The regulations focus on existing and new substances on site, hazardous wastes, pollution and wastes, government operations on aboriginal lands, and species protection. Environment Canada's recommendations and regulations on water pollution, erosion and sedimentation, wastewater, groundwater, water management also affect zoning bylaws in Canada.

The Progress Report on the Federal Sustainable Development Strategy, and the Canadian Environmental Sustainability Indicators also set direction for environmental codes and standards used in national building codes. Environment Canada also set the regulations and guidelines for wildlife protection, control of air and land pollutions, pollution prevention, managing and reducing waste, etc. are cited by the codes and bylaws in different cities. (Environment Canada (b) 2012; Environment Canada (c) 2012).

Safety. There is no code related to safety in Canada.

GREEN BUILDING CODES

Green Features and Requirements in Mandatory Codes

The model building codes have the following green features: indoor air quality (ASHRAE 62.1), noise reduction, containment of hazardous materials, daylighting and outdoor view, water and sewerage protection of buildings, resource conservation, water conservation, energy conservation, and environmental integrity. The national energy code (NECB–National Energy Code for Building 2011, and CSA SB-10–Supplementary Standard SB-10 Energy Efficiency Supplement) establishes the minimum energy efficiency design and construction of building. The model plumbing code has water efficiency requirements. Some provincial governments, such as those of British Columbia and Ontario, are mandating the use of energy efficient design, high efficiency toilets, solar hot water ready home, and the use of renewable energy.

Green Building Rating System

The voluntary green building rating systems in Canada include

- BOMA BEST
- Canadian Standards Association BREEAM Canada
- Canadian Standards Association Climate Change Buildings and Infrastructure
- Green Globes
- LEED® Canada for New Construction and Major Renovations
- Natural Resources Canada ENERGY STAR®
- EnerGuide
- GreenGlobes
- R-2000.

Chile

1. Synopsis

NATIONAL APPROACH

Chile's national building code is the General Law of Urban Planning and Construction. It has three levels:

- **General Law**, which contains the principles, functions, powers, faculties, responsibilities, duties, penalties, and other regulations governing bodies, officials, professionals, and individuals involved in urban planning, urbanization, and construction.
- **General Ordinance**, which contains the provisions of the law and regulations governing administrative procedures, urban planning processes, development and construction, and technical standards of design and construction.
- **Technical standards**, which contain and define the technical characteristics of projects, materials, and construction and development systems for compliance with standards required by the General Ordinance.

By decree, the Ministry of Housing and Urban Development approves the standard developed by the National Institute of Standardization (*Instituto Nacional de Normalización* INN), and the regulation for potable water, sewerage, and paving installations. Standards can also be prepared by the Ministry of Housing and Urban Development and its departments. Therefore building standards in Chile are mainly developed by the INN, which is a member of the International Standards Organization (ISO). INN publishes design criteria in the form of individual standards.

CODE ADOPTION AND IMPLEMENTATION

Code adoption takes place at a local level through regional secretariat ministries. The Ministry of Housing and Urban Development supervises the laws, regulations, and administrative and technical requirements for construction and urbanization and interprets the provisions of land zoning tools.

Municipalities implement the code. In each municipality, the departments of municipal works implements the General Law of Urban Planning and Construction, its general ordinance and technical standards, and other regulations. These departments have administrative and technical competencies. Compliance with structural code is verified by reviewers in the Structural Calculation Project. These reviewers are qualified professionals and certified by governmental offices through private schools and organizations.

CODE INSPECTION

The Department of Municipal Works supervises building and urbanization works executed in the jurisdiction to verify building occupancy. According to the General Law of Urban Planning and

Construction, builders are responsible for failures, mistakes, or defects in construction—including works by subcontractors and the use of defective materials. Technical inspectors, who are competent professionals independent of the builder, supervise conformance with construction standards according to the building permits. Technical inspectors are secondarily liable with the builder.

REFERENCED STANDARDS

Like other economies in the Latin America, Chile has mandatory and voluntary standards. Standards become mandatory when they are cited or incorporated in a regulation (resolution, decree, or law). Standards for different sectors, including construction, can be found at the INN's catalogue: http://www.inn.cl/pdfs/catalogonormas/Catalogo_2012%2012_Diciembre.pdf

GREEN BUILDINGS

Chile has its own building certification system but does not to have a national green construction code. It has developed energy efficiency standards for the building sector and enjoys broad-based support for energy efficiency, giving it a unique opportunity to develop a green building code with public and private sector stakeholders. Identifying gaps in energy efficiency as well as other green aspects (e.g., water conservation, renewable energy), would help direct attention to the development of a green code. However, the strengthening of code implementation and enforcement must be considered fundamental to green building efforts that support Chile's Energy Efficiency Strategy 2020.

2. Building Regulatory System

NATIONAL APPROACH

Chile's national building code is known as the General Law of Urban Planning and Construction.² It has three levels as follows:

- **General Law**, which contains the principles, functions, powers, faculties, responsibilities, duties, penalties, and other regulations governing bodies, officials, professionals, and individuals involved in urban planning, urbanization, and construction.
- **General Ordinance**, which contains the provisions of the law and regulations governing administrative procedures, urban planning processes, development and construction, and technical standards of design and construction.
- **Technical standards**, which contain and define the technical characteristics of projects, materials, and construction and development systems for compliance with standards required by the General Ordinance.

² D.F.L 458 de 1975 Ley General de Urbanismo y Construcciones- updated by Law 20599, published in the official paper of June 11 2012. http://www.minvu.cl/opensite_20070404173759.aspx

A number of engineering professors in Chile are graduates of engineering programs in the United States and Europe. Chile's Law of Urban Planning and Construction has an influence from international standards including those of the United States and Europe, as well as local experience.

The Ministry of Housing and Urban Development proposes to the President modifications of General Law required to adapt it to the challenges and opportunities of national development. The Ministry also studies the General Ordinance to keep it in accordance with technological advancement and economic development. It also works with professional schools and technical experts.

By supreme decree, the Ministry of Housing and Urban Development approves the technical standard developed by the National Institute of Standardization (*Instituto Nacional de Normalización INN*), and the regulation for potable water, sewerage and paving installations. Standards can also be prepared by the Ministry of Housing and Urban Development and its departments. Therefore building standards in Chile are mainly developed by the INN, which is a member of the International Standards Organization (ISO). INN publishes design criteria in the form of individual standards.

CODE ADOPTION

Code adoption takes place at a local level through regional secretariat ministries. The Ministry of Housing and Urban Development supervises laws, regulations, administrative and technical requirements for construction and urbanization and interprets the provisions of land zoning tools.

Commercial Buildings—Construction Practices

Urban centers include many tall residential and commercial structures made of reinforced concrete bearing wall systems. Commercial construction is typically cast-in-place concrete or confined masonry construction. The southern portion of Chile, which has extensive forestation, includes some wood frame construction. Structural steel construction is typically limited to industrial facilities and long-span applications such as airport terminals and stadiums. The economy experienced major growth during the 1990–2010 period and building development during the period was extensive.³

CODE ADMINISTRATION

Municipalities implement the code. In each municipality, the Department of Municipal Works implements the General Law of Urban Planning and Construction, its general ordinance and its technical standards, and other regulations. These departments have administrative and technical competencies.⁴

Some of their main roles in code compliance are as follows:

- Approve subdivision of urban and rural premises
- Approve development and construction projects
- Grant building permits

³ NIST GCR 12-917-18. Comparison of US and Chilean Building Code Requirements and Seismic Design Practice 1985-2010. NEHRP Consultants Joint Venture. A partnership of the Applied Technology Council and the Consortium of Universities for Research in Earthquake Engineering. October 2012.

⁴http://www.nacimiento.cl/index.php?option=com_content&view=article&id=87&Itemid=201

- Supervise construction
- Authorize building occupancy
- Inspect buildings according to the law and technical standards
- Apply environmental regulations related to construction and urbanization.

In general, the departments apply the regulations for construction and development in their jurisdiction.

By law, all municipalities will have a Director of Works, function that must be performed by a professional with a university degree. In jurisdictions with more than 40,000 inhabitants, this position must be filled by an architect or civil engineer; in other jurisdictions it may be filled by a general constructor. The professional filling this position should be a member of the respective professional school (architecture or engineering). Compliance with structural code is verified by reviewers in the Structural Calculation Project. These reviewers are qualified professionals and certified by governmental offices through private schools and organizations.⁵

The construction, reconstruction, repair, alteration, extension, and demolition of buildings and development works of any kind, whether urban or rural, requires that the owner request a building permit from the Department of Municipal Works. The General Ordinance provides for some exceptions. The building permit requires that an independent structural and seismic reviewer must approve the plans. In addition, the set of drawings must also be submitted to the building department of the municipality where the site is located. The documents become public record.

CODE INSPECTION

The Department of Municipal Works supervises buildings and urbanization works in its jurisdiction and verifies building occupancy. According to the General Law of Urban Planning and Construction, builders are responsible for failures, mistakes, or defects in construction, including works by subcontractors and the use of defective materials. Technical inspectors, who are competent professionals independent of the builder, supervise conformance with construction standards according to building permits. Technical inspectors are secondarily liable with the builder.

Construction quality is regulated by jurisdictional ordinance, with construction specifications set by the structural design team in charge of the project following the parameters of the General Law and the internal standards of the construction companies and external construction inspectors. According to “Overview of Building Codes and Standards in Chile at the Time of the 27 February 2010 Offshore Maule, Chile Earthquake”:

for public projects, the law and the specifications require that public projects have external independent construction inspection. For a private project, construction inspection is optional and is dependent on the desires of the owner of the project. However, construction inspection is becoming a standard for medium to large projects or when the owner of the project is different from the construction companies in charge of the project. The purpose of external inspection is to assure the quality of the construction and that the specifications set by the township, structural engineers and the law are being followed. Structural engineers provide

⁵ http://www.geofisica.unam.mx/sismologia/app/webroot/files/ssn/1-SI-48-20110524172257-Informe_Final_Completo_130510.pdf

the drawings and technical specifications of the projects; the drawings and specifications define and specify the construction materials to be used, the physical properties of the materials and the geometry of placement. These documents also specify the control that needs to be applied to ensure compliance. Also, the structural engineers are legally responsible to visit the construction site on a regular basis to approve the construction by confirming that the plans and specifications given by them are being followed. Townships regulate the quality of the construction through specifications of construction set by them; these must be followed by the construction companies to be able to obtain the township approval of the building. In addition, each township has officials and inspectors that are in charge of visiting the construction site typically every 15 days to assure that the specifications of the township and the law are being followed.⁶

REFERENCED STANDARDS

All Chilean standards are voluntary. These standards become mandatory when they are cited or incorporated in a regulation (resolution, decree, or law). Standards for different sectors including construction can be found at the INN's catalogue:

http://www.inn.cl/pdfs/catalogonormas/Catalogo_2012%2012_Diciembre.pdf

GREEN BUILDINGS

Chile has a certification system supported by (1) a mandatory regulation that increases the base condition- The Chilean mandatory standards is the building code “Ordenanza General de Urbanismo y Construcción); (2) official energy calculation systems, (3) system regulations (sanitary hot water systems, refrigeration, etc); and (4) objective information (labeling of equipment, appliances, buildings).⁷ It does not yet have a national green construction code but has developed energy efficiency standards for the building sector. According to the World Bank

in Latin America, in addition to Mexico, Chile seems to be the most proactive country with regard to building energy efficiency. One of the drivers for developing a BEEC has been that the use of dirty fuels for heating has had negative impacts on occupants' health. In 2000, a thermal regulation for roofs was enacted, establishing maximum heat transmission values for each of the seven climatic zones. In 2007, it was extended to the rest of the building envelope (walls, windows, doors). The regulation is part of the General Ordinance of Urban Planning and Construction and is mandatory for all new residential buildings and retrofits. It was developed by the nongovernmental Construction Institute in a collaborative process with industry, consumer, and expert participation. The standard is considered to be relatively lenient in comparison to international state of art. Insulation is not even necessary, since brick masonry construction can satisfy the requirements. Work has started in the development of a performance standard as an alternative to the prescriptive standard. It will take into account all factors that influence indoor climate and energy balance of a building. The necessary software was developed and tested. The Ministry of Energy with its Program Pais de

⁶ The Structural Design of Tall and Special Buildings Struct. Design Tall Spec. Build. 19, 853–865 (2010) Published at wileyonlinelibrary.com). DOI: 10.1002/tal.676

⁷ Implementation of Latin America's First Certification System. APEC Presentation by Chile. Green Buildings and Green Growth: The Enabling Role of Standards and Trade. Housing and Urban Ministry. Government of Chile. Washington, D.C., United States 3-4 March 2011.

Eficiencia Energetica (PPEE, Program Energy Efficient Country) and in collaboration with the Ministry of Housing and Urbanism, is supporting the development of a BEE Certification system for new buildings. Other initiatives under the PPEE include pilot projects subsidizing the construction of new social housing units that go beyond the BEEC and the energy efficient housing for which guides have been developed.”⁸

Chile enjoys broad-based support for energy efficiency, giving it a unique opportunity to develop a green building code with public and private sector stakeholders. Identifying gaps in energy efficiency as well as other green aspects (e.g., water conservation, renewable energy), would help direct attention to the development of a green code. However, the strengthening of code implementation and enforcement must be considered fundamental to green building efforts that support Chile’s Energy Efficiency Strategy 2020.

3. Code Details

The area “F” in the INN’s catalogue relates to basic construction standards and there are several standards under each category as follows (when the standard uses an international standard as its basis the reference is highlighted, see examples F.2.1 and NCh 430)

F.1.1 Basic Standards for Construction

F.2.1 General Architectural design

Example: NCh2077:2000

ISO/TR 9527:1994

Building construction-Needs of disabled people in buildings-Design guidelines.

F.2.2 Modular coordination-dimensional requirements

F.2.3 Technical Drawing-Project presentations-Technical Specifications

Examples:

- NCh433–*Earthquake Resistant Design of Building* encompasses requirements for calculating seismic loads for design of structures, comparable to Chapters 11 through 22 of ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*, in the United States.
- NCh430 – *Reinforced Concrete Design and Analysis Requirements sets the criteria for design and detailing of reinforced concrete structures, comparable to ACI 318, Building Code Requirements for Structural Concrete*, in the United States.
- NCh431 Snow Loading 1977
- NCh432 Wind Loading 1971
- NCh1537 Dead/Live Loads 1986
- NCh427 Design of Steel 1977

⁸ World Bank Paper No. 204, Mainstreaming Building Energy Efficiency Codes in Developing Countries. 2010. The International Bank for Reconstruction and Development.

- NCh1198 Design of Wood 2006
- NCh1928 Design of Reinforced Masonry 2003
- NCh2123 Design of Confined Masonry 2003
- NCh2369 Earthquake Resistant Design of Industrial Structures and Facilities 2003
- NCh2745 Earthquake Resistant Design of Base Isolated Buildings 2003

F.3.2 Soil Mechanics and Foundations	F.6.26 Floor Coating
F.3.3 Steel Structures	F.6.27 Partitions
F.3.4 Masonry structures	F.6.28 Joints
F.3.5 Reinforced Concrete Structures	F.6.29 Roofing
F.3.6 Timber structures	F.6.3 Asbestos-cement
F.3.7 Autoclaved aerated concrete masonry	F.6.30 Masonry walls
F.4.1 Acoustic insulation	F.6.31 Facades
F.4.2 Thermal Insulation	F.6.32 Fiber cement
F.4.3 Humidity	F.6.33 Asphalt membranes
F.4.4 Natural ventilation	F.6.4 Asphalt and tar
F.4.6 Sustainability	F.6.6 Rubber
F.5.1 Fire prevention	F.6.7 Cement
F.5.2 Safety in execution of works - Personal Protection	F.6.8 Pottery (clay)
F.6.1 Steel and Alloys	F.6.9 Copper and copper alloys
F.6.10 Cast iron	F.7 Facilities
F.6.11 Concrete and mortar	F.7.1 Drinking water installations
F.6.12 Wood	F.7.2 Sewerage facilities
F.6.13 Albuminoidal substances, glues, adhesives	F.7.3 Electricity and artificial lighting
F.6.15 Prefabricated panels	F.7.4 Gas
F.6.16 Wood-Plastic	F.7.5 Heating, artificial ventilation, air conditioning
F.6.17 Paints, varnishes and similar	F.7.6 Transport (elevators, escalators)
F.6.18 Plastics	F.7.7 Electrical installations of buildings
F.6.20 Doors, windows and ironmongery	F.8.1 Tools
F.6.21 Soil and soil cement	F.8.2 Machinery and equipment
F.6.22 Textiles (for construction)	F.9 Furniture
F.6.23 Glasses	F.9.1 Appliances
F.6.24 Plaster	F.9.2 School furniture
	F.9.3 Storage Units

People's Republic of China

1. Synopsis

CODE ADMINISTRATION AND ENFORCEMENT

Construction laws are administered by the Ministry of Construction, while building codes and mandatory standards are drafted and maintained by multiple parties: the Ministry of Construction, Ministry of Housing and Urban and Rural Development, the Chinese Academy of Building Research, Ministry of Health, and Ministry of Environment. The Standardization Administration of the People's Republic of China (SAC) is authorized by the State Council of China to exercise administrative responsibilities by undertaking unified management, supervision, and overall coordination of standardization work. Local governments frequently develop regional codes and mandatory standards, and the SAC also administers these. Thus, the SAC administers all codes and standards. Codes and mandatory standards are enforced by local governments and private companies contracted by the governments conduct inspection and testing.

REFERENCE STANDARDS

The SAC is authorized by the State Council of China to exercise administrative responsibilities by undertaking unified management, supervision, and coordination of standardization work in China. The SAC represents China in the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and other standardization organizations. The SAC is responsible for organizing the activities of the Chinese National Committee for ISO and IEC. It approves and organizes the implementation of international cooperation and the exchange of projects on standardization. The General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ)—a ministerial department under the State Council and the SAC—is in charge of national quality, metrology, entry-exit commodity inspection, entry-exit health quarantine, entry-exit animal and plant quarantine, import-export food safety, certification and accreditation, standardization, as well as administrative law enforcement.

PATHWAYS TO GREEN

The Code of Green Design for Civil Buildings (JGJ/T229-2010) is the green building code of PRC (Chinese Academy of Building Research 2010). The code will become mandatory by 2014 on all publicly owned buildings. Mandatory renovation code will also be required in the future. In addition, China has implemented mandatory energy efficiency code, and integrated mandatory energy efficiency and environmental standards in some building codes (SAC 2005; ENR 2013) Green building codes are being implemented in several municipalities, such as Beijing and Guangzhou. Chongqing municipal government has also made plans to mandate green building code (KNAUF 2012).

2. Code Development, Adoption, and Enforcement

BUILDING REGULATORY SYSTEM

The Construction Law of China was established as the Order of the President of the People's Republic of China (Ministry of Commerce, 1998). The Standing Committee approved the act, and the President passed the order and thus enacted the law. The law outlines the building and construction regulatory system, including supervisory and inspection procedures, permits issuance procedures, qualifications of operators, contractual documents and agreements, contracting issues, project supervisory and control, project safety management, project quality control, legal liability, and supplementary provisions. The Ministry of Construction and the Ministry of Housing and Urban-Rural Development administer the regulatory system.

Enforcement of Building Laws, Regulations, Codes and Standards

The administration of various laws, regulations, codes, and standards lies with the central government, and various state and provincial governments. County government at the city or jurisdiction level conducts inspections and issues permits. The permit to start a project must be obtained from a state council, and that permit is tied to other permits granted by other authorities (e.g., city planning, land use, demolition). The individual state or province engages a building control department to administer and enforce the regulatory system. Laws, regulations, codes, and standards are uniform throughout China. In addition to states, provinces and councils, other ministries and agency also issue permits and enforce their laws. Project safety management is enforced and administered by the Ministry of Labor; state councils enforce rules governing supervisory and control systems and project quality control.

Construction Regulations and Codes Differences between Central Government and States

The Construction Law requires uniformity in the building control regulatory system; however, the state councils are tasked to include, administer, and enforce additional regulations and codes pertaining construction quality, safety, and supervision. Permit and inspection methods are similar even though there are some differences in regulations and codes.

MANDATORY CODES AND STANDARDS

There are many mandatory codes, standards, and design guidelines covering structural design, fire safety and protection, heating, ventilation, and air-conditioning, civil defense basement, energy efficiency, residential building, public buildings, thermal design, mechanical system, plumbing and sanitation, drainage system, industrial equipment, noise control, environmental pollution, occupational exposure, emissions, indoor air quality, and acoustics.

Written like specifications, *codes* are mandatory and are divided into design, construction, installation, operation, and test and evaluation. Design codes are mainly prescriptive; codes for construction,

installation, and operations are mostly performance-oriented, contain specific requirements, and are often accompanied by compliance guidebooks to assist engineers and designers with compliance. These guidebooks are also mandatory. “Trade-off” options are also very regularly used in the codes, especially those pertaining to green features. *Standards* consist of mandatory national standards, voluntary national standards, and national guiding technical documents. *Design guidelines* are usually developed along with codes and mandatory standards to help engineers and designers comply with them. The codes are developed, administered, and regularly reviewed by the Ministry of Construction, Ministry of Housing and Urban-Rural Development, Ministry of Environment, and others. The ministries develop, review, update, and replace codes. Even though there is no mandatory review period, they are updated regularly. The ministries also develop standards but these are administered by the SAC.

REFERENCE STANDARDS

Mandatory codes in China incorporate standards from China and various economies (e.g., Australia, Germany, Japan, United Kingdom, United States). Most codes copied directly from standards do not refer to or cite the standards, but note that the standards are from international standards. The wording in the codes is modified to suit regional conditions.

Chinese standards may be mandatory or voluntary. Mandatory standards have the force of law as do other technical regulations. They are enforced by laws and administrative regulations and concern the protection of human health, personal property, and safety. Standards that fall outside of these characteristics are considered voluntary. Many technical regulations developed under the Chinese standards system are referred to as “mandatory standards.” In addition to these mandatory standards, individual agencies also develop regulatory requirements outside of the Chinese standards system.

There are four levels of standards. The most widely implemented are national standards, followed by professional standards, then local standards, and finally enterprise standards. These levels are hierarchical, so that local standards supersede enterprise standards, professional standards supersede local standards, etc. For any given product or service, only one type of standard will apply (Standards Portal 2012).

National standards are often referred to as “GB standards.” They are consistent across all of China and are developed for technical requirements. As of 2006, there were 21,410 Chinese national GB standards, among which approximately 15 percent were mandatory and 85 percent voluntary. Chinese national GB standards can be identified as mandatory or voluntary by their prefix code. GB/T indicates voluntary national standards, and GB/Z indicates national guiding technical documents (SAC (a) 2010; SAC 2012).

Many Chinese national GB standards are adoptions from ISO, IEC, or other international standards developers. (As of 2006, nearly half of Chinese national GB standards were adoptions of international standards and “advanced foreign standards.”) China has also expressed a goal of significantly increasing the number of standards that are adoptions of international or advanced foreign standards. The database of Chinese national GB standards provides information on which standards have been adopted.

Professional standards are often referred to as “industry standards.” They are developed and applied when no national GB standard exists, but where a unified technical requirement is needed for a specific industry sector. Professional standards are coded by industry sector. The codes of mandatory standards are shown

in the following table, and the codes of voluntary standards have "/T" added after the mandatory codes. For example, the code for agricultural voluntary standards is "NY/T."

Local standards are often referred to as “provincial standards.” They are developed when neither national nor professional standards are available, but unified requirements for safety and hygiene of industrial products are needed in a local area. Local standards are delineated with either “DB + *” (mandatory) or “DB + */T” (voluntary). The codes for local standards are shown below. The * represents the province code as defined by the ISO 3166-2:CN and GB 2260/T, so a local voluntary standard in Sichuan Province would be DB + 51/T.

Enterprise standards may be developed and/or used by an individual company when national, professional, and local standards aren't available. However, companies doing business in China are encouraged to use/adopt national, professional and local standards if they are available. The formula for determining an enterprise standards code is below, where the * represents the enterprise code (EU-SME 2011).

Codes and mandatory standards in China are divided up finely into technical requirements, systems, approaches, materials etc. For example, there are 48 national codes and 25 mandatory standards on structures alone, and nearly 60 national codes and mandatory standards pertaining to building energy and heating, air-conditioning and refrigeration (HVAC) systems. In turn, the HVAC codes and mandatory standards are divided into types of systems, design methods, building types, regional weathers, and equipment etc. The structural codes are divided into building types, materials, design methods, and regional constraints.

The national codes and mandatory standards also include more than 800 national codes and mandatory standards pertaining to building design. These pertain to plumbing, sanitation, foundation, piling, stormsewer, water quality, oxygen stations, lighting etc. Codes can be further categorized into prescriptive code, technical codes, and design codes for design. Many regions have developed regional codes and mandatory standards, and these categorize buildings differently. While national codes and mandatory standards are mandatory to the region, the regional codes and mandatory standards can sometimes overwrite the national codes and mandatory standards if they are more stringent, or if the regional can better address regional issues.

GREEN FEATURES IN MANDATORY LAWS

Green features are included in most building regulations, codes, and mandatory standards in China. China has also developed extensive regulations, codes, and standards pertaining to green buildings. As reported by the Xinhua News Agency, China's top economic planner has said that the government will require new urban buildings to reach mandatory energy-saving standards and require the renovation of existing buildings to make them more environmentally friendly by 2015,. A green building code will be adopted for all government- invested buildings built from 2014 onward, even though many cities have already adopted green building codes. Beijing has adopted mandatory green building codes, and Chongqing is planning to adopt mandatory green building standards in 2013 (KNAUF 2012).

TYPES OF BUILDINGS

The Construction Law is applied to all types of buildings in China. It loosely categorizes buildings into commercial, residential, industrial and others. Codes and mandatory standards, on the other hand, are developed for specific types of buildings (e.g., high-rise residential, low-rise residential, commercial, special commercial, military, industrial, heavy industrial, cold-region residential). More national and regional codes and mandatory standards are found for residential and commercial buildings than any other categories, and there are also more codes and mandatory standards that address the cold regions.

ADOPTION AND EVOLUTION PROCESS OF CODES AND MANDATORY STANDARDS

As noted above, the Construction Law is administered by the Ministry of Construction, while construction codes are administered by the Ministry of Construction, the Ministry of Building, and Rural and Urban Development, and other ministries (e.g., Ministry of Environment). The SAC administers many building codes. The ministries and SAC nominate and elect committee members and chairs on the basis of expertise. Committees draft codes and standards, while SAC and ministry leadership implements these codes and mandatory standards.

CODE ENFORCEMENT

Code enforcement, including city planning code, is the responsibility of the eleven municipal governments (that can delegate the enforcement to their district government), the city governments (for prefecture level cities), and the county-level cities. The adopted documents for the municipal governments and city governments at the prefecture level can include codes and mandatory standards of the central, provincial, and city governments. The county-level cities adopt codes and mandatory standards of the central, provincial and county governments. Enforcements is carried out by a designated building regulatory body (e.g., building control department), and permits are issued by the municipal and prefecture-level city governments. Permits for county-level cities are issued by the county.

Building Energy Code. A Department of Energy study of building energy code (Department of Energy (China) 2009) states that the Ministry of Housing and Urban and Rural Development (MOHURD) is responsible for adopting and overseeing code implementation nationally. The Chinese Academy of Building Research (CABR) takes the leading role in the drafting of codes, and provision of training and support for implementation. At the local level, government institutions and private third parties enforce building energy code. The construction administration department of the local jurisdiction oversees the enforcement of building energy code. The jurisdiction is also responsible for the issuance of permits. Some quality supervision and testing station processes are carried out by nongovernment related companies, though these companies are funded and authorized by the local governments. The Department of Energy report said that compliance with building energy code is still an issue.

3. Code Details

MANDATORY AND/OR MINIMUM CODES

Electrical. The main national electrical code is the GB 50303-2002 (code of acceptance of construction quality of electrical installation in building). Other national codes and mandatory standards include GBJ 303-88 (building electrical safety inspection national standards), GB 50259-96 (code of acceptance of electrical installations of over 1kv and below), and GB 50259-96 (code of acceptance of electrical installations and lighting during construction). Electrical codes and mandatory standards are also developed for and divided into different categories, such as buildings type, equipment, systems, processes, procedures, and professionals, etc. Examples include JGJ 16-2008 (commercial building electrical code), JGJ242-2011 (residential building electrical code), GBC63-90 (electrical installations and distribution code), GB 50062 (electrical installation protection and automated system code), and GB 50055 (electrical distribution network design system code) (Wenku Baidu 2012; Zhulong 2012). There are at least 200 national building electrical codes and mandatory standards.

Energy. There are several energy related codes and mandatory standards. MOHURD's GB 50411-2007 (code for acceptance of energy efficient building construction) is a critical to regulatory efforts to implement building energy codes in China (Ministry of Construction and General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China 2009) (Department of Energy (China) 2009). It covers construction quality, testing and documentation for the building envelope (wall, window, door, roof and floor), heating, HVAC systems, lighting, monitoring and controls. It applies to new construction, and additions and retrofits. Other codes and mandatory standards include the GB 19577-2004 (chiller energy efficiency limited value and energy efficiency rating), GB 50019-2003 (HVAC design specifications), and GB 50189-2005 (public building energy efficiency design standards).

Water and Sanitation. Plumbing and sanitation codes and mandatory standards are developed for and divided into types of systems, material types, locations of installation, use of systems, procedures, and processes etc. There are many codes and mandatory standards, for example:

- Code of Design for Steel Potable Water Pipes (CECS 137:2002)
- Code of Installation for Waste Water Storm Water System (GBT19570-2004)
- Code of Design and Installation for Aluminum and Copper Potable Water Pipes (GCC-T98-2003)
- Mandatory Guideline, Design Code and Standards for Concrete and Gas Delivery Pipes (GBT 11836-89)
- Code of Design and Installation of External Potable Water and Gas Delivery in Earthquake Zone (GB50032-2003)
- Design Code for Rainwater Disposal Systems (DBJ 08-42-95)
- Code of Installation and Design Mandatory Guidebook, Code of Design and Installation for Pressure Piping–Industrial Piping, Code of Design for Soldered Pipes (GB3091-2001)
- Code of Design and Installation of Underground Piping (CECS164-2004).

There are at least 60 national codes and mandatory standards pertaining to plumbing, sanitation, and storm water systems (360doc 2012; docin 2012). Some of the plumbing and sanitation codes are grouped together with other mechanical systems codes under building systems. Building systems include plumbing, sanitation, mechanical, and fire protection (China Construction Publisher 2002).

Several codes and mandatory standards pertain to water quality: Drinking Water Quality Inspection Code (2001), and GB17051-1997 (grey water quality code). China also adopts the WHO Guidelines for Drinking Water Quality (1993) (Government of China 2012).

Mechanical Systems. Some of the codes and mandatory standards pertaining to mechanical systems (not exhaustive) include, the Code of Design and Installation for Heating and Hygiene Engineering (GBJ 242-82), Mandatory Quality and Inspection Control Guidelines and Standards (GBJ 302-88), Code of Installation and Inspection of Mechanical Systems (GB 50231-88), Code of Design and Installation of HVAC (GB 50243-97), Mandatory Standards for Steel Piping Used for Mechanical Systems (GB 50235-97), Mandatory Standards for HVAC (GBJ 304-88), Code of Design and Installation of Air Quality Handling Systems for Refrigeration of Air (GB 50274-98), Code of Design and Installation of Fan, Compressors and Boiler Systems (GB 50275-98), various Codes of Design and Installation for various mechanical systems (GBs for pressurized system, elevators, escalators, appliances etc.) (China Construction Publisher 2002). There are at least 50 codes and mandatory standards pertaining to building mechanical systems.

Indoor Air Quality. There is at least one IAQ code in China. The code is jointly administered by the Ministry of Health, SAC, and the Ministry of Environment. These codes incorporate different IAQ standards, technical specification, and design guidelines, and thus the purpose for having different codes is likely to serve different regions in China (深圳邦奥伟业, 2011; RnRI, 2005). Standards include the following:

- GB 11737-89 Standards for benzene, toluene, and xylene health inspection and test methods of residential properties
- GB/12372-90 Allowable standard for residential area's atmospheric nitrogen dioxide
- GB/T14582-93 Ambient air radon measurement method
- GB/T15438-1995 Standards for UV spectrophotometry for ambient air ozone level
- GB/T15439-1995 Standards of measurement of environmental air benzo and pyrene,
- GB/T16128-1995 Allowable residential area's atmospheric sulfur dioxide health inspection standard
- GB/T16129-1995 Method for determining atmospheric formaldehyde in public places
- GB/T16147-1995 Air radon concentration measurement methods with scintillation vials
- GB 16356-1996 Underground construction radon and progeny control standards
- GB/T17095-1997 Indoor air health standards for workers
- GB 6566-2000 - Construction materials radiological protection standards
- GB/T18204.18-2000 Indoor air quality determination method in public places
- GB/T18204.23-2000 Method for measuring atmospheric carbon monoxide in public places
- GB/T18204.24-2000 Method for measuring atmospheric carbon dioxide in public places
- GB/T18204.25-2000 Method for measuring atmospheric ammonia in public places
- GB/T18204.26-2000 Residential sanitation area's atmospheric formaldehyde inspection standard
- GB/T18204.27-2000 Method for measuring atmospheric ozone in public places.

Lighting. Requirements for lighting energy use and lighting installation methods are part of the energy and building system (including fire) codes and mandatory standards. GB 50034-2004 (standard for lighting design of buildings) is mandatory and incorporated into many codes. This standard is administered by the Ministry of Construction.

Security. There are security codes for airports, air defense shelters, hospitals, and other military facilities, but there are none for commercial buildings.

Fire. There are several fire codes and mandatory standards; examples include

- GB 50045-95 Code of Design for High Rise Buildings
- GBJ 16-2001 Code of Design for Buildings (Guobiao, 2005)
- GB 50016-2006 Code of Design on Building Fire Protection and Prevention
- GB 50067 -97 Code of Design for Garage and Parking Fire Protection
- GB 50038-2005 Mandatory Design Specification for Civil Air Defense (include Fire Protection)
- GB 50098-2009, Code of Engineering Design for Fire Safety Norm for Civil Air Defense Basement
- GB 50222-95 Code of Fire Prevention Design of Interior Decorations in Buildings
- GB 50261 Code of Installation for Automated Fire Extinguishing System.

The building codes also contain extensive fire protection requirements. For example, GB 50368-2005 (residential building code) has design requirements for smoke detection systems in stairwells and fire alarm systems in residential buildings.

Structural. There are 42 mandatory structural codes and 28 mandatory structural standards in China. Codes are divided into loading, concrete, steel, brick and masonry, timber, rolled steel, seismic, foundation, PRC, RC structure for tall buildings, RC structure for shell, mash concrete structure, FRC structure, and RC solid (Jin & Zhao 2011).

Location/Siting/Zoning and Environment. City planning, location planning, and zoning are carried out by city government. These are implemented as laws. The rules set by the city governments have to comply with the City Planning Law of the People's Republic of China (China.com.cn, 2003).

Safety. There is no safety code that focuses on building. The safety codes focus mostly on construction site safety.

GREEN BUILDING CODES

The Code of Green Design for Civil Buildings (JGJ/T229-2010) is the green building code of PRC. The code includes requirements for location/zoning, land use, building exterior and interior environment (IAQ and environmental pollution), construction materials, mechanical systems, storm water management, water efficiency and conservancy, HVAC, building mechanical systems (including appliances), and light pollution (Chinese Academy of Building Research, 2010). Added to the code are various standards pertaining to the code, such as the GB/T 50378-2006 (evaluation standard for green building) published by the Ministry of Construction (SAC , 2005).

As mentioned, energy efficiency code is enforced by a third party engaged by the local government. Similarly, green building code is supposed to be enforced at the local level and by third parties (mostly private sector). According to the Xinhua News Agency, the Code of Green Design for Civil Buildings will become mandatory for all publicly built buildings from 2014. It will be applied to affordable housing projects in China's provincial-level cities, provincial capitals, and vice-provincial-level cities, as well as to public construction projects with an area of more than 20,000 square meters per building from 2014. New green renovation code will also be developed and will become mandatory for government-owned buildings. The cost of meeting the minimum requirements will be 50 Yuan (US\$8 dollars) per square meter, according to the official (ENR 2013). Green building codes are already implemented in several municipalities, such as Beijing and Guangzhou. Chongqing municipal government has also made plans to mandate green building code (KNAUF 2012).

Hong Kong, China

1. Synopsis

Hong Kong, China, like Singapore, Malaysia, and Brunei, does not have a code system. Building regulations do not cite code, but all standards and codes of practice are strongly recommended. Failure to comply with standards and codes of practice may not get a professional into trouble; however, once failure to comply results in a disaster, the professional will be subject to criminal penalty.

BUILDING REGULATION ADMINISTRATION AND ENFORCEMENT

The Building Department of Hong Kong Special Administrative Region (SAR) administers and enforces building regulations in Hong Kong China. The regulations are mandatory while guidelines are recommended. Regulations are enforced by the Building Department or Housing Department and are the minimum standard required by the industry. Failure to comply with some of these regulations is considered a criminal act and punishable by jail and/or fine. The Building Department may impose a fine for failure to comply with the less critical mandatory regulations (such as those for water efficiency). Other punishment for noncompliance includes withdrawal of license or delay in the issuance of permit. Mandatory regulations and standards are legal requirements and enforced by the designated government agencies for specific purposes.

Companies are encouraged to comply with recommended or voluntary standards and compliance is often rewarded with certification. Financial incentives include tax rebates. Recommended codes are not mandatory and an engineer or architect may choose to use similar codes from other sources. The chosen code becomes mandatory once the engineer or architect chooses it. For example, engineers and architects may choose to use codes and standards developed and used elsewhere since these are not mandatory. Inspections are conducted by employees of the Buildings Department and/or the Housing Department.

The Buildings Department and Housing Department establishes committees to conduct regulatory review and revision. Committee members are selected for their experience and affiliation (professional organizations, academic institutions, government agencies). Regulations are not regularly updated in Hong Kong but standards are.

REFERENCE STANDARDS

The Buildings Department will cite relevant references and develop the codes; however, in the absence of references and codes, engineers and architects are required to use recognized codes and standards from reliable sources. These sources normally include British Standards (BSI), the Australian/New Zealand Standards (AS/NZ), and the Japanese Standards (JIS). Hong Kong, like Singapore and Brunei, allows engineers, designers, and contractors to use international standards.

GREENING OF CODES

Hong Kong has attempted to implement energy efficiency in building through various incentives. The energy efficiency standard is still not mandatory. There are two voluntary green building rating tools in Hong Kong, one administered by the government and the other by the private sector. These tools are not widely used.

2. Code Development, Administration, and Enforcement

Hong Kong building regulations are based on the Buildings Ordinance, passed by the Hong Kong Special Administrative Region (SAR) legislature. The ordinance is similar to an act or law passed by the government. It does not cite codes or standards from any organization but is the legal document for enforcement of building codes and standards in Hong Kong. It covers the following (Hong Kong SAR 2012):

- Engineering licensing for structural engineers, geotechnical engineers, architects, inspectors, and surveyors
- Disciplinary and Action committee
- Person authorized to design and construct buildings
- Registration of contractors
- Submission of plans and application to begin construction
- Regular inspection
- Appeals
- Mandatory elements in codes: structures, soil and geotechnical engineering, pipes, building systems, drainage, paved areas, urban planning, plumbing and sanitation, temporary works.

In addition to the ordinance, Hong Kong has building regulations for administration; planning; private streets and access roads; standards of sanitary fitments, plumbing, drainage works and latrines; and oil storage installations.

DEVELOPMENT AND ADMINISTRATION

The SAR Buildings Department develops, modifies, and enforces codes of practice and standards. (A code of practice is not a code per se, but is equivalent to a guideline.) The department's New Building Division takes care of new construction and site monitoring. Its Existing Building Division takes care of existing building maintenance and operation, and slope safety. Its Mandatory Building Inspection Division takes care of fire safety and other structural and mandatory inspections only, while its Corporate Services Division take care of other minor technical service, minor works, and R&D. The Buildings Department handles licensing, alteration and addition works, the building information center, building safety, and social services. It also develops, maintains, and enforces the following:

Codes of Practice

Building Works for Lifts and Escalators 2011
 Dead and Imposed Loads 2011
 Fire Safety in Buildings 2011
 Foundations
 Mandatory Building Inspection Scheme and the Mandatory Window Inspection Scheme
 Precast Concrete Construction 2003
 Provision of Means of Access for Firefighting and Rescue 1995
 Provision of Means of Access for Firefighting and Rescue 2004
 Site Supervision 2009
 Structural Use of Concrete 1987
 Structural Use of Concrete 2004 (second edition)
 Structural Use of Steel 1987
 Structural Use of Steel 2005
 Structural Use of Steel 2011

Guidelines, etc.

Barrier Free Access Design Manual 2008
 Design and Construction of Bamboo Scaffolds
 Design and Construction of Buildings and Building Works for Installation and Safe Use of Lifts and Escalators 1993
 Demolition of Buildings
 Explanatory Materials for Code of Practice for Structural Use of Steel 2005
 Fire Resisting Construction 1996
 Fire Safety Design for Caverns 1994
 Mandatory Building Inspection Scheme
 Mandatory Window Inspection Scheme
 Minor Works Control System, General Guidelines
 Oil Storage Installations
 Overall Thermal Transfer Value in Buildings 1995
 Practice Guidebook for Adaptive Re-use of and Alteration and Addition Works to Heritage Buildings 2012
 Provision of Means of Escape in Case of Fire 1996
 Technical Guidelines on Minor Works Control System
 Wind Effects in Hong Kong 2004

CODE ADOPTION AND EVOLUTION

As mentioned, the Buildings Department manages and controls most mandatory regulations. These are developed with the Hong Kong Housing Society and the Urban Renewal Authority. Most codes and standards are developed by the Authority with the help of various professional groups and academics. These professional groups include the Hong Kong Institute of Surveyors, Hong Kong Institute of Architects, Hong Kong Institute of Construction Managers, Chartered Institute of Buildings, Hong Kong Institute of Engineers, and the Hong Kong Contractors Association. Codes and standards are modified by the Buildings Department with the help of professional groups and academics.

Many standards and guidelines are not mandatory even though the Buildings Department strongly encourages the industry to adopt them. These standards are initially developed by the department with the help of academics from local universities. A committee of industry professionals and representatives of government agencies oversees standards development. Over the years, some standards and guidelines have become mandatory. The following are *not* mandatory:

Operation Building Bright Standard. This standard aims to strengthen facility management in Hong Kong. It details maintenance and operational standards for older buildings and provides for grants for maintenance and repair of such buildings. The standard is developed with the Hong Kong Housing Society and the Urban Renewal Authority (Buildings Department D 2012).

Minor Work Control System/Household Minor Work Validation Scheme. This scheme is designed to assist small contractors in improving their work practices while reducing the workload on the Buildings Department (Buildings Department E 2012).

Bamboo Scaffolding Resistance Against Wind Standard. While bamboo scaffolding is regulated on its design to carry loads (human plus any loads he/she carries), the design of bamboo scaffold against wind load is not mandatory (Buildings Department F 2012).

Guidelines for Preventing Water Seepage in Buildings.

REFERENCED STANDARDS

Most of the structural standards are referenced to the Australia and New Zealand Standards (AS/NZ), ASTM International Standards, ACI Standards, AISC Standards, Chinese Standards (GB and YB), Japanese Standards (JIS), British Standards (BS), ISO, and Steel Construction Institute (SCI) of UK Standards. References are also made to the National Standards of Canada (Buildings Department A 2005). The Buildings Department provides a list of pre-approved programs for use in structural, geotechnical and miscellaneous elements (Buildings Department A 2012; Buildings Department B 2012; Buildings Department C 2012).

GREEN FEATURES OF MANDATORY LAWS

There is no green feature in Hong Kong building regulations.

TYPES OF BUILDINGS

Building codes are divided into landed residential, high-rise residential, commercial, institutional, industrial, civil engineering, and overseas.

3. Code Details

MINIMUM CODES

Electrical. The Electrical and Mechanical Services Department (EMSD) of Hong Kong manages codes of practice for electrical works. The code of practice for electricity (wiring) regulations is the electrical “code” used in Hong Kong (EMSD 2009). References in the code are from the International Electrotechnical Commissions (French), British Standards, NFPA, AS/NZ Standards, and ASTM International. (A code of practice is equivalent to guidelines and best practices; Hong Kong does not have a code system).

Energy. EMSD operates the Energy Efficiency Registration Scheme for Building in Hong Kong. That scheme is based on the performance-based Building Energy Code (BEC), Building Energy Efficiency Ordinance, Guidelines for Energy Audit, and the Energy Consumption Indicators and Benchmarking Tools (EMSD 2012; EMSD A 2012; EMSD B 2012; Hong Kong Legislation 2011). The performance-based BEC does not reference any other standards.

Developers or owners of newly constructed buildings are to ensure that the four key types of building services (air-conditioning, lighting, electrical, lift and escalator installation) comply with the design standards of the BEC. When “major retrofitting works” are carried out, owners, tenants, occupiers etc., are responsible for ensuring these services meet the BEC design standards. Owners of commercial buildings (including commercial portions of composite buildings, such as shopping malls under residential storeys) should carry out energy audits for those services in accordance with the Energy Audit Code every 10 years. Part of this scheme is voluntary and part of it is mandatory.

Water/Sanitation. EMSD administers the code of practice for mechanical systems that can be used in water pumps. The Buildings Department administers the code of practice and design manuals for plumbing and sanitation. The Water Supplies Department administers the *Handbook for Plumbing Installations in Buildings* (Water Supplies Department of Hong Kong 2012). Water and sanitation regulations are managed by the Environmental Protection Department, the Water Supplies Department, and the Buildings Department. The Water Pollution Control Ordinance, enacted in 1980, is the main legislation to control water pollution in Hong Kong. Relevant regulations include the following:

Water Pollution Control Ordinance (Cap.358) 1980. Provides for the designation of control zones within which discharges of effluent other than domestic sewage into a foul sewer must be licensed.

Water Pollution Control (Appeal Board) Regulations 1985. Sets out procedures to be followed in appeals against orders made or directions given under the ordinance.

Water Pollution Control (Sewerage) Regulation 1994. Imposes requirements on private lot owners to collect and convey wastewater to public sewers and provides for control over the operation and maintenance of private wastewater treatment facilities.

Buildings Ordinance (Cap.123) 1956. Allows the Building Authority to require adequate waste treatment facilities in any new building. Provides for control over the design of refuse chutes within buildings, private drainage works and oil storage facilities.

Public Health and Municipal Services Ordinance (Cap.132) 1960. Provides for control over the discharge of hazardous materials to sewers, and for the control of littering. Also provides for the designation of bathing beaches and the control of pollution at such beaches, together with swimming pools and wells.

Waterworks Ordinance (Cap.102) 1975. Prohibits polluting discharges in water gathering grounds.

Radiation Ordinance (Cap.303) 1957. Controls the use and disposal of radioactive substances.

Mechanical Systems. Mechanical system standards are administered by the Buildings Department and EMSD. Building systems related to ventilation and plumbing are covered in the building codes of practice, design guides, and best practices administered by the Buildings Department and Water Supplies Department, while EMSD manages the manufacturing and design aspects of the systems. EMSD also administers and regulates the energy efficiency of the systems, air conditioning cooling systems, energy efficiency labeling, and engineering services for mechanical system installation (EMSD 2012). The Hong Kong Building Commissioning Center also develops standards for the cleaning of air-conditioning ducts (2012). There is no mandatory standard for mechanical systems; the British Standards for mechanical engineering is the dominant standard in Hong Kong. The Buildings Department manages the codes of practice for lifts and escalator, fire protection systems, and ventilation systems (Buildings Department G 2012).

Indoor Air Quality. To improve the indoor air quality (IAQ) and promote public awareness of the importance of IAQ, the Environmental Protection Department (EPD) of Hong Kong has launched a voluntary IAQ Certification Scheme for Offices and Public Places. The IAQ certification scheme is administered by the Indoor Air Quality Information Center. Minimum codes are documented in *Guidance Notes for the Management of Indoor Air Quality in Offices and Public Places* (Indoor Air Quality A 2003), and *Guide on Indoor Air Quality Certification Scheme for Offices and Public Places* (Indoor Air Quality B 2003). These guidelines are not mandatory. The code is based on standards and references published in ASHRAE 55, ASHRAE 62.1, Health Canada, World Health Organization, Standards Australia, U.S. EPA, U.S. NIOSH, British Research Establishment, AHRI, Carpet and Rug Institute, Air Filtration and Ventilation Center, Air-conditioning Contractors of America, Center for Building Science etc.

Lighting. EMSD develops and manages the code of practice for energy efficiency of lighting installations. The code aims to set out minimum design requirements and is part of a set of comprehensive building energy standards that address energy efficiency in building service installations. Designers are encouraged to adopt a proactive approach to exceed the minimum requirements of this code (EMSD H 2005). The performance-based BEC contains provision for energy efficiency, control, power, and intensity (EMSD B 2012). *Guidelines on Industry Best Practices for External Lighting Installations* is the new voluntary guideline developed by the Environment Bureau. The guidelines recommend lighting intensity, type of lights and lighting operating hours (Environmental Bureau 2012). The codes of practice and guidelines do not reference any standards.

Security. The Security Bureau of Hong Kong maintains and manages security standards for buildings. Codes and standards (nonmandatory) include *Manual for Security Personnel Providing Guarding Services in Buildings* (Security Bureau A 2010), and *Aide-Mémoire - Suspicious Objects and Bombs* (Security Bureau B 2012).

Fire. The Buildings Department develops, manages, and enforces fire safety codes of practice for buildings. These include (Buildings Department G 2012):

Code of Practice for Building Works for Lifts and Escalators 2011

Code of Practice for Fire Safety in Buildings 2011
 Code of Practice for the Provision of Means of Access for Firefighting and Rescue 2004
 Code of Practice for the Provision of Means of Access for Firefighting and Rescue 1995
 Fire Resisting Construction 1996
 Oil Storage Installations
 The Provision of Means of Escape in Case of Fire 1996

The Fire Services Department formulates fire services requirements for buildings with reference to the following codes of practice:

Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment

Safety. Building safety in Hong Kong mainly addresses fire hazards. Construction safety is managed by the Occupation Safety and Health Council. OSHC develops and maintains construction safety standards and the Buildings Department enforces them. OSHC publications on construction activities include the *Care Campaign for New Workers in Construction Sites – Experience Sharing, and the Safety and Health Guidelines for Construction Workers* (OSHC 2012). Contractors frequently use the *Construction Site Safety Handbook* published by the Real Estate Developers Association of Hong Kong and the Hong Kong Contractors Association (REDAS and HKCA 2005).

Location/Siting/Zoning. All land and building uses are governed by outline zoning plans prepared under the Town Planning Ordinance (the Ordinance). The Town Planning Board, a statutory body appointed under the Ordinance, is charged with the duties to promote the health, safety, convenience and general welfare of the community through the systematic preparation of statutory plans (namely, outline zoning plans and development permission area plans with land use zonings and/or specific development parameters) for the layout of areas in Hong Kong as well as for the types of building suitable for erection therein.

Environment. Environmental regulations are administered by the Environmental Protection Department (EPD). They include the following:

Air Pollution Control Ordinance (Cap.311)
 Waste Disposal Ordinance (Cap.354)
 Water Pollution Control Ordinance (Cap.358)
 Noise Control Ordinance (Cap.400)
 Ozone Layer Protection Ordinance (Cap.403)
 Dumping at Sea Ordinance (Cap.466)
 Environmental Impact Assessment Ordinance (Cap.499)
 Hazardous Chemicals Control Ordinance (Cap.595)
 Product Eco-responsibility Ordinance (Cap. 603)
 Motor Vehicle Idling (Fixed Penalty) Ordinance (Cap. 611).

Most of these are universally enforced, while some (e.g. product eco-responsibility) are enforced only for large projects. These ordinances cited references from the U.S. Environmental Protection Agency, British Standards, Australian/New Zealand Standards, Japanese Standards, and China Standards (Environmental Protection Department 2011). EPD also manages statutory and nonstatutory standards and guidelines

pertaining to air, noise, waste, water and environmental assessment and planning (EPD 2012; EPD A 2012).

Structure and Design. The Buildings Department also develops, maintains, and enforces the following:

Codes of Practice

- Dead and Imposed Loads 2011
- Foundations
- Mandatory Building Inspection Scheme and the Mandatory Window Inspection Scheme
- Precast Concrete Construction 2003
- Structural Use of Concrete 1987
- Structural Use of Concrete 2004 (Second Edition)
- Structural Use of Steel 1987
- Structural Use of Steel 2005
- Structural Use of Steel 2011

Guidelines, etc.

- Demolition of Buildings
- Design Manual - Barrier Free Access 2008
- Explanatory Materials to Code of Practice for the Structural Use of Steel 2005
- Guide to Fire Safety Design for Caverns 1994
- Guidelines on the Design and Construction of Bamboo Scaffolds
- Oil Storage Installations
- Wind Effects in Hong Kong 2004

Most structural codes rely on references from the Australia and New Zealand Standards (AS/NZ), ASTM International, ACI, AISC, Chinese Standards (GB and YB), Japanese Standards (JIS), British Standards (BS), ISO, and Steel Construction Institute (SCI) of UK. References are also made to the National Standards of Canada (Buildings Department A 2005).

GREEN BUILDING CODES

There is no green building code in Hong Kong and regulations and codes of practices do not have green features. The ESMD, however, manages the performance-based Building Energy Code (BEC), Building Energy Efficiency Ordinance, Guidelines for Energy Audit, and the Energy Consumption Indicators and Benchmarking Tools (EMSD 2012; EMSD A 2012; EMSD B 2012; Hong Kong Legislation 2011). None of these is mandatory. (The BEC is not mandatory as it is not similar to codes defined in the United States, Canada, and Australia.)

Green Building Rating Tools

The Comprehensive Environmental Performance Assessment Scheme for Buildings (CEPAS), managed by the Buildings Authority, is a rating system operated by the Hong Kong SAR government. CEPAS was developed by industry professionals, government officials and employees, academics, and representatives of professional organizations. Like Hong Kong's other codes, standards, and guidelines it has no set timeframe for updates or revision.

CEPAS was introduced in 2006 and revised in 2008. It provides a means for evaluating the environmental performance of all types of buildings in Hong Kong. It is recommended that in using this assessment scheme, reference should also be made to guidelines of local and international academics, professional organizations, and the government.

The ultimate goal of CEPAS is to improve the environmental performance of buildings in Hong Kong and keep pace with the global trend in building sustainability. CEPAS provides four assessments (pre-design, design, construction, and operation) and manuals for each (Buildings Authority I 2011). CEPAS assesses documentation and verifies sites. Compliance and verification pertain to the design, construction, and operation stages but not pre-design. Assessment criteria include indoor environmental quality, building amenities, resources use, loadings, site amenities, neighborhood amenities, site impacts, and neighborhood impacts. These criteria include reference to the following:

- All Building Department codes and standards
- All EPD ordinances
- ASHRAE 55
- ASHRAE Standard 62.1
- ASHRAE Fundamental Handbook 2001, Chapter 7
- BD PNAP 278 Lighting and Ventilation Requirements
- British Standard BS 882
- CIBSE Daylighting and Window Design, CIBSE Code for Lighting (2002) and CIE unified glare rating
- CIBSE TM21:1999 Minimizing Pollution at Air Intakes
- EMSD code of practice for lighting installations
- EPD indoor air quality certification scheme
- EPD Guidance Notes for IAQ and Ventilation Equipment, Section A5: Indoor Air Quality of the General Specification for Air-conditioning, Refrigeration, Ventilation and Central Monitoring & Control System Installations in Government Buildings, 2001, issued by the ArchSD
- EPD ProPECC PN 2/96: Control of Air Pollution in Car Parks
- Green Guide to Specification
- Hong Kong Green Label Scheme
- HVCA DW/TM2 Guide to Good Practice, Table 11: Design Guidelines for HVAC-Related Background Sound in Rooms
- ISO 14000
- ISO 2631-2
- ISO 7730
- Occupational Health and Safety Management System 18001
- Practice Note for Authorized Personnel (PNAP 270)
- PNAP 277
- Repeated standards from the BS, AS/NZ, and JIP
- Safety statutes of Hong Kong.

Projects are certified by CEPAS on the basis of certain criteria and scores, and receive a CEPAS label.

Grade	CEPAS Design Stage	CEPAS Construction Stage (Construction Works)	CEPAS Construction Stage (Demolition Works)	CEPAS Operation Stage
Minimum score required to achieve each grade (based on 100 full marks)				
Bronze	28	29	29	29
Silver	45	50	50	48
Gold	57	62	67	64
Platinum	77	79	78	85

The Hong Kong SAR legislature may make CEPAS a required standard in the near future.

BEAM Plus

Hong Kong’s other voluntary green building rating system is BEAM Plus, endorsed by the Hong Kong Green Building Council since April 2010. The industry was introduced to BEAM Plus Version 1.1 and professional training in April 2010. In November 2012, Version 1.2 for new buildings and existing buildings was available for formal registration. BEAM is very similar to USGBC LEED; projects have to score a number of points for different levels of certification. Platinum certification means a project earned 75 percent of the possible score and bronze certification means it earned 40 percent. The project must also achieve a minimum number of credits in different categories; for example, to achieve a gold certification, a project must achieve at least 65 percent of the credits, and 60 percent must be in the “sustainable” category. The only difference between BEAM and LEED is that BEAM has a two-phase inspection. In the first phase project documents are inspected; in the second phase the building site is inspected and verified. Appeals follow the same process.

Indonesia

1. Synopsis

TOP-DOWN APPROACH AND JURISDICTION

The central government develops regulations for the issuance of environmental permits, disturbance permits, and industry permits. How those are applied depends on the situation. Municipalities may choose to reject or to adopt and enforce regulations of the central government.

Law 28 is Indonesia's mandatory building regulation. It pertains to building functions, building requirements, building processes, the role of the community, the role of government, and sanctions for noncompliance. The regulations reference standards from Standards Indonesia (SNI). Most local governments and municipalities have their own regulations but these focus on fee collection. Even though the central government will provide assistance in implementing the regulations, and some municipal governments have adopted them, many have not done so. Thus, the regulations are implemented only in some parts of Indonesia. Building permits are not required for all buildings in Indonesia and not all buildings with permits comply with the codes and regulations.

Building regulations are developed entirely by the central government, with some assistance from the private sector, academics, and government officials. Many of those involved in developing regulations are also involved in developing standards adopted by the regulations.

REFERENCE STANDARDS

All mandatory standards are developed by SNI. These are listed at the end of section 3, below.

GREEN FEATURES

Currently, there is no green feature in any Indonesian building regulation. None of the referenced standards are related to green design. There is, however, a rating system in Indonesia that applies Indonesian "green" standards.

2. Code Development, Administration, and Enforcement

Indonesia has three basic regulatory systems that address land use and building control. These are (1) location permit (*Izin Lokasi*); (2) advice planning permit (IPPT); and (3) building permit (IMB). In practice, at least three other groups of regulations come into play for investors considering construction or expansion of facilities: (1) environmental permits and reviews (AMDAL and UKL/UPL); (2) disturbance permit (HO permit, or *Hinderordonnantie*); and (3) industry permits. The latter three are mandatory if the situation necessitates. The Indonesian Building Code was legislated after 2005 to introduce mandatory standards into the building and construction industry. The code should be used alongside Law 28 and Law 29 (implementation of Law 28).

IMB National Regulation Law 28 of 2002 and Regulation 36 of 2005 are the two regulations applicable to Indonesia. Law 28 regulates building functions, building requirements, building processes, the role of the community, the role of government, and sanctions for noncompliance. Local jurisdictions carry out building control functions and/or develop their own regulations.⁹ As of 2011, 70 percent of municipalities had developed their own codes and enforcement departments. The Indonesian government also provides planning advisories (IPPT), to municipalities that adopt the IMB National Regulation.¹⁰

Although Law 28 addresses a range of issues related to regulation of building permits, almost all local regulations address only the calculation and payment of fees for the issuance of IMBs. More specifically, the national law on building permits addresses (1) the function of buildings; (2) requirements for buildings (e.g., layout, use, intensity, architecture, environmental impact, reliability, safety, health, convenience, access); (3) construction (including conservation, demolition, and rights and obligations of owners); (4) public role; (5) Nurture (i.e., technical assistance, training, and education); (6) sanctions; and (7) transitional provisions.

In contrast, the local regulations of Bojonegoro Regency and the municipalities of Pekalongan, Sukoharjo, Bandung, and Bekasi address only fee payment (*retribusi*). The regulations of Tangerang Regency and Sleman Regency are somewhat broader in also addressing permit administration (application requirements, sequence, preliminary/temporary permit, and relation to some other permits). But none address building construction, safety size, or siting. Several define technical terms required for building regulation—such as building coverage ratio (KDB), floor area ratio (KLB), and building height ratio (KKB)—but do not include substantive regulations related to those definitions.¹¹ This regulatory

⁹ Examples include the IMB Local Regulations of Bojonegoro Regency (Regulation 09 of 2005), Cimahi Municipality (Regulation 76 of 2003), Pekalongan Municipality (Regulation 19 of 2000), Tangerang Regency (Regulation 10 of 2006), and Sukoharjo Regency (Regulation 17 of 2003).

¹⁰ Examples include the Bandung Municipality (Regulation 04 of 2002), the Bekasi Municipality (Regulation 74 of 1999), and the Sleman Regency (Regulation 11 of 2001).

¹¹ The exception is the IMB regulation for Cimahi Municipality, which goes beyond provisions on fee calculation and collection to address environment and building architecture, base coefficients, fencing, environment/open space,

focus on fees raises two concerns. First, no standards for construction, safety, and design are established or referred to. Second, the costs determined do not reflect the environmental and social impact but rather the operation of local administrative units.

SNI is a standard agency owned by the central government. Standards are formulated by technical committees based on consensus of industry experts and academia and with the participation of government officials. Acts and regulations are developed by ministries and they become laws after they are approved by the Parliament. Local codes and acts are approved by municipal governments with the technical and financial support of the central government. Participation by the general public is extremely limited, even though the central government and municipal governments plan to integrate public opinions into their future acts and standards.

Indonesia's Building Code addresses the need to integrate extensive regulations, building standards, and guidelines into the regulations. Relevant building regulations are as follows:

- Construction Maintenance Guidelines Water Supply System Expansion
- Guidelines for Government Performance Accountability Report and Determination of Environmental Performance in the Ministry of Public Works
- Spatial Planning Guidelines for National Strategic Areas
- Irrigation Asset Management Guidelines
- Organizational Structure and Work Mechanism Governing Council Secretariat Corps Personnel Ministry of Public Works of the Republic of Indonesia Republic of Indonesia
- Amendment to the Regulation of the Minister of Public Works No. 01/PRT/M/2010 on the Organization and Public Service Employment in the Environmental Sector Fund Secretariat Toll Road Regulatory Agency
- Evaluation Guidelines Performance Accountability Reports Government (LAKIP) The Environment Ministry of Public Works
- Technical Instructions Establishment Licensing and Certification Unit

Most reference standards are adopted from SNI. These are mostly modified from British Standards, ASTM International, Singapore Standards, and Australian Standards. The building regulations are developed internally by ministries and municipal governments. Some experts are involved but information on their involvement is not clear. Sources suggest that there are participants from various professional groups, academic institutions and government officials. It is also interesting that building permits are not required for all buildings and not all buildings with permits comply with codes and regulations.

public areas, relation to AMDAL, building above and below ground, water absorption, height, airport safety zones, reconstruction after fire, boundary lines, and how to address areas for which there is no detailed city plan in place. In other words, the Cimahi regulation addresses many more of the technical areas where regulation is authorized by Law 28 of 2002.

REFERENCE STANDARDS

All mandatory standards are developed by SNI. All 50 are listed at the end of the next section.

GREEN FEATURES OF THE MANDATORY LAWS

Indonesia's building codes do not have green features.

TYPES OF BUILDINGS

Categories of buildings specified by the building code are as follows: homes, reinforced concrete buildings, steel buildings, public schools, urban residential, modular building, hospitals, public buildings, and other civil infrastructures (roads, dams, and bridges).

3. Code Details

MINIMUM CODES

Electrical. There is no mandatory electrical code, even though some guidelines are provided in SNI design procedures for different types of buildings.

Energy. There is no mandatory energy code. Indonesia has adopted the voluntary commercial energy codes in 1992 per APEC. The code applies to building façades, lighting, and HVAC but is not enforced. The government passed the Energy Law in 2007 to shift focus from oil to alternative sources, such as natural gas and renewables. A National Energy Council led by the President was set up to develop a national energy policy that will provide incentives for building owners and developers to use renewables. This policy has yet to be enacted into law (APEC 2009, President of Indonesia 2006).

Water and Sanitation. There is no plumbing and sanitation code in Indonesia, but the International Association of Plumbing and Mechanical Officials (IAPMO) is planning to introduce a uniform plumbing code into Indonesia.

USAID, the World Health Organization (WHO), and UNEP are providing considerable aid to Indonesia to improve water and sanitation access. WHO's guidelines on drinking water quality and its other policies for water, sanitation and health, the USAID's guidance on drinking water and sanitation programs in developing economies, and UNEP's water quality and sanitation development programs are considered mandatory standards in Indonesia for projects funded by these agencies.

The Ministry of Environment Strategic Plan provides guidelines on water and sanitation development and it has integrated environmental laws enacted by the government (e.g., national laws, government regulations, presidential decrees, presidential regulations, decrees of the Minister of Environment, regulations of the Minister of Environment, legislation, decrees of the heads of various municipalities,

technical guidelines, guidance, memoranda of understanding). While most regulations and laws are mandatory, local municipalities do not have to follow them. Nearly all of these publications are in Malay.

The planning procedures also contain provisions for plumbing design and construction guidelines and standards. These guidelines and standards are adapted from the *National Plumbing Code Handbook* (1997).

Mechanical Systems. There is no specific mandatory standard; however, some planning procedures have guidelines and standards for mechanical system design (published in Malay). Guidelines and standards (see table at end of this section) are adapted from the International Association of Plumbing and Mechanical Officials' Uniform Mechanical Code.

Indoor Air Quality. There is no mandatory code.

Lighting. SNI 03-2396-2001 Procedures for Natural Lighting System Design in Building is mandatory.

Security. There is no mandatory code.

Fire. There is no mandatory fire code in Indonesia but the building regulation mandates the use of the following standards:

- SNI 03-1735-2000 - Planning procedures for building access and access to environmental hazards prevention fire at building houses and buildings
- SNI 03-1736-2000 - Planning procedures for building structure hazard prevention Kebakaran on building houses and buildings
- SNI 03-1745-2000 - Hydrant system installation procedures for fire hazard prevention in building houses and buildings
- SNI 03-1746-2000 - Procedure for the planning and installation of roads out to rescue against fire in buildings

Structural. Structural design standards are mandatory standards in the Indonesian building regulations.

Location/Siting/Zoning and Environment. Zoning Law 26 of 2007 is a mandatory law (even though local governments and municipalities should develop their own laws). Indonesia passed this law in 2007 to initiate a land use zoning system (also known as Laying-Out). While this marks a big step forward for local governments and investors, it may take several years before the national and local regulations and local maps are developed to implement zoning. Zoning is very difficult to enforce in Indonesia, and building permit legislation is often used to enforce zoning instead of Zoning Law 26. This is because Law 26 does not address technical standards for building construction safety. On the basis of the experience of other economies, environmental and industry permits may also need to stay in place for certain types of industries and developments that create significant risk or impact. There is hope, however, that a successful zoning system can replace several other regulatory tools listed above, and that the resulting system will be streamlined and transparent.

Before Law 26 becomes nationally accepted, six regulations will be used to enforce local zoning: the location permit (*Izin Lokasi*), advice planning permit (IPPT), building permit (IMB), environmental

permits and reviews (AMDAL and UKL/UPL), disturbance permit (HO permit, or *Hinderordonnantie*), and industry permits. The Ministry of Environment also provides guidelines on zoning affected by environmental regulations.

Safety. Provisions for mandatory safety standards are included in Law 28 and Regulation 36. SNI 03-2397–1991 (*Planning Procedures for Simple Household Wind*) is also a mandatory safety standard for homes.

GREEN BUILDING CODES IN INDONESIA

There is no mandatory green building standard in Indonesia. There are no green features in Indonesia's building regulations.

Green Building Rating System

The Green Building Council of Indonesia (GBCI), a nonprofit and private organization, provides the only voluntary green building standards in Indonesia. Its rating system is called GREENSHIP and covers new buildings, existing buildings, and interior space. Its credit point system covers site development, energy efficiency, refrigerant, water conservation, material sources and cycle, air quality, and environmental management. It offers four levels of certification: platinum (more than 74 points), gold (58–73), silver (47–57), and bronze (35–46). GREENSHIP has adopted a number of standards:

- SNI 03-6386-2000 on noise and reverberation time in building and housing
- SNI 03-6197-2000 on energy conservation in lighting systems,
- VOC emission standards from California
- Indonesian government forestry regulations
- Forest Stewardship Council certified wood
- CSR certification
- SNI 03-7065-2005 on water conservation
- SNI 03-6390-2000 on energy modeling and design for building,
- SNI 03-6389-2000 OTTV calculation methods
- Minister of Public Works' Decree No. 5/PRT/M/2008 on green open space (RTH),
- Minister of Public Works' Regulation No 30/PRT/M/2006 on technical facility and accessibility guidelines for building and environment, Appendix 2B
- Minister of Public Works' Decree No. 5/PRT/M/2008 on green open space (RTH) , Article 2.3.1 on vegetation criteria in the yard
- Ministry of Internal Affairs' Decree No 1/2007, Article 13 (2a.): 50% area covered with small, medium, and large size-trees, half-shrub trees, shrubs, bushes in mature sizes.

50 Standards and References Used by the Indonesian Building Regulations

	Code	Title	Purpose
1	SNI 3418-2011	Test method for air content in fresh concrete by methods press	This method aims to obtain the value of air content in fresh concrete as a percentage (%) over volume.
2	SNI 0004-2008	The procedure for commissioning of water treatment plant	The procedure includes the terms and definitions, the requirements that apply to all capacity Water Treatment Plant (WTP) and how to work. Commissioning IPA is a test of the performance of each unit and the whole process of the IPA from the raw water to be drinking water conducted by a team set.
3	SNI 02-2406-1991	General Planning Procedures for Urban Drainage	The procedure is used to obtain the results of the urban drainage planning can be carried out in accordance with the provisions of planning techniques
4	SNI 03-0090-1999	Specifications BRONJONG Wire	This standard specifies the dimensions of gabion wire and raw material requirements, quality requirements, sampling, the requirement of passing the test, packaging and labeling requirements gabion wire.
5	SNI 03-0675-1989	Specifications Frame Size Wood Door, Wooden Window Frame, Leaves Door For Building Wooden Houses and Buildings	This specification aims to realize the manufacture, installation, and monitoring the implementation of the optimal
6	SNI 03-1724-1989	Procedures Perencanaann Hydrology and Hydraulics for Buildings on the River. Title revised to: The procedure for calculation of river discharge mainstay with curved frequency analysis	The procedure is used in designing the river Building (building utilization, conservation and cross) in order to meet the requirements of hydrological and hydraulic requirements, and aims to preserve and enhance the reliability of the buildings on the river and the river itself.
7	SNI 03-1726-2002	Earthquake Resilience Planning Procedures For Home and Building.	The procedure is used to direct the planning and execution of the job creation that meets the minimum requirement of steel and get the job structure is safe, convenient and economic.
8	SNI 03-1727-1989	Procedure for Imposition Plan For Home and Building	The procedure is used to provide an allowable expense for homes and buildings, including living expenses for a sloped roof, building multi-storey car park and a helipad on the roof of a tall building where the helicopter parameters contained practically covers all common types of aircraft operated . Including live load reduction for carriers and portal beam planning and review of the quake, which use optional, not a requirement, especially if the harm reduction of construction or construction elements were reviewed
9	SNI 03-1728-1989	Implementation Procedures for Establishing Building	The procedure is used to provide a foundation in making building regulations in each region, with the goal of uniform shape and contents of the building regulations that will be used in all major cities in Indonesia
10	SNI 03-1729-2002	Planning Procedures for Building Steel Buildings	The procedure is used to direct the planning and execution of the job creation that meets the minimum requirement of steel and get the job structure is safe, convenient and economic
11	SNI 03-1730-2002	Planning Procedures for Public School Buildings	The procedure includes: "architectural planning, structural / building construction and utilities;" public school education system; "Changes in public high school system;" Standardization of public high schools.
12	SNI 03-1731-1989	Dam Safety Procedures.	The procedure was used in conducting the design, construction, operation and maintenance, and removal of the dam in order to ensure the safety of the dam and its environment.
13	SNI 03-1732-1989	Planning Procedures for Pavement Thickness Bending Motorway with Component Analysis Method	Procedure is fundamental in determining flexible pavement thickness required for a highway.

	Code	Title	Purpose
14	SNI 03-1733-2004	Procedures for environmental planning in urban residential	The procedure is intended to produce a functional residential neighborhood sekurangkurangnya for the occupants. (Procedures for Town Planning Housing Areas).
15	SNI 03-1734-1989	Planning Procedures and Structure Reinforced Concrete Walls Reinforced For Home and Building	The procedure is used to shorten the time of planning the various forms of a general structure and ensure the planning requirements for earthquake-resistant homes and buildings policies
16	SNI 03-1735-2000	Planning Procedures for Building Access and Access to Environmental Hazards Prevention Fire At Building Houses and Buildings.	The procedure is used in the planning of the building and its environment especially in the prevention of fire and rescue cover safeguards the life, property and the continuity of the function of the building
17	SNI 03-1736-2000	Planning Procedures for Building Structure Hazard Prevention Kebaka-ran on Building Houses and Buildings	The procedure is used for the structural design of buildings to the prevention of fire hazards in the home building and building
18	SNI 03-1738-1989	Field CBR Test Method Title revised to: CBR Test Method (California Bearing Ratio) field	This method is used to determine the value of CBR (California Bearing Ratio) on the spot (in place) or when required to do by taking the example of the original soil with CBR mold (undisturb).
19	SNI 03-1744-1989	CBR Test Method Laboratory	This method is used to determine the CBR (California Bearing Ratio) of soil and soil aggregate mixture compacted in the laboratory on a specific moisture content.
20	SNI 03-1745-2000	Hydrant System Installation Procedures for Fire Hazard Prevention in Building Houses and Buildings.	The procedure is used as a guide in the installation of fire hydrant system to provide minimum requirements for the installation of a fire hydrant system in the prevention of fire hazards in the home building and building
21	SNI 03-1746-2000	The procedure for the planning and installation of roads out to rescue against fire in buildings	Used for the installation of the tools in the effort to save the human evacuation and increase security against fire
22	SNI 03-1747-1989	Bridge Construction Specifications Type Beams T Landscape s / d 25 yards for the BM 70.	This specification contains general description, technical and image detail The plan Bridge Beams "T" class expenses BM 70 (70% load BM)
23	SNI 03-1748-1989	Jem Construction Specifications T-Beam bridge type Landmarks s / d 25 yards for BM 100	This specification contains general description, technical explanations and detailed drawings Beam Bridge Plan "T" class expenses BM 100 (100% deliverance banan BM).
24	SNI 03-1758-1990	How to test the eternal nature of aggregate for concrete mix and the effect of a saturated solution of sodium and magnesium sulfate	Define how to test the eternal nature of aggregate that includes equipment, testing solutions, test samples and test sample preparation, test execution, and report test results. Sample calculation for fine and coarse aggregate are given
25	SNI 03-1962-1990	Avalanche Disaster Planning Procedures	The procedure is used to handling local avalanches in particular and covering a vast area in general.
26	SNI 03-1963-1990	Basic Procedures for Coordination Modular Building Design Houses and Buildings	The procedure is used as the basis for planning a handle home and building using modular coordination. The goal is to create a technical plan of the house and building the optimal
27	SNI 03-1965.1-2000	Soil Moisture Testing Method by Speedy Tool	This method is used to determine soil moisture content using a speedy
28	SNI 03-1968-1990	Sieve Analysis Testing Method About Fine and Coarse Aggregates	This method is used to determine the distribution point (gradient) of fine aggregate and coarse aggregate sieve.
29	SNI 03-1971-1990	Moisture Testing Methods Aggregate Title revised to: Test method for total moisture content of aggregate by drying	This method is used to determine the moisture content of aggregate.

	Code	Title	Purpose
30	SNI 03-1974-1990	Concrete Compressive Strength Testing Method Title revised to: Test method for compressive strength of concrete	his method is used to determine the compressive strength (compressive strength) concrete cylindrical specimens were made and matured (curing) in the laboratory and in the field.
31	SNI 03-1975-1990	Sample Preparation Methods of Soil and Soil Aggregate containing	This method is used to prepare soil samples and soil containing dried aggregate to obtain a specimen preparation further testing.
32	SNI 03-1977-1990	Coordination specification Houses and Buildings Modular Buildings	This specification is used as a handle for the technical planners, implementers, manufacturers of building materials, building components and building elements, in order to choose the dimensions of the module horizontal and vertical directions for building houses and buildings. The goal is to save on materials, components and elements of the building as well as installation time and labor.
33	SNI 03-1978-1990	Selected Size Specifications For Building Houses and Buildings	This specification is used as a handle for the technical planners, implementers, manufacturers of building materials, building components and building elements, to choose the size of the horizontal and vertical directions, and building houses. The goal is to save on materials, components and elements of the building as well as installation time and labor utilization
34	SNI 03-1979-1990	Specifications Matra Space for Home and Building	This specification is used as a handle on a reference dimension minimum space in the technical planning of the residence according to the size of the modular. The goal is efficient use of space and building materials.
35	SNI 03-2393-1991	Cement Injection Procedure of the Rock	The procedure is used in the implementation of the injection of cement in the rock that aims to minimize the passing water and increase the strength of the rock in an attempt to repair the foundation stone of a building.
36	SNI 03-2394-1991	Procedures for Planning and Building Design of Nuclear Medicine at the Hospital	The procedure is used to plan and design a building particularly radiation to building nuclear medicine
37	SNI 03-2395-1991	Procedures for Planning and Building Design Radiology at the Hospital	The procedure is used in planning and designing for construction of hospital radiology
38	SNI 03-2396-2001	Procedures for Natural Lighting System Design in Building	The standard procedure for the design of daylighting systems in buildings is intended as a guide for paraperancang and development practitioners in designing the building in the daytime natural lighting systems, and aims to obtain natural daylight lighting systems in accordance with the terms of health, comfort and in accordance with the provisions of other applicable provisions. "This standard covers the minimum requirements of natural daylight lighting systems in buildings.
39	SNI 03-2397-1991	Planning Procedures Simple House Hold Wind.	The procedure is used as basis for the design of a simple house is not air-practical level to guarantee the safety of the occupants of modest homes in areas prone to wind
40	SNI 03-2398-2002	Planning Procedures With Septic Tank Absorption Systems	This ordinance contains terms and definitions, requirements septic tank and leach systems that apply to the disposal of domestic wastewater for groundwater areas is low and the number of users up to 10 head of family (1 Patriarch equal to 5 people)
41	SNI 03-2399-2002	Planning Procedures for Public MCK Building	The procedure includes the terms and definisih, requirements applicable to indoor toilet facilities are located in dense residential location, with a maximum user weight 200. Public toilets can be a single entity or a bang Unan separately for bathing, washing and toilet facilities.
42	SNI 03-2400-1991	General Planning Procedures Krib in the river. (currently in revision)	The procedure is used to overcome the damage caused by the flow of the river and can preserve the buildings on the river.
43	SNI 03-2401-1991	General Planning Procedures Weir.	The procedure is used to obtain the weir design that meets the requirements of hydraulic and structure and implementation requirements correctly and safely according to the pattern of environmentally sound development.

	Code	Title	Purpose
44	SNI 03-2402-1991	General Planning Procedures Irrigation Pond Shrimp.	The procedure is used for the implementation of irrigation farms in supplying raw water shrimp work well in accordance with the requirements of shrimp culture.
45	SNI 03-2403-1991	Installation Procedures for Concrete Blocks Locked Road Surface	The procedure aims to get the concrete block pavement layers locked qualifies as pavement layers.
46	SNI 03-2404-1991	Termite Prevention Procedure for Making Buildings At Home and Building	The procedure is intended to protect the houses and buildings to be erected to termite attack, so that uniformity and effectiveness of efforts to achieve
47	SNI 03-2405-1991	Termite Control Procedure In Building Houses and Building with Termiticide	The procedure is used as a reference in termite control treatment, to protect the houses and buildings
48	SNI 03-2408-1991	Metal Painting Procedures	The procedure is a technical manual way of painting the metal is good and right and how to overcome them in the event of a failure in painting
49	SNI 03-2410-1994	Procedures for Wall Painting Wall With Paint Emulsion	The procedure is intended to provide technical guidance in the work of painting the walls with paint emulsion order to obtain good results, and the load on the requirements of materials and tools, implementation of the painting, and how to control when there is a failure in the paint.
50	SNI 03-2414-1991	Measurement Methods Debit River and Open Channels. Title revised to: The procedure for measuring river flow and open channel flow using gauges and buoys	Same

Japan

1. Synopsis

Different System in Japan

Codes are equivalent to mandatory standards while code is equivalent to law in Japan. The Central Government of Japan develops and administers the law and municipal governments enforce codes. The authority to approve building inspectors is retained by the central government. Laws are applied uniformly throughout Japan with very few regional modifications. Municipal governments control the building control approach (i.e., whether to employ their own building officials or engage private companies to conduct the inspection). In both instances, the building officials still have to obtain certification from the central government.

Laws Versus Codes

There are two laws in Japan pertaining to building, the Building Standard Law (BSL) and the Fire Standard Law (FSL). These are administered by the central government. The laws adopt codes that are developed or accepted by the Architectural Institute of Japan (AIJ). AIJ is a quasi-government agency that develops or imports relevant codes, standards, and guidelines internationally. The majority of AIJ members are private and public sector professionals. Code enforcers are also active members.

Updating of Codes and Laws

AIJ codes, standards, and guidelines are revised every three to five years, but there is no mandatory time period for updating the BSL and FSL. The codes in the BSL and FSL are, however, regularly updated (monthly to yearly) while the enforcement languages are updated irregularly. BSL and FSL contain all minimum building codes, and architects and engineers do not need to use other codes.

Enforcement of Laws

Municipal governments are required to enforce the BSL and FSL using a qualified building official. The official has to be appointed by the Ministry of Land, Infrastructure, and Transport. Each municipality has to pass its own ordinance and thus issues its own building and construction permits.

Green Features and Codes

Codes pertaining to sick building syndrome (indoor air quality) and energy efficiency are incorporated into the BSL. In an interview, an expert from Japan said that codes on water efficiency are also in the BSL. This statement cannot be confirmed at this time. Laws and codes on light pollution and environmental impact are not in the BSL but are already enforced as laws in Japan. Thus, green features do not have to be included in actual building regulations, as they can be enforced by the other relevant authorities.

2. Code Development, Administration, and Enforcement

Codes can be better described as laws in Japan. Japan's building code system is not like those in the United States, Canada, or Australia. The codes are documented in the laws, and thus there are multiple codes. Some of the standards have been converted into codes as codes are mandatory and standards may not be. Thus, codes are mandatory standards while standards are not mandatory.

BUILDING STANDARD LAW AND FIRE SERVICE LAW

There are two mandatory building laws in Japan, the Building Standard Law (BSL) and the Fire Service Law (FSL) (The Building Center of Japan, 2012). The BSL contains codes and standards pertaining to site development, structural components, equipment use, and building use that safeguards the life, health, and property by incorporating. The FSL includes a series of codes and standards pertaining to extinguishment facilities, alarm systems, and fire protection systems that protect people, lives, and property from damages caused by fire and disasters.

The BSL covers structural requirements and construction methods for fire safety requirements, equipment and sanitary requirements, window, smoke exhaust, escape stairs, openings, exterior wall, finishing and cladding, structural calculations, loading requirements, ground and soil, fire safety and access, concrete, steel, wood, fire resistivity, fire protection zone, elevators and escalators, fire retardant materials, evacuation, safety of materials and electrical works, wind force, roof, soil bearing pressure, toxic emitting materials, and combustible materials.

The BSL consists of three sections: general provisions, building codes, and planning codes. General provisions list penalties and enforcement procedures. The building codes section contains all codes pertaining to structural design, fire protection, and building equipment (HVAC, plumbing and sanitation included). The planning codes section contains codes on land use, building height, districting, fire protection categorization, external works, external infrastructures, and the use of external roads and facilities with the building.

FSL includes fire protection (preventive measures and outbreak prevention), and fire evacuation (access and fire retardant). The code includes types of finishes, building components, room separation, evacuation facilities, exhaust system, emergency entrance and elevators.

The unique feature of BSL is that it contains both specification and performance codes. Specification codes are used in areas where the quality of material used is essential (such as steel joints) while performance codes are used in areas where multiple solutions may be available.

ENFORCEMENT

Both the BSL and the FSL are enforceable through the Enforcement Order of the Minister of Land, Infrastructure, and Transport, and ordinances of municipal governments. Both are applicable throughout

Japan. Enforcement is carried out by the Japan Housing Loan Corporation, the Ministry of Land, Infrastructure, and Transport, and municipal governments by building officials designated by the BSL and FSL. Building engineers are also obligated to ensure code compliance. Engineers from consulting firms are obligated to comply with codes and standards specified in the BSL and FSL. In Japan, the terms “architect” and “engineer” are interchangeable. The Architect Law defines the qualifications of both engineers and architects.

BUILDING OFFICIALS

In addition to the Enforcement Order, municipal governments are required to pass ordinances in order to enforce the BSL and FSL. Building officials from the Ministry of Land, Infrastructure and Transport, and/or from the municipal governments are responsible for the inspection of the buildings throughout the design and construction phases. Central and municipal governments may subcontract the inspection works to private companies, and thus may designate these employees as building officials, but the designation of building official can only be given by the Ministry. The owner of a building applies for the building to be inspected, and a building official is required to inspect the plan, drawings, and site. A certificate is granted upon the completion of the construction work.

QUALIFICATIONS

Architects and engineers are categorized according to their qualifications (1st class to 3rd class). They are required to pass examinations. In addition, building officials designated by the Ministry are required to pass examinations on the BSL and FSL.

ADDITIONAL REGULATIONS

In addition to the BSL and FSL, Japan also has the Law concerning Promotion of Improvement of Earthquake-Resistance Construction Act (1995), and the Housing Quality Assurance Act (1999). These were introduced to resolve conflicts due to disasters and conflicts. Some codes may be exempt if these codes are too stringent.

CODE ADOPTION AND EVOLUTION

Changes in the BSL and FSL are solely the responsibility of the Ministry of Land, Infrastructure and Transport. The BSL and FSL are modified internally by the Ministry, while additions and exclusions to codes are determined by a committee that works closely with the Architectural Institute of Japan (AIJ). AIJ will establish new codes if needed and those will likely be included as codes in the BSL and FSL. The committee will recommend the inclusion and exclusion of the codes, and then the Minister of Land, Infrastructure and Transport will amend the BSL and FSL accordingly. Code changes in the BSL and FSL can take place as regularly as needed, while modification of the BSL and FSL will depend on the Ministry’s directions.

REFERENCE STANDARDS

The AIJ develops all reference standards. AIJ codes, standards, guidelines, and specifications, and JCI guidelines, specifications and manuals (in Japanese) are non-legal by itself. They become legal if they are incorporated into the BSL and FSL. AIJ is a quasi-government agency, and most of its members are private sector and public sector working professionals and the rest are academics. Committee members

are mostly self-nominees and invitees, and consensus is a critical component of the approval process. The public may view these documents and share their comments.

GREEN FEATURES OF MANDATORY LAWS

Codes pertaining to sick building syndrome (indoor air quality) and energy efficiency are incorporated into the BSL. In an interview an expert from Japan said that codes on water efficiency are also in the BSL. This statement cannot be confirmed at this time. Laws and codes pertaining to light pollution and environmental impact are not included in the BSL but are already enforced as laws in Japan.

TYPES OF BUILDINGS

The BSL is applicable to all types of buildings.

3. Code Details

MINIMUM CODES

Electrical. Code JIS C 60364-5-55 (electrical installations of buildings—parts 1 to 9) is in the BSL.

Energy. Codes JIS Q 50001:2011 (energy management systems—requirements with guidance for use) and JIS Z 9204:1991 (general rules for energy evaluation method by available energy) are in the BSL.

Water and Sanitation. JIS B 2312 (pipe fittings and JIS sanitation rule) is in the BSL. The Ministry of Land, Infrastructure and Transport has mandated the Building Sanitation Law (2002) but has not integrated it into the BSL. A law cannot be integrated into other laws.

Mechanical Systems. Codes JIS A 1431 (method of measurement of air quantity for ventilation and air conditioning system), JIS B 9908 (test method of air filter units for ventilation and electric air cleaners for ventilation), and JIS F 0408:1999 (standard of air-conditioning and ventilation of machinery control-rooms on board ships —Design conditions and basis of calculations) are in the BSL.

Indoor Air Quality. Mandatory [Indoor Air Quality Standards](#) (VOCs, indoor air chemicals, and air-change rate) have been incorporated into the Building Standard Law (2003). An example is JIS A 1431 (method of measurement of air quantity for ventilation and air conditioning system). In addition to the AIJ code, the Ministry of Land, Infrastructure and Transport has mandated and administers Emission Control and Installation of Ventilation System (2007), Indoor Air Quality Guidelines, and Housing Quality Assurance Law (2002).

Lighting. Codes pertaining to lighting are in the BSL. These include JIS C 0364 (electrical installations of buildings), JIS C 8105 (luminaires in buildings), JIS Z 9120 to 29 (lighting for indoor workplace, outdoor workplace, sports lighting, tennis court, sport stadiums, swimming pools etc.), ISO 8995 (lighting for

work place: indoor, security, and outdoor), ISO 30061 (emergency lighting), and the Ministry of Energy's Design Code for Outdoor Light Pollution.

Security. No security code can be found in the BSL.

Fire. Both the BSL and FSL contain extensive codes pertaining to fire. FSL codes pertain to fire protection (preventive measures and outbreak prevention) and fire evacuation (access and fire retardant). The code covers types of finishes, building components, room separation, evacuation facilities, exhaust system, emergency entrance and elevators.

Structural. Structural codes are included in the BSL.

Location/Siting/Zoning and Environment. Codes pertaining to location, siting, zoning, and the environment are in the City Planning Law. The law divides the planning areas into urban control areas, urbanization promotion area, quasi-city planning area, exceptional FAR applied area. City planning is mostly decentralized, with planning activities carried out by prefecture councils and local councils. The prefecture councils administer the planning of road, and land use within their prefectures, while local councils administer the planning of local services and residential amenities. The planning includes land use zones, special land use zones, height districts (with tall buildings), fire protection districts, special districts for urban renaissance, and landscape zones. The plan is also divided into low-rise residential, high-rise residential, quasi-residential, medium-rise residential, neighborhood commercial, commercial, quasi-industrial, industrial, and exclusively industrial zones.

The Ministry of Environment also enforces laws on water, waste, air, soil, ground, health, chemical, nature, and parks (Ministry of Environment (a) 2012). It has developed standards to ensure the quality of water, air, soil and noise (Ministry of Environment of Japan (b) 2012). The environmental standards are mandated.

Safety. Safety codes are included in structural codes. Earthquakes are the main reason why safety from earthquake surpasses any other disaster in Japan.

GREEN BUILDING CODES AND FEATURES

There are no green building codes in Japan. Energy efficiency codes, indoor air quality codes, and possibly water efficiency codes (in plumbing) have been included in the BSL.

Green Building Rating System

The Comprehensive Assessment System for Built Environment Efficiency (CASBEE) is a tool for assessing and rating the environmental performance of buildings and built environment. The Japan Green Building Council maintains CASEBEE. Criteria for this voluntary system include, indoor environment (sonic, thermal, illumination, air quality), quality of service (service ability, functionality, maintenance), durability and reliability, flexibility and adaptability, outdoor environment on-site (biotope, characteristic, comfort, energy (thermal load, natural energy, building system efficiency, efficient operation), water efficiency, reducing use of non-renewable resources, off-site environment (pollution, noise, heat island), and surrounding environment (noise, wind, light pollution).

Republic of Korea

1. Synopsis

BUILDING REGULATORY SYSTEM

The building regulatory system of the Republic of Korea is extremely centralized and structured. The system begins with a decree issued by the Senate and House. The decree is then converted into the Building Act, which is administered by the Ministry of Land, Transport and Maritime Affairs (MLTM). Presidential decrees define the specific requirements in the Act, such as the use of the Act, and building categories. Ordinances issued by the MLTM are supplementary to the Act. The ordinances specify construction and building standards to support the Act. They also specify the acts and regulations of other ministries that have to be applied with the Building Act.

Acts, ordinances, and decrees are developed the Building Committee. Members of the committee are selected by MLTM from various ministries, academic institutions, and professional organizations. Korean Standards are developed by similar groups of professionals, whose members are selected by the Korean Standards Agency. There is no mandatory review and revision period for the Act, ordinances, or decrees.

The Act, ordinances and decrees are mandatory throughout Korea, and enforced by local governments. Local governments also issue permits and certificates, engage building inspectors, and pass ordinances to enforce the Act.

REFERENCED STANDARDS

Korean Standards (KS) are referenced by the ordinance of the MLTM. The ministry also allows equivalent international standards in place of KS. ASTM International, International Code Council, ASHRAE, and American Concrete Institute are some of the codes and standards developing organizations that the regulations cited.

GREEN FEATURES

Green features are introduced into the regulatory system through the Building Act. The Act mandates energy efficiency, construction waste recycling and reuse, and water efficiency standards for buildings. These are translated into implementable documents by the Ministry of Knowledge, and Ministry of Environment. In addition, the Ministry of Environment also mandated standards for indoor air quality, storm water management, and the environment.

2. Code Development, Administration, and Enforcement¹²

The Republic of Korea's building regulatory system has a very formal structure highly dependent on the Central Government. The Building Act (2009) establishes the building and construction regulatory system. The Act is administered by the Building Planning Division of the Ministry of Land, Transport and Maritime Affairs (MLTM). The Act establishes the standards that the industry has to adopt.

KEY PLAYERS IN THE REGULATORY SYSTEM

MLTM, mayors, governors, and heads of cities nominate representatives to a building committee that enforces regulations, ordinances, and Presidential decrees. Inspection and permitting are the responsibility of the building control department of the city mayor's office (for metropolitan city), governor of special-self governing office, and the head of a city. All local enforcement regulations must be aligned with those implemented by the MLTM. The ministry reviews, revises, and develops regulations; incorporates standards pertaining to the Act; and establishes relationships with ministries and agencies involved in the approval and issuance of building permits. These include the Ministry of Environment (environmental regulations such as the River Act, Farm Act, and Management of Mountainous Act), and in the Ministry (National Planning and Utilization Act). Building permits and certificates are tied to permits from other ministries and agencies. Building inspectors are appointed by local government.

BUILDING STANDARDS

Presidential Decrees are assigned to address the standards used for different building elements. MLTM specifies the technical standards to be used in regulating buildings through a commissioned team of experts. The experts include National Research Laboratory, academic, and professionals from specialized organizations or associations.

GREEN BUILDINGS

The Building Act has included the certification of environmentally friendly buildings. It also has requirements for energy efficiency and construction waste management (including a certification for energy efficiency in building).

STRUCTURE OF BUILDING REGULATORY DOCUMENTS

The Building Act lays down the regulatory processes as it involves enforcement decrees, Presidential decrees, and MLTM ordinances. Enforcement decrees specify rules and requirements not stated in acts, decrees and ordinances. Presidential decrees specify enforceable items that are in acts, decrees and ordinances. The ordinances contain the mandatory standards. Other mandatory standards are specified by MLTM (MLTM (c) 2012). Other regulatory documents include the following:

¹² MLTM 2012; MLTM (b) 2012

- Construction Machinery Management Act
- Construction Ordinance of the Ministry of Land, Transport and Maritime Affairs
- Construction Technology Management Act
- Enforcement Decree of the Building Act
- Enforcement Decree of the Construction Technology Management Act
- Enforcement Decree of the Framework Act on the Construction Industry
- Presidential Decree for the Construction Machinery Management Act
- Presidential Decree of Building Act (Seumteo 2012; Law Society of Korea 2012).

REFERENCE STANDARDS

Korean Standards (KS) are referenced in the ordinance of the MLTM. The ministry also allows equivalent codes and international standards to replace referenced KS. ASTM International, International Code Council, American Society for Heating, Refrigeration and Air-conditioning Engineers (ASHRAE), and American Concrete Institute are some of the codes and standards developing organizations that the regulations cited. For example, the regulations used by the Keangnam Millennium Park Development include the following:

Korean Acts, Regulations, and Standards

- Building Act Enforcement Rule
- Enforcement Rule of Fire Equipment Installation and Safety Maintenance Regulation
- Enforcement Rule of Parking Act
- Equipment Installation Standards
- Korean Building Act
- Korean Fire Act
- Korean Handicap Regulation
- National Fire Safety Act
- Parking Installation Rule
- Regulation of the Standards of Egress and Fire Protection Construction in Buildings

International codes and standards

- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), 2004
- International Building Code (IBC), 2003 edition
- International Electrical Code (IEC), 2003 edition
- International Fire Code (IFC), 2003 edition
- International Mechanical Code (IMC), 2003 edition
- National Fire Protection Association (NFPA), 2005 edition

GREEN FEATURES

The Republic of Korea has included most green features in its mandatory laws (see Section 3, below, for details). The Building Act requires the MLTM to develop a mandatory green building rating system for the construction industry.

TYPES OF BUILDINGS

The Building Act classifies buildings as follows:

- Amusement facilities
- Apartment houses
- Business facilities
- Cemeteries and related facilities
- Class I neighborhood living facilities
- Class II neighborhood living facilities
- Commercial facilities
- Correctional facilities and military installations
- Detached houses
- Education and research facilities
- Facilities for
 - Animals and plants,
 - Broadcasting and telecommunications
 - Cultural activities and assembly
 - Motor vehicles
 - Power generation
 - Storage and treatment of dangerous substances
 - Elderly and infants
 - Tourism and relaxation
 - Treatment and excretes and wastes
- Factories
- Lodging facilities
- Medical facilities
- Religious facilities
- Sport facilities
- Warehouses
- Other facilities prescribed by the Presidential Decree.

3. Code Details

MINIMUM CODES

Electrical. All mandatory electrical standards are in the Building Act, decrees, ordinances, and regulations issued by the MLTM.

Energy. The section on energy efficiency and utilization of construction waste in the Building Act states mandatory requirements for buildings. The Act also mandates the use of building design criteria for energy saving and a building certification system. Energy audits are recommended.

Water and Sanitation. Mandatory plumbing and sanitation standards are in the Building Act, decrees, ordinance and regulations issued by the MLTM. The ministry also enforces the Protection of Groundwater Act (MLTM (b) 2012). An ordinance of the Ministry of Environment requires that rainwater and water be treated before discharge. The Ministry of Environment also requires the protection of storm water quality, through the Protection of Water Quality Act.

Mechanical Systems. Mandatory mechanical systems standards are in the Building Act, decrees, ordinance and regulations issued by the MLTM.

Indoor Air Quality. Protection of indoor air quality is mandatory. The laws are enforced by the Ministry of Environment’s Indoor Air Quality Control in Public Use Facilities, the Ministry of Land, Transport and Maritime Affairs’ Organic Act of Construction Facility, and the Ministry of Environment’s Underground Air Quality Management Act.

Lighting. Mandatory lighting design standards are in the Building Act, decrees, ordinances, and regulations issued by the MLTM. Ministry of Environment’s Lighting Pollution Prevention Law Based on Artificial Lighting—which is administered by local governments—is mandatory (Energy Korea, 2012). Korea’s Energy Standards and Labeling has a section on energy efficiency of lighting and lighting design.

Security. No mandatory standard

Fire. Mandatory fire standards are in the Building Act, decrees, ordinances and regulations issued by the MLTM.

Structural. Mandatory structural design standards are in an ordinance of the MLTM (Rules Regarding the Structure of the Building Standards). The ordinance is part of the extensive documentation of the building regulatory system mentioned above. Guidelines and standards of the Korean Concrete Institute and the Korean Society of Steel Construction are also mandatory. Most standards from the Korean Research Institute of Standards and Science, and the Korean Agency for Technology and Standards are also mandatory (Korea Concrete Institute 2012; Korean Society of Steel Construction 2012; KRISS 2012; KATS 2012).

Location/Siting/Zoning and Environment. Mandatory standards for location, siting, and zoning are the responsibility of the MLTM (MLTM (b) 2012). Site planning and management are in the National Planning and Utilization Act. MLTM also enforces the following laws:

- Act on Urban Parks, Greenbelts, etc
- Balanced Regional Development and Fostering of Local Small and Medium Enterprises Act
- Enforcement Decrees
 - Act on Special Cases for Simplification of Procedures for Authorization and Permission for Industrial Complex
 - Act on Acquisition of Land, etc. for Public Works and the Compensation Therefore
 - National Land Planning and Utilization Section, Act on the Acquisition of Land, etc. for Public Works and the Compensation
 - Parking Lot Act

- Framework Act on Restrictions on Land Utilization (and enforcement decree)
- Framework Act on The National Land (and enforcement decree)
- Groundwater Act (and enforcement decree)
- Industrial Sites and Development Act
- River Act (and enforcement decree)
- Seoul Metropolitan Area Readjustment Planning Act (and enforcement decree)
- Special Act on Simplification of Procedures for Authorization and Permission for an Industrial Complex
- Special Act on the Construction and Support of Innovative City Acceptance of Public Institutes Relocating to Local Cities (and enforcement decree)
- Special Act on Development of East, West and South Coast Areas (and enforcement decree)
- Urban Development Act
- Wetland Conservation Act (and enforcement decree)

Mandatory standards enforced by the Ministry of Environment

- Act on Special Measures for the Control of Environmental Offenses
- Act on the Control of Trans-boundary Movement of Hazardous Wastes and Their Disposal
- Act on the Promotion of Saving and Recycling of Resources (and enforcement decree)
- Clean Air Conservation Act (and enforcement decree)
- Development of and Support for Environmental Technology Act (and enforcement decree)
- Environment Improvement Expenses Liability Act
- Environmental Dispute Adjustment Act
- Environmental Impact Assessment Act (and enforcement decree)
- Framework Act on Environmental Policy (and enforcement decree)
- Framework Act on Low Carbon, Green Growth
- Management of Drinking Water Act (and enforcement decree)
- Natural Environment Conservation Act (and enforcement decree)
- Noise & Vibration Control Act
- Promotion of Installation of Waste Disposal Facilities and Assistance, etc. to Adjacent Areas Act
- Sewerage Act
- Soil Environment Conservation Act (and enforcement decree)
- Toxic Chemicals Control Act (and enforcement decree)
- Wastes Control Act (and enforcement decree)
- Water Quality and Ecosystem Conservation Act (and enforcement decree)
- Water Supply & Waterworks Installation Act (and enforcement decree)

Safety. The Special Act on the Safety Management of Facility is a mandatory standard administered by the MLTM (MLTM 2012).

GREEN BUILDING CODES IN REPUBLIC OF KOREA

Standards in Laws and Regulations

The green features that are mandatory in Korea include:

- Energy efficiency and construction waste recycling (under the Building Act's Energy Efficiency and Utilization of Construction Waste section).
- Energy saving building design criteria and a building certification system, under the Building Act Building audits are recommended (Korea Energy Management Corporation 2012; Korea Energy Management Corporation (a) 2012; Korea Energy Management Corporation (b) 2012).
- Treatment of rainwater and water before discharge, under an ordinance of the Ministry of Environment.
- Protection of storm water quality under the Protection of Water Quality Act of the Ministry of Environment.
- Protection of indoor air quality, under the Ministry of Environment's Indoor Air Quality Control in Public Use Facilities; the MLTM's Organic Act of Construction Facility, and the Ministry of Environment's Underground Air Quality Management Act (Jee 2005; Ministry of Environment 2012)

Mandatory Green Building Certification

MLTM and the Ministry of Environment have developed a mandatory green building certification system for residential dwellings, mixed-use dwellings, office buildings, and schools using four rating tools.

Rating criteria cover

- Land development and commuting transportation (land development and change in land quality, impact on adjacent properties, commuting transportation, provision of pleasant residential environment)
- Energy and resources consumption and environmental loads (energy consumption, resources conservation, environmental pollution loads, water resources, and management)
- Ecological environment (use of natural resources, creation of green space in complex, and creation of biological habitat)
- Indoor environmental quality (indoor air quality, thermal environment, noise and acoustics, indoor services)
- Supplementary items (noise and acoustics, energy consumption, alternative energy, installation of grey water system, preservation of natural resources, noise attenuation performance through the floor, and ratio of direct sunlight into primary living areas of dwelling units).

Daejeon district has its own green building rating (Korea Green Building Council, 2012).

The total possible score is 120 and there are two ratings, best (85+ points) and excellent (65-84). The standards used by the system are developed by the Korean Agency for Technology and Standards, Ministry of Environment, and MLTM (KATS 2012).

Malaysia

1. Synopsis

BUILDING REGULATORY SYSTEM

Malaysia's building regulatory system is similar to Singapore's, Brunei's, and Hong Kong China's. The federal government develops and implements regulations and there is no building code. The regulations refer to codes of practices (equivalent to guidelines or best practices), standards, and design guidelines developed, published and administered by the Department of Standards Malaysia, a government department under Ministry of Science, Technology and Innovation. These are mandatory if the regulations so specify, otherwise practitioners may use equivalents developed from other sources.

The federal government administers all building regulations and state and territorial governments enforce them in their building control departments. Review and revision of the regulations are the responsibility of the Ministry of Works. There is no mandatory time period for regulation review or revision. Reviews of codes of practices, standards, guidelines, and best practices depend on the agencies that administer them. For example, Malaysia Standards (MS) are usually revised every three to five years, while codes of practices, guidelines and best practices administered by the Public Works Department do not have a mandatory time period for review and revision.

State and territorial governments conduct building inspection works and issue permits for their states, and municipal or city governments may also take responsibility for inspection works and permits for their areas. This depends on the arrangements between the state and territorial governments and the local governments.

REFERENCE STANDARDS

While reference standards are mainly from Malaysian Standards (MS), Malaysia draws from ASTM International, ASHRAE, the British Standards Institute, Australian and New Zealand Standards, Chinese Standards, and the American Institute of Steel Construction..

PATHWAYS TO GREEN: FEDERAL GOVERNMENT

The government takes a voluntary approach to green features in buildings and no regulations require such features. Codes of practice and standards for indoor air quality, water efficiency, and resource efficiency are not mandatory; and policies on energy, water, and the environment have not affected building design and construction. Still, ASHRAE 90.1 (on energy efficiency) is widely applied in high-rise commercial buildings in Malaysia.

2. Code Development, Administration, and Enforcement

Like Singapore, Brunei, and Hong Kong, Malaysia does not have a building code system. The system relies on laws implemented by the government, and the laws require relevant standards and codes of practices pertaining to buildings. Engineers and architects determine standards and codes of practices relevant to their projects. Even if laws refer to a standard, an equivalent can replace the reference. While codes of practices, standards, and guidelines are generally not mandatory, they can be required if the laws make them mandatory.

BUILDING REGULATIONS

Malaysia's building regulations are based on the Street, Drainage and Building Act (1974), the Uniform Building By-Laws (1984), and Building (Federal Territory of Kuala Lumpur) By-Laws 1985. These legal instruments stipulate guidelines for the approval of building plans and prescribe the control of construction. In conjunction with these laws, the Fire Services Department prescribes requirements for fire safety in buildings through the provisions of the Fire Services Act 1988, and through its own guidelines. These guidelines and provisions specify the "passive" aspects of the laws, (i.e., structural requirements for fire containment and life safety precautions). The laws do not dictate the types of standards mandated by the regulations as long as there are equivalent standards.

ENFORCEMENT PROCEDURES

Local authorities develop and enforce their own building codes, and are not required to follow the Uniform Building By-Laws (1984). Penalties for offenses committed by developers, contractors, owners, and occupiers are imposed by local building control officers. The federal building control department can apply to the court for a "Mandatory Order" requiring an offending owner or occupier to demolish an unauthorized building or to abate any nuisance or danger related to construction. The main functions of a local authority are planning and control of development and building control, while laws, bylaws, and standards development are the responsibility of the federal government. Local building control departments do not have jurisdiction over buildings owned by the federal government; their codes apply only to buildings in their state or territory.

COMPLIANCE PROCEDURES

The Uniform Building By-Laws (1984) prescribes plan submission procedures, space provisions and design methods, provisions of temporary works, structural requirements, construction requirements, fire requirements, alarm, detection, extinguishment, and access, and other miscellaneous items. Building By-Laws 1985 specifies the enforcement and regulation for the Territory of Kuala Lumpur only. The federal government is the local authority for the Territory. The Street, Drainage and Building Act (1974) has provisions on street design and maintenance, plants management, drainage design and maintenance, back-lanes provision, design and maintenance, and other administration procedures.

LAW ADMINISTRATION AND REVISION

Local Authority under each states and territorial governments enforce the laws if they adopt them. They may choose to develop their own regulations. The local authority has control over the ordinances or regulations they wish to impose in their states, while the federal laws apply to federal projects built on non-federal lands. Most states and territories have adopted federal building regulations.

No time period for review or revision of law is specified, so laws are updated as and when needed by the Ministry of Works. Standards referred by the laws are updated by the Department of Standards Malaysia based on request from the Ministry of Works. All Malaysian Standards (MS) will be reviewed every 5 years.

CODE ADOPTION AND EVOLUTION

Malaysia's federal government develops the Uniform Building By-Laws (1984), Building (Federal Territory of Kuala Lumpur) By-Laws, and the Street, Drainage and Building Act (1974) Act. Local authorities adopt these or develop their own enforceable codes. The bylaws and acts were originated by and are updated as needed by a panel of industry experts, academics, government officials, and representatives of various states and territories. Updates are reflected in later versions of legislation passed by Parliament. Local authorities enact their codes by making them laws for their own state or territorial government. The federal building control department enforces laws on behalf of the federal government (including federally owned buildings outside of Kuala Lumpur) and for buildings inside the Federal Territory of Kuala Lumpur. Local building control departments enforce local building codes. No information is available on the development and evolution processes of the local codes.

MALAYSIAN STANDARDS (MS)

The Department of Standards Malaysia (STANDARDS MALAYSIA) under the Ministry of Science, Technology and Innovation (MOSTI), is the National Standards and Accreditation Body. In performing its duties and functions, STANDARDS MALAYSIA is governed by Standards of Malaysia Act 1996 (Act 549). As the National Standards Body, STANDARDS MALAYSIA through the Industry Standards Committee (ISC) develop Malaysian Standard (MS) in 24 sectors including for building, construction and civil engineering. The ISC consists of local industry experts, academics, government officials, and international experts. STANDARDS MALAYSIA recommends reviewing the MS every 5 years or earlier as necessary.

REFERENCE STANDARDS

Most reference standards are Malaysian Standards . Besides MS, the laws also referred to other standards such as British Standards , ASHRAE, AS/NZS, and ASTM .ISC D may refer to other source of standards (e.g., ASTM, ASHRAE, AS/NZS, BS) in developing MS. Local authorities are free to adopt their own standards.

GREEN FEATURES OF MANDATORY LAWS

Although Malaysia has developed MS related to ‘green’ such as on energy efficiency but the Uniform Building By-Laws (1984), Building (Federal Territory of Kuala Lumpur) By-Laws, and the Street, Drainage and Building Act (1974) do not have green features. The bylaws only require compliance with MS developed by ISC D, and does not include other ISCs.

TYPES OF BUILDINGS

The Uniform Building By-Laws (1984), Building (Federal Territory of Kuala Lumpur) By-Laws, and the Street, Drainage and Building Act (1974) apply only to commercial, institutional, and industrial buildings. They do not govern housing and low-cost development. These are mandatory laws for federally owned buildings, and it is up to the state or territory to determine if the laws apply to them.

3. Code Details

MINIMUM CODES

Electrical. MS 1979 (Electrical Installations of Buildings – Code of Practice)) has been developed by ISC E - Generation, Transmission and Distribution of Energy based on the source material as contained in the guide to MS IEC 60364 on electrical installations of buildings. The federal government and all states and territorial governments have made this standard as mandatory.

Energy. Currently there is no mandatory standard for building energy efficiency. However, ASHRAE 90.1 is widely applied and buildings that pursue LEED and Green Mark certifications must comply with ASHRAE 90.1. Although it is not mandatory standard, MS 1525 (Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings) is widely used in Malaysia.

The National Energy Policy of Malaysia was developed by the federal government and addresses energy production, distribution, and consumption. It provides energy use guidelines and lays out renewable energy use and development guidelines for buildings. The policy is based on the 1974 Petroleum Development Act, 1975 National Petroleum Policy, 1980 National Depletion Policy, 1990 Electricity Supply Act, 1993 Gas Supply Acts, 1994 Electricity Regulations, 1997 Gas Supply Regulation, and the 2001 Energy Commission Act. The Government agencies such as the Ministry of Energy, Green Technology and Water, the Energy Commission, and the Malaysia Energy Center also Government-linked companies, like Petronas and Tenaga Nasional Berhad are contributed to the development of the National Energy Policy of Malaysia. .

The Energy Commission is the regulator of the energy sector and service companies. The Malaysian Guidelines for Energy Efficiency in Buildings is a voluntary, set of building energy standards for non-

residential buildings. They cover envelope, lighting, and HVAC systems. The guidelines are developed by industry experts, academics, and government officials. Currently, none of these guidelines had been made mandatory.

Water and Sanitation. Malaysia does not have a mandatory standard on plumbing but various piping standards are widely adopted. These include the MS 525 (Specification for Concrete Porous Pipes for Under Drainage), MS 881 (specification for precast concrete pipes and fittings for drainage and sewerage), and MS 1193 (Specification for Devices without Moving Parts for the Prevention of Contamination of Water by Backflow). MS 2015 (public toilets), is a voluntary standard that has been widely adopted.

Standards on water and sewerage quality has been made mandatory in Water Services Industry Act and the National Water Services Commission Act for Peninsula Malaysia. These acts are not applicable in East Malaysia. The Sewerage Act 1994 (affects both), and the Ministry of Energy, Green Technology and Water Malaysia are implemented and enforceable in Malaysia. These regulations are enforced by the Ministry of Energy, Green Technology and Water Malaysia and required local governments to maintain certain levels of water and sewerage quality.

The National Standard for Drinking Water Quality (second version, January 2004) is issued by the Engineering Services Division of the Ministry of Health. The standards are adopted from the World Health Organization's guidelines for drinking water quality. The Concession Agreement of December 31, 2004, specifies that treated water supplied by SYABAS must comply with the standard stipulated in National Standard for Drinking Water Quality. The standard has 131 parameters. These standards has been made mandatory in Malaysia as the government obtains funding from the World Health Organization.

The National Water Services Commission Act and the Water Services Industrial Act 2006 (both by the Ministry of Energy, Green Technology, and Water) contain provisions for commissioning water treatment facilities. Both are mandatory only in Peninsula Malaysia.. The Water Forum and the Ministry of Energy, Green Technology and Water Malaysia has developed guidelines on water savings and efficiency. The most common voluntary standards on plumbing in Malaysia include MS 1058 (Polyethylene piping systems for water supply), SPAN Approval, Australia/NZ Joint Standard AS/NZS 2642, Australia/NZ Joint Standard AS/NZS 4129/4130, WaterMark AS/NZS 2642, WaterMark AS/NZS 4129, and United Kingdom BS 7291.

Mechanical Systems. There is no mandatory standard for mechanical systems in Malaysia as a whole, but guidelines for mechanical system design and installation has been made mandatory for all Federal Government according to the Public Works Department (Public Works Department, 2011)

Indoor Air Quality. Malaysia does not have a mandatory standard for indoor air quality. The standard on indoor air quality was issued by the Ministry of Human Resources, Department of Occupational Safety and Health, sets minimum standards but is only a guide. It sets standards for indoor air quality (oxygen, carbon dioxide etc.), zoning of indoor pollutant sources, and elimination of pollutants from indoor sources (DOSH 2005). All federal government buildings comply with this standard and thus this is somewhat mandatory for most federal buildings.

Lighting. The code of practice on occupational safety and health issued by the Ministry of Human Resources, Department of Occupational Safety and Health, is the minimum standard for lighting, but it is not mandatory. It sets minimum and maximum luminaries, and recommends types of luminaries, and color use for office spaces. Malaysian Standards (MS) developed under ISC F also has voluntary standards on lighting design.

Security. Malaysia does not have a Malaysian Standard (MS) for building security.

Fire. Malaysian Standards (MS) for fire safety in building are referred in the Uniform Building By-Laws (1984), Building (Federal Territory of Kuala Lumpur) By-Laws (1984), and Fire Services Act (1988). These laws and act also include provisions for fire safety access, room plans, provision of fire extinguishing methods and systems, fire resistance of materials, and design methods etc.

Structural. The Uniform Building By-Laws (1984) and Building (Federal Territory of Kuala Lumpur) By-Laws (1984), have Malaysian Standard (MS) on structure. The standards cover loading requirements, material use, spatial loading standards, weight of partitions, stacking, roof design, dynamic loads etc. ISCS D are focuses on design and construction methods of timber, concrete, steel and plastic materials (ISCS D Section, MS 416, MS 977, MS IEC 8124, MS 544, MS 1294, MS 1057, MS 229, MS 1933, MS 1195, MS 1226, MS 1553, MS 1314, MS 1490 etc.).

Location/Siting/Zoning and Environment. Building zoning and siting is governed by the 10th Malaysia Plan, which is managed by the Economic Planning Unit of the Prime Minister's Office and the Malaysia Economic Planning Unit in the office of the Attorney General of Malaysia, and the Town and Country Planning Act (1976, amended in 2006). The 10th Malaysia Plan focuses on types of development, land use, and other land issues. The Town and Country Planning Act sets out the rule on planning authority, authorizations, and format.

Developed by the Ministry of National Resources and Environment in 2002, the National Policy on the Environment dictates environmental standards. The policy covers environmental stewardship, conservation of nature's vitality and diversity, continuous improvement in environmental quality, sustainable use of natural resources (including land), integrated decision-making, the role of the private sector, commitment and accountability, and participation in the international community. Other related regulations include the:

- Environmental Quality Act 1974-2011,
- Fisheries Act, Land Conservation Act,
- Local Government Act,
- National Forestry Act,
- National Park Act,
- Protection of Wildlife Act,
- Radioactive Substances Act,
- Water Enactment Act,
- Sarawak Biodiversity Center Ordinance,
- Sabah Biodiversity Enactment,
- Sarawak Natural Resources and Environment Ordinance,
- Sabah Environmental Protection Enactment, and

- Sabah Forest Enactment, Sarawak Forest Ordinance.

Safety. Occupational Safety and Health Act 1994 under purview of The Department of Occupational Safety and Health specifies minimum safety standards in Malaysia. It specifies the responsibilities and duties of employers and employees with regard to workplace safety and safety requirements for products and materials. The Uniform Building By-Laws, and the Building By-Laws (1984) also have provisions for safety during construction, fire exits, smoke detectors, obstructions, etc.

Other voluntary standards are including the Department of Occupational Safety and Health's guidelines for public safety and health at construction site, and code of practice for safe working in a confined space. The guidelines cover the duties of different parties, hazard identification, risk assessment and control, emergency response methods, hoarding, movement of traffic, utilities disconnection, demolition, explosive use, site clearance, safety measures for types of construction works, the use of hoisting equipment, and crane storage. The code of practice specifies approaches to working in confined spaces, permitting requirements, duties of various parties, ventilation standards, and safety protection methods.

GREEN BUILDING CODES

Malaysia does not have a mandatory standard or code for green building standard but two green building rating systems are frequently used. The Green Building Index (GBI) is Malaysia's rating tool for buildings and towns. It is very similar to USGBC LEED. Buildings and townships can apply for certifications in nonresidential, residential, industrial, and township categories. Certifications are at four levels (certified, silver, gold, and platinum) and take three steps: (1) application and registration, (2) design assessment, and (3) completion and verification assessment. A verifier visits the site to certify compliance with GBI standards for energy efficiency, indoor environmental quality, sustainable site planning and management, materials and resources, water efficiency, and innovation. The township assessment has one additional step for approval of final plans before verification.

Mexico

1. Synopsis

Like the United States, Mexico does not have a national building code. Responsibility for the development and enforcement of building codes resides with authorities in individual jurisdictions, including states and cities. Municipalities are entitled to establish appropriate regulations for urban development and housing, such as land use and building permits. Detailed regulations are in the Federal Law on Urban Development. These rules have been interpreted for long time so that every municipality has the power to issue its own building code, although municipalities may together issue a regional or state building code. Because Mexico has a federal district (Mexico City) and 31 states with more than 2,400 municipalities, the number of possible building codes is quite large.

MEXICO'S BUILDING CODE

Most code development in Mexico focuses on Mexico City, the capital and largest city in the economy. Although cities and municipalities of different sizes are in regions with different hazards most have simply adapted or outright copied Mexico City Building Code (MCBC) (the latest version is from 2004). The MCBC is basically a model code. It is the product of a process dating from 1920 in which design requirements, professional liabilities, and overall performance requirements have evolved.

BUILDING REGULATORY SYSTEM—BOTTOM UP APPROACH

State and municipal governments are responsible for developing the regulatory system and involving industry professionals in that development. Local authorities not always have a technical infrastructure to rely on in developing regulations or codes, nor can they always count on the legal infrastructure needed to ensure application and compliance once regulations are developed. Some localities adopt building regulations from elsewhere, generally those of the federal district, as mentioned above. The jurisdiction appoints a committee or designates parties who write or research the regulations, the local legislature approves them, and the local government enforces them. But each jurisdiction has different levels of enforcement and in some enforcement is limited

The MCBC, which has evolved from a prescriptive to a performance-based code, is the result of collaboration among parts of the federal district authorities with jurisdiction in building safety. These include the Secretary of Urban Development & Housing and the Secretary of Public Works and Services. In addition, academic and professional institutions and the Federal District Advisor's Committee on Structural Safety participate in code development. The MCBC can be obtained at the Secretary of Public Works and Services website: <http://cgservicios.df.gob.mx/prontuario/vigente/385.htm>.

REFERENCED STANDARDS

The MCBC refers to the complementary technical standards/standards (CTN), which are Mexican standards developed by national private and public sector organizations. Some of these standards are based on international standards, such as those from the United States and other economies. Based on the Federal Law on Metrology and Standards, the National Standardization Program requires all federal ministries to develop mandatory technical standards (*Normas Oficiales Mexicanas*, or NOM) for the areas they regulate. For example, the Energy Ministry transferred the mandate to develop appliance standards and building energy efficiency codes to the Mexican Energy Efficiency Commission (CONAE).

Mexican standards (NMX) are voluntary regulations that can be enacted by accredited private standardization organizations. Further down in the hierarchy of standards, technical suitability reports (*Dictamen de Idoneidad Tecnica* or DIT) can be developed to assure the quality of certain appliances and equipment.

CODE COMPLIANCE AND ENFORCEMENT-GOVERNMENT OVERSIGHT OF BUILDING CONSTRUCTION

Jurisdictional authorities are responsible for enforcing building code provisions. There are local systems for enforcement of general building codes, with some third party involvement through auxiliary, nongovernmental entities that are responsible for confirming compliance with codes. Enforcement varies from jurisdiction to jurisdiction. Some states have well-established and automated systems for permits, inspections, and certificates of occupancy while others have only limited systems.

PATHWAYS TO GREEN

Mexico does not have green code for commercial buildings. Efforts to develop and regulate green provisions in the built environment are ongoing. Like other emerging economies, Mexico is moving towards “green” or friendlier environmental activities in the built environment. The construction industry has embraced green building and is learning from the experiences of Europe, Canada, and United States. Mexico’s architectural tradition favors environmentally sensitive, small-footprint buildings, but promotion of green buildings specifically is new and focused on housing. Stakeholders, such as the National Housing Commission (CONAVI) and the Mexican Chamber for the Construction Industry (CMIC), are documenting green practices and defining criteria for green buildings and homes. Such documentation will be fundamental should Mexico choose to develop a green code. And developing a code and standards would require extensive coordination. Mexico has many national technical standards and other documents that can serve as a foundation for a green code; energy efficiency standards are highlighted here. Development of a green code or standard for commercial buildings is just the beginning of a process that above all needs a strong system for compliance. Compliance and enforcement, in fact, need to be strengthened for the economy’s building code system overall.

2. Code Development, Adoption, and Administration¹³

How building codes are developed, adopted, administered, and enforced in Mexico is rooted in the type of government, which is a federal republic consisting of one federal district and 31 administrative divisions or states.¹⁴ Mexico does not have a national code itself. According to Article 27 of the Mexican Constitution, municipalities are entitled to establish appropriate regulations for urban development and housing, such as land use and building permits. Detailed regulations are in the Federal Law on Urban Development. They have been interpreted for a very long time so that every municipality has the power to issue its own building code, although municipalities may together issue a regional or state building code. Since Mexico has a federal district (Mexico City) and 31 states with more than 2,400 municipalities, the number of possible building codes is very large.¹⁵ The National Housing Authority (CONAVI) had identified more than 100 before 2003. The existence of multiple codes creates a big challenge for coordination.¹⁶

CODE DEVELOPMENT

For years, the Ministry of Social Development, which is part of the executive branch of the federal government, has tried to coordinate the development of model building codes in the economy. So far, results have been limited. CONAVI's model for the residential sector, the Residential Building Code (CEV), has been slow to be adopted.¹⁷

Most code development in Mexico focuses on Mexico City, the capital and largest city in the economy. Cities and municipalities of different sizes and in regions with different hazards (i.e., earthquakes, winds, floods) have building codes that are simply adaptations or outright copies of the Mexico City Building Code (MCBC), the latest version being from 2004. Federal agencies have issued standards and manuals applicable to structures other than buildings. The most significant example is from the Federal Commission of Electricity (CFE 1994) for the design and construction of power supply facilities. The

¹³ The report has benefited from papers and information by experts such as Dr. Sergio M. Alcocer, Dr. Victor M. Castaño, local building codes and standards experts, and ASTM International. Important content related to the Mexico City Building Code is excerpted from the *Evolution of codes for structural design in Mexico*, a paper by Sergio M. Alcocer, and Víctor M. Castaño published in 2008.

¹⁴ Aguascalientes, Baja California, Baja California Sur, Campeche, Chiapas, Chihuahua, Coahuila de Zaragoza, Colima, Distrito Federal*, Durango, Guanajuato, Guerrero, Hidalgo, Jalisco, Mexico, Michoacan de Ocampo, Morelos, Nayarit, Nuevo Leon, Oaxaca, Puebla, Queretaro de Arteaga, Quintana Roo, San Luis Potosi, Sinaloa, Sonora, Tabasco, Tamaulipas, Tlaxcala, Veracruz de Ignacio de la Llave (Veracruz), Yucatan, Zacatecas. CIA Website. January 30, 2013.

¹⁵ Sergio M. Alcocer, Víctor M. Castaño. 2008. *Evolution of codes for structural design in Mexico*.

¹⁶ Alberto Herrera, codes and standards expert, January 29, 2013.

¹⁷ Herrera, January 29, 2013.

MCBC is regarded as a model code for the economy.¹⁸ Other agencies—such as PEMEX, the national oil agency, and the Mexican Institute for Social Services (IMSS)—have their own construction regulations. (Research on the development process is needed.¹⁹)

The MCBC incorporates important innovations and numerous scientific and technological advances in the following fields: seismic, seismology and wave propagation, subsoil and foundation studies, and the analysis of structure's response under seismic forces.

The MCBC is the product of an important process dating from 1920 in which design requirements, professional liabilities, and overall performance requirements have evolved. See *Evolution of codes for structural design in Mexico* by Sergio Alcocer and Victor M. Castaño (2008).

CODE ADOPTION

Local governments (state and municipal) are responsible for developing the regulatory system, with the participation of industry professionals and government. Such instruments are of a local character. Local authorities do not always have the technical infrastructure needed for developing regulations or codes, nor do they always have the legal infrastructure needed to ensure application and compliance once regulations are developed. Some adopt regulations from elsewhere, generally those of the federal district, as indicated above. The jurisdiction appoints a committee or designates parties who write or research the regulations, the local legislature approves and the local government enforces regulations.²⁰ However, there are different levels of enforcement in each jurisdiction and in some cases, the enforcement is limited.

ESTABLISHMENT AND ENFORCEMENT

The MCBC is the result of collaboration among parts of the federal district authorities with jurisdiction in building safety. These include the Secretary of Urban Development & Housing and the Secretary of Public Works and Services. In addition, academic and professional institutions and the Federal District Advisor's Committee on Structural Safety participate in code development. The MCBC can be obtained at the Secretary of Public Works and Services website:
<http://cgsservicios.df.gob.mx/prontuario/vigente/385.htm>.

BUILDINGS COVERED

There are no separate codes for building types. The MCBC 2004, a major revision of the 1987 code, consists of 257 articles under 11 titles (GDF, 2004a):

- I. General requirements
- II. Public streets and facilities for public use
- III. Directors Responsible for Works and Co-Responsibles
- IV. Permits and authorizations
- V. Architectural projects

¹⁸ Alcocer, et al.

¹⁹ Herrera, January 29, 2013.

²⁰ Herrera, January 29, 2013.

- VI. Structural safety
- VII. Construction
- VIII. Use, operation and maintenance
- IX. Building extensions
- X. Demolitions
- XI. Inspections, sanctions and appeals.

Title VI on structural safety itself has 12 chapters. It requires that structures be classified into Groups A, B1, or B2. Group A are essential buildings. Group B are structures used for housing, offices, and commercial business, hotels, and others not included in Group A. Group B1 buildings are taller than 30m or larger than 6 000m² of total floor area for soil zones I and II (firm and transition), or taller than 15m or larger than 3 000m² for zone III (soft soil). Group B2 are other types of structures.²¹

CODE EVOLUTION

General concepts for structural design are incorporated in the MCBC while technical details are concentrated in complementary technical standards (CTN), which allows for updating in keeping with technical advances and research. Code updates are coordinated by a technical committee of academics and practitioners. Key actors involved in code development include the government, the private sector, and research and academic institutions.

CODE ADMINISTRATION

Building departments or their local equivalents, usually as appointed by the jurisdiction, administer the code. The private sector or a third party is usually involved in code compliance: the “building permits system in Mexico appears to be simple, efficient and well established (if very diverse) at the local level. Discretion is, however, commonly practiced in building inspection, raising doubts on the effectiveness of compliance.”²²

ENFORCEMENT MECHANISMS

Enforcement mechanisms vary from jurisdiction to jurisdiction. Some states have well established and automated systems for permits, inspections, and certificates of occupancy and states limit their scope to an administrative processes only.

BUILDING INSPECTION

Building inspection systems vary from jurisdiction to jurisdiction. According to MCBC Title I, Article 3, and in accordance with legal provisions, the application and enforcement of code provisions is the responsibility of the Federal District’s Administration, which has the following responsibilities, among others (<http://cgsservicios.df.gob.mx/prontuario/vigente/385.htm>):

²¹ Alcocer et al.

²² Liu, Feng et al. Mainstreaming Building Energy Efficiency Codes in Developing Countries, World Bank Paper No. 204, 2010.

- Set up technical requirements for construction and installation in zones to satisfy conditions for habitability, safety, health, comfort, accessibility, and good aesthetics.
- According to applicable law, establish the purposes for which it may authorize the use of the premises and determine the type of buildings that can be built on them.
- Register the Construction Notice, the *Manifestaciones de Construcción*, and grant or deny building permits and special permits for the execution of works and use of buildings and premises.
- Keep a group of Directors Responsible for Works (Directores Responsables de Obra) and Co-Responsible.
- Conduct administrative verification visits during implementation to make sure that the use made of a property, structure, facility, building or construction, fits features previously registered.
- Approve or deny, in accordance with the MCBC, the occupation or use of a facility, property, or building
- Impose appropriate penalties for violations of these rules.
- Issue and change, when deemed necessary, the provisions of these rules, agreements, instructions, circulars and other administrative provisions that apply for the proper enforcement of the code.

The following, also from the code, describes the code development process, participants, etc.

To study and propose amendments to this Regulation (MCBC), a commission will be created, whose members are appointed by the Head of Government of the Federal District.

The Commission may extend to representatives of professional associations and other organizations and institutions that management deems appropriate to invite. In this case, the Administration will have equal representation. From this point of view, the process for the MCBC updates seems pretty open to the society. However, more research is needed regarding the code update practices at the local level. (Article 4 of Title I)

Those responsible in the Delegations (*Delegaciones*, territorial divisions of the Federal District²³) for registering construction notices and issuing special construction licenses, permits and/or authorizations, must have a current licensed qualified Director Construction Manager, in order to issue the technical advice specialized that is required. (Article 5)

REFERENCED STANDARDS

Mexico Electrical Installation Code NOM-001-SEDE 2012 maintained by the Secretary of Energy is based on international standards, such as the National Fire Protection Association (NFPA) 70, National Electrical Code (NEC) 2011. NOM-018 on thermal insulation for buildings is maintained by the Energy Agency and National Agency for Standardization and Certification of Building and Construction.²⁴

²³ The delegations, in some cases with the support of the Secretariats of Urban and Housing Development (Seduvi), through the Verification Institute of the Federal District (Invea) are responsible for supervising compliance with the MCBC. <http://eleconomista.com.mx/entretenimiento/2012/09/17/quien-responsabilidad>

²⁴ Sustainability in Building Construction (Commercial Buildings)—Efficiency and Conservation Survey

Mexico was one of the first economies in Latin America to adopt a building energy efficiency code (BEEC) for nonresidential industrial buildings.²⁵ NOM-008-ENER-2001, Energy Efficiency in Buildings, was developed by the Mexican Energy Efficiency Agency (CONAE) in 2001 with support from the Lawrence Berkeley National Laboratory (LBNL). The code sets minimum requirements for the design and construction of the envelope of new buildings and extensions of buildings. The objective is to optimize thermal behavior of buildings by limiting heat gains through their envelope and the use of energy for space cooling. The code is performance based. But,

the BEEC has not been applied anywhere since it would have to be integrated into local construction regulations to become effective. No state or municipality has included references to the BEEC in its construction regulations to become effective. This is a matter of the lack of information of the importance of building energy use by local authorities and it can also be attributed to the resistance of developers due to the cost of compliance.²⁶

In compliance with the provisions of the MCBC, the Federal District Government—with the participation of interdisciplinary groups, experts from education and research centers, as well as governmental entities and technical and scientific associations—has developed and issued ten complementary technical standards (CTN) (*normas técnicas complementarias*.)

1. Design and construction of masonry structures (NMX-C-404-ONNCCE; NMX-C-036 – Compression resistance. NMX-C-021- Masonry Cement)
2. Design and Construction of Wood Structures. (NMX- C-224-ONNCCE (ref. 3) “Dimensiones de la madera aserrada para su uso en la construcción”)
3. Design and Construction of Concrete Construction
4. Design and Construction of Steel Structures
5. Criteria and Actions for the Structural Design of Buildings
6. Design and Construction of Foundations
7. Wind Design
8. Seismic Design
9. Design and execution of works and hydraulic installations
10. Architectural projects

Overview of CTN and Their Referenced Standards and Standards

As indicated earlier, the MCBC refers to the CTN, which refers to Mexican standards developed by national private and public sector organizations. Some standards are based on international standards, such as those from the United States and other economies. The following describes the development of codes, standards, and standards in Mexico:

²⁵ Feng, et al.

²⁶ Feng, et al.

Based on the Federal Law on Metrology and Standards, the National Standardization Program was established, requiring all federal government ministries to develop mandatory official technical standards²⁷ (Normas Oficiales Mexicanas NOM), for the areas they regulate. For example, in the case of energy efficiency codes and standards, the Energy Ministry transferred the mandate to develop appliance standards and BEEC to the Mexican Energy Efficiency CONAE (Comision Nacional para el Ahorro de Energia).

The Mexican Standards (NMX) are voluntary regulations that can be enacted by accredited private standardization organizations. Further down in the hierarchy of standards, Technical Suitability Reports known as (DIT) Dictamen de Idoneidad Tecnica, can be developed to assure the quality of certain appliances and equipment.²⁸

The following table presents the three types of standards and the building-relevant standards of each.

Type of Norm	Targeted Elements	In Force	In Process
NOM – Official Mexican Standards Mandatory; established by federal agencies; contain regulations, specifications, attributes and provisions. Have a real objective such as public welfare, protect the environment, etc.	Products and services	Compact fluorescent, lamps, water closets, shower heads, water quality, water heaters	Thermal envelop for residential buildings
NMX- Mexican Standard Voluntary; contain technical specifications; established by consensus; based on experience and technical development.	Products and services	Thermal insulation – R values, valves for domestic water use, residential supervision and inspection services, construction materials such as: cement, blocks, steel bars, aggregates.	Thermal insulation test methods, foam block.
DIT – Technical Suitability Report In the absence of a NOM or a NMX standard, this is a criteria developed under a specific protocol for quality assurance purpose.	Products	Solar-gas water heater	Photovoltaic panel systems, LED (light emitting diode), motion sensors for lighting.

SOURCE: Liu, Feng et al. 2010. Mainstreaming building energy efficiency codes in developing countries; global experiences and lessons from early adopters. World Bank Paper No. 204, page 151.

See the next section for examples of type of standards, sources, use, and application.

GREEN BUILDING CODES

Before discussing work on a green building code in Mexico, note that there are voluntary rating systems in the market, such as the Leadership in Energy and Environmental Design (LEED) and Environmental Assessment Method (BREEAM). Mexico doesn't have a single green code for commercial buildings. But there are efforts to develop and regulate green provisions in the built environment.

In 2001, Mexico developed a mandatory commercial building code but has largely failed to implement it because local governments are not interested in incorporating its requirements into their local building regulations. More recently, CONAVI developed a national model regulation for residential construction that has sustainability requirements. Developers wanting to participate in CONAVI's subsidized low-

²⁷ Norms are mandatory documents. Standards are voluntary.

²⁸ Feng, et al.

income housing development program will have to satisfy those requirements. This represents an attractive approach to leverage market uptake of more energy efficient buildings.²⁹

According to Green Building Sector 2011, Expert Views, <http://www.globaltrade.net/f/market-research/text/Mexico/Building-Products-and-Construction-Green-Building-Sector-2011.html>

Like other emerging economies, Mexico is moving towards “green” or friendlier environmental activities. The construction industry has embraced the green building movement and Mexico has joined the World Green Building Council (WGBC). Mexico is learning from the European, Canadian and United States’ best practices and occasional missteps to reap the cost and health benefits of green buildings. It also can show other countries how to use simple, moderate-cost strategies from its own longstanding building practices to achieve green building advantages. Mexico’s tradition of architecture favors environmentally sensitive, small-footprint building practices and designs. But promotion of green buildings is fairly new and focused on housing. A number of groups are documenting green practices and defining criteria for green buildings and homes: CONAVI; INFONAVIT, the country’s largest housing fund for workers; the Mexican Chamber for the Construction Industry; the National Chamber for Consulting Firms; the National College for Architects; the Mexican Council for Sustainable Edification; and the Association of Firms for the Saving of Energy on Construction and Buildings. INFONAVIT has also created a green mortgage program, supported by mandatory employer and employee contributions.

CONCLUSIONS

Development of a green building code in Mexico seems to be a dispersed effort. Further development will require coordination. Overall, code compliance seems to be an important challenge for building safety and code enforcement and compliance in the federal district and municipalities should be prioritized. The lack of local infrastructure and local technical capacity are impediments to compliance. Additional research on green buildings in Mexico is recommended.

3. Code Details

EXAMPLES OF MEXICO’S STANDARDS AND STANDARDS

Referenced standards and standards can be accessed through standards development organizations and public and private sector agencies involved in standards development. For example, a database of *normas oficiales mexicanas* (NOM) can be accessed through the website of the Secretary of Economy (<http://www.economia-noms.gob.mx/noms/inicio.do>). Background information is provided for each NOM (e.g., government agency in charge of compliance, stakeholders who participated in development, a bibliography for development of the standard, and harmonization with other international standards).

²⁹ Feng, et al.

Organizations such as the Organismo Nacional de Normalización y Certificación de la Construcción y Edificación (ONCCE), develops Mexican standards NMX following the NMX-Z-013-1977 (standards for the development of Mexican standards). ONCCE's online catalogue lists standards related to specific industry segments, such as construction (*Normas Mexicanas de la Serie C*), together with the standard's cost: <http://www.oncce.org.mx/normas/catalogoDnormasV100210.pdf>

Examples below are taken from the Government Secretary reports on updated/current standards. (http://www.dof.gob.mx/nota_detalle.php?codigo=5282167&fecha=13/12/2012):

Clave o codigo	Titulo de la norma
NMX-C-024-ONNCCE-2012	INDUSTRIA DE LA CONSTRUCCION-MAMPOSTERIA- DETERMINACION DE LA CONTRACCION POR SECADO DE BLOQUES, TABIQUES O LADRILLOS Y TABICONES-METODO DE ENSAYO (CANCELA A LA NMX-C-024-1974).
<p>Objetivo y campo de aplicación</p> <p>Esta norma mexicana establece el método de ensayo para la determinación de la contracción por secado, es aplicable a los bloques, tabiques o ladrillos y tabicones de concreto, bajo condiciones específicas de secado.</p> <p>Este método de ensayo no aplica para bloques, tabiques o ladrillos de arcilla cocida debido a que en este material no se presenta contracción por secado superior al límite especificado en la norma mexicana NMX-C-404-ONNCCE-2005.</p>	
<p>Concordancia con normas internacionales</p> <p>Esta norma no coincide con ninguna norma internacional por no existir referencia alguna al momento de su elaboración.</p>	
<p>Bibliografía</p> <p>ASTM C 426, 2010 Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units-ASTM Internacional, Estados Unidos (Parcialmente armonizada con esta norma extranjera).</p> <p>UNE-EN 772-14, 2002 Methods of test for masonry units-Part 14: Determination of moisture movements of aggregate concrete and manufactured stone masonry units (Parcialmente armonizada con esta norma extranjera).</p>	
NMX-C-052-ONNCCE-2012	INDUSTRIA DE LA CONSTRUCCION-MATERIALES ASFALTICOS- PENETRACION EN CEMENTOS Y RESIDUOS ASFALTICOS-METODO DE ENSAYO (CANCELA A LA NMX-C-052-1974).
<p>Objetivo y campo de aplicación</p> <p>Esta norma mexicana establece el método de ensayo para determinar la consistencia mediante la penetración vertical de una aguja en una muestra bajo condiciones establecidas de masa, tiempo y temperatura.</p> <p>Esta norma mexicana es aplicable a los cementos asfálticos, residuos asfálticos y cementos asfálticos modificados.</p>	
<p>Concordancia con normas internacionales</p> <p>Esta norma no coincide con ninguna norma internacional por no existir referencia alguna al momento de su elaboración.</p>	
<p>Bibliografía</p> <p>M MMP-4-05-006, 2000 Penetración en Cementos y Residuos Asfálticos, de la Normativa para la Infraestructura del Transporte, de la SCT, México.</p> <p>ASTM D5, 2006 Standard test method for penetration of bituminous materials-ASTM Internacional Estados Unidos (Parcialmente armonizada con esta norma extranjera).</p>	
NMX-C-087-ONNCCE-2012	INDUSTRIA DE LA CONSTRUCCION-MATERIALES ASFALTICOS- DETERMINACION DE LA VISCOSIDAD SAYBOLT-FUROL-METODO DE ENSAYO (CANCELA A LA NMX-C-087-1980).
<p>Objetivo y campo de aplicación</p> <p>Esta norma mexicana describe el método de ensayo para obtener la viscosidad Saybolt-Furol; es aplicable a los materiales asfálticos.</p>	
<p>Concordancia con normas internacionales</p> <p>Esta norma no coincide con ninguna norma internacional por no existir referencia alguna en el momento de su elaboración.</p>	
<p>Bibliografía</p> <p>M MMP 4 05 004, 2000 Viscosidad Saybolt-Furol en Materiales Asfálticos, de la Normativa para la Infraestructura del Transporte</p>	

Clave o codigo	Titulo de la norma
	<p>de la SCT, México.</p> <p>ASTM D88, 2007 Standard Test Method for Saybolt Viscosity. ASTM Internacional-Estados Unidos (Parcialmente armonizada con esta norma extranjera).</p> <p>ASTM E 102 / E102M-93, 2009 Standard Test Method for Saybolt Furol Viscosity of Bituminous Materials at High Temperatures. ASTM Internacional-Estados Unidos (Parcialmente armonizada con esta norma extranjera).</p> <p>ASTM D 244, 2009 Standard Test Method and practices for emulsified asphalts. ASTM Internacional-Estados Unidos (Parcialmente armonizada con esta norma extranjera).</p> <p>ASTM 7496-11, 2011 Standard Test Method for Viscosity of Emulsified Asphalt by Saybolt Furol Viscometer ASTM Internacional-Estados Unidos (Parcialmente armonizada con esta norma extranjera).</p>
NMX-C-183-ONNCCE-2012	INDUSTRIA DE LA CONSTRUCCION-MATERIALES ASFALTICOS-PUNTO DE REBLANDECIMIENTO EN CEMENTOS ASFALTICOS (ANILLO Y ESFERA)-METODO DE ENSAYO (CANCELA A LA NMX-C-183-1974).
<p>Objetivo y campo de aplicación</p> <p>Esta norma mexicana describe el procedimiento para determinar el punto de reblandecimiento, mediante el anillo y la esfera; es aplicable a los cementos asfálticos.</p>	
<p>Concordancia con normas internacionales</p> <p>Esta norma no coincide con ninguna norma internacional por no existir referencia alguna en el momento de su elaboración.</p>	
<p>Bibliografía</p> <p>M-MMP-4-05-009, 2000 Punto de reblandecimiento en cementos asfálticos, de la Normativa para la Infraestructura del Transporte de la SCT, México.</p> <p>ASTM D36 / D36M, 2009 Standard Test Method for Softening Point of Bitumen (Ring-and- ball Apparatus) ASTM Internacional-Estados Unidos (Parcialmente armonizada con esta norma extranjera).</p>	
NMX-C-203-ONNCCE-2012	INDUSTRIA DE LA CONSTRUCCION-MATERIALES ASFALTICOS-METODOS DE MUESTREO (CANCELA A LA NMX-C-203-1973).
<p>Objetivo y campo de aplicación</p> <p>Esta norma mexicana describe el procedimiento a seguir para la toma de muestras; es aplicable a los asfaltos líquidos, semisólidos; sólidos y emulsionados.</p>	
<p>Concordancia con normas internacionales</p> <p>Esta norma no coincide con ninguna norma internacional por no existir referencia alguna al momento de su elaboración.</p>	
<p>Bibliografía</p> <p>M MMP 4 05 001, 2000 Muestreo de Materiales Asfálticos, de la Normativa para la Infraestructura del Transporte de la SCT, México.</p> <p>ASTM D 140, 2000 Standard Practice for Sampling Bituminous Materials. ASTM Internacional-Estados Unidos (Parcialmente armonizada con esta norma extranjera).</p>	
NMX-C-404-ONNCCE-2012	INDUSTRIA DE LA CONSTRUCCION-MAMPOSTERIA-BLOQUES, TABIQUES O LADRILLOS Y TABICONES PARA USO ESTRUCTURAL-ESPECIFICACIONES Y METODOS DE ENSAYO (CANCELA A LA NMX-C-404-ONNCCE-2005).
<p>Objetivo y campo de aplicación</p> <p>Esta norma mexicana establece las especificaciones y métodos de ensayo a cumplir por los bloques, tabiques o ladrillos y tabicones; es aplicable a los bloques, tabiques o ladrillos y tabicones para uso estructural en las edificaciones de fabricación nacional y de importación, que se comercialicen en territorio nacional. No aplica a las piezas accesorias.</p>	
<p>Concordancia con normas internacionales</p> <p>Esta norma no coincide con ninguna norma internacional por no existir referencia alguna al momento de su elaboración.</p>	
<p>Bibliografía</p> <p>NOM-008-SCFI-2002 Sistema General de Unidades de Medida</p> <p>NMX-C-307/1-ONNCCE-2009 Industria de la construcción-Edificaciones-Resistencia al fuego de elementos y componentes-Especificaciones y métodos de ensayo.</p> <p>ASTM C-55, 2011 Standard-Specification for Concrete Building Brick-ASTM Internacional-Estados Unidos (Parcialmente armonizada con esta norma extranjera).</p>	

Clave o codigo	Titulo de la norma
	ASTM-C-67, 2011 Standard Test Methods of Sampling and Testing Brick and Structural Clay tile-ASTM Internacional - Estados Unidos (Parcialmente armonizada con esta norma extranjera).
	ASTM-C-88, 2005 Standard Test Method Soundness of aggregates by use of sodium sulfate or Magnesium Sulfate-ASTM Internacional-Estados Unidos (Parcialmente armonizada con esta norma extranjera).
	ASTM-C-140, 2011 Standard Methods of Sampling and Testing Concrete Masonry Units-ASTM Internacional-Estados Unidos (Parcialmente armonizada con esta norma extranjera).
	ASTM-C-90, 2011 Standard Specification for Load bearing Concrete Masonry Units-ASTM Internacional-Estados Unidos (Parcialmente armonizada con esta norma extranjera).
	Le Bloc Béton-Système Constructif-Bloc Béton Développement (Parcialmente armonizada con esta regulación extranjera).
	Concrete Masonry-Shapes and Sizes Manual-National Concrete Masonry Association, 2002.- Estados Unidos (Parcialmente armonizada con esta regulación extranjera).
	Blocs Spéciaux et Accessoires de Maçonnerie-Rapport Technique ER (A) 79/13 Août 1979-CERIB (Centre d'Etudes et de Recherches de l'Industrie du Béton Manufacturé) (Parcialmente armonizada con esta regulación extranjera).

As indicated in the previous section, Mexico does not have a green code but various entities issue standards that address specific aspects of sustainability in the built environment.

New Zealand

1. Synopsis

BUILDING REGULATORY SYSTEM

New Zealand's regulations and codes are straight forward. The Building Act is the basis of the Building Code, which contains most of the minimum codes, and of the Building Regulation. The regulation defines the roles of various participants in design and construction processes, and penalties, and the code documents design and construction standards and practices.

The Department of Building and Housing administers the act, regulation, and code. It engages members of professional organizations, academic institutions, private companies, and other ministries in development and review of the code and regulations. The act and regulation do not have to be updated on a periodical basis, but the code is reviewed frequently and revised when necessary. Public review is conducted regularly and the public may make suggestions about the code through the website for the code.

Town and city councils enforce the code enforcement (check, inspection, and certificate issuance). Councils are required to engage inspectors accredited by the Building Consent Authority (BCA) to carry out inspections and certifications. The Department of Building and Housing administers the accreditation program. Accredited inspectors can be employees of the councils or subcontractors. Punishment for code infringement is the responsibility of the Department.

REFERENCE STANDARDS

The code refers to standards mainly from the New Zealand and Australian standards agencies. Standards in New Zealand are regularly updated by New Zealand Standards, which is run by the government. The agency has procedures for standards addition, review, renewal, and removal, and these follow a three-year cycle. The code also refers to international standards published by various code and standards development organizations.

PATHWAYS TO GREEN: A CENTRAL GOVERNMENT APPROACH

The building code covers green features like energy efficiency, indoor air quality, prevention of the use of hazardous materials, and noise pollution. The Ministry of Education, Ministry of Health, and Ministry of Environment enforce regulations that add green standards to existing codes (e.g., water efficiency, air pollution, storm water management, green spaces). The green features are mostly driven by the ministries that handle the building codes and green features.

2. Code Development, Administration, and Enforcement

BUILDING REGULATIONS

The Department of Building and Housing of New Zealand manages and enforces building regulations. Building regulations are developed in accordance with the Building Act 2004. Sections 400-415 of the act cover the type of regulations that can be made and the development process. Building Regulations 1992, and amendments, were made under the Building Act 1991 but are now treated as if they were made under the 2004 act. The majority, however, were revoked on March 31, 2005, by the Building (Forms) Regulations 2004. The only part of the 1992 regulations still in force is Schedule 1 containing the Building Code. The act sets out the law on building work. The Building Code sets out performance standards that all new building work must meet. It covers structural stability, fire safety, access, moisture control, durability, services, and facilities, among other things. All new building work must comply with the Building Code.

BUILDING CODE

The Department of Building and Housing translates the Building Act into mandatory building code, develops the code itself, and develops the code compliance document and handbook. The compliance document provides detail on methodologies for meeting the standards specified in the code. This is the only code in New Zealand and every jurisdiction must comply with it.

BCA ACCREDITATION SCHEME

The codes are passed to the BCAs for enforcement. BCAs are legislated personnel who work for a jurisdiction or a private company to enforce the codes. They are distinct from licensed engineers, architects, and contractors; BCAs check on their works for conformance and compliance. The committee is responsible for regular updates and for getting feedback from the general public. The BCA accreditation and registration scheme is among a suite of Building Act 2004 reforms designed to improve the control of, and encourage better practice and performance in, building design, regulatory building control, and building construction.

REGIONAL ENFORCEMENT OF BUILDING CODE

The BCA scheme requires that any territorial authority or regional authority (council) carrying out building consent, inspection, and approval work be accredited by a building consent accreditation body (International Accreditation New Zealand [IANZ]) against the standards and criteria in the Building (Accreditation of Building Consent Authorities) Regulations 2006. The council must then be registered by the Department of Building and Housing against the standards and criteria in the Building (Registration of Building Consent Authorities) Regulations 2007. The Chief Executive of the Department of Building and Housing has appointed International Accreditation New Zealand (IANZ) the building consent accreditation body. Councils may contract others to undertake some or all of their BCA functions, but this does not relieve them of the requirement to be accredited and registered. Councils not wishing to

be accredited and registered as a BCA can transfer their functions to another accredited and registered council BCA, but their building control will still have to be administered by at least one BCA.

PRIVATIZATION OF BUILDING INSPECTION

The Building Act also enables private organizations to seek accreditation and registration as BCAs, but places considerable emphasis on ensuring adequate consumer protection before a private organization may be registered.

ACCREDITATION REASSESSMENTS

The Building Act requires accredited councils or private BCAs to undergo re-assessments at a frequency set by the Chief Executive of the Department by notice in the *New Zealand Gazette*. In summary, the jurisdictions have the additional responsibility of engaging an accredited BCA to inspect the building works.

CODE DEVELOPMENT

The Parliament passes law pertaining to building control. These acts are then translated into codes by the Building Industry Authority of New Zealand. The authority then sets up committees of industry practitioners, academics, and government officials to develop the codes, which are then reviewed by experts and the general public. The Department also holds workshops to get feedback on the code, and to provide training on code implementation.

REFERENCE STANDARDS

The Building Code refers to standards mainly from New Zealand and Australia. Relevant organizations include Standards New Zealand, Standards New Zealand and Australia, Australian Standards, and Building Research Agency of New Zealand (BRANZ). The code also refers to standards of ASTM International, the British Standards Institute (BSI), the Building Research Establishment (BRE), the National Fire Protection Association (NFPA) and, ASHRAE. The code also refers to various journals and conference proceedings.

GREEN FEATURES OF MANDATORY LAWS

The New Zealand building code contains provisions for energy efficiency, hazardous wastes, waste treatment, indoor air quality, and noise pollution reduction.

TYPES OF BUILDINGS

The code classifies building types into housing, communal residential, communal non-residential, commercial, industrial, outbuildings, and ancillary.

GREEN BUILDING FEATURES AND STANDARDS

The building codes cover energy efficiency, hazardous waste, indoor air quality, and noise pollution. Water quality and efficiency, and storm water quality management are enforced by the Ministry of Environment through several regulations.

Under the auspices of the Green Building Council (GBC), New Zealand has applied Australia's Green Star environmental rating system for buildings since 2006. The system considers a range of practices for reducing the environmental impact of buildings, showcases innovation in sustainable practices, and considers occupant health and productivity and cost savings. Buildings are scored in nine categories: management, indoor environment quality, energy, transport, water, materials, land use and ecology, emissions, and innovation. A four-star score of 45-59 signifies best practice in environmentally sustainable design and/or construction; a five-star score of 60-74 signifies 'Australian Excellence;' and a six-star score of 75-100 signifies "world leadership." The rating system is divided into office, interior, industrial, and education categories as well.

Green Star is voluntary and operates very similar to LEED. The GBC has at least two third-party assessors—seasoned industry experts—validate a project's submission and recommend a certified rating. It facilitates assessments to ensure that projects are assessed fairly and equally.

Building project teams submit up to 10 credits at an early stage of a project to ensure they are on the right track for certification. This review of sample documentation helps teams meet required standards and minimizes the amount work beyond the first round of assessment. When teams deliver their full submission, GBC conducts a pre-assessment check to ensure it is robust enough to send to assessors. They spot check five credits; if three have inconsistencies, the submission is returned for amendment. When the three credits are resubmitted, the submission is formally accepted and sent to assessors.

A project facilitator and two external assessors conduct further evaluation, and share their comments with the Accredited Professional responsible for the submission. Once the project has gone through a second assessment, the assessors recommend a rating to the Technical Subcommittee, which makes a final ruling. GBC contacts the building owner confirming the certified rating. Green Star is updated regularly by GBC volunteers.

Two other programs assist consumers in buying greener properties and homes. ConsumerBuild provides independent and up-to-date information about building, buying, renovating and maintaining houses in New Zealand. Smarter Homes is a one-stop information resource about making homes smarter and more sustainable.

3. Code Details

Electrical. The Electricity Act 1992 and the Electricity Regulation 1997 govern building-related electrical work. The Building Code has extensive provisions and requirements for electrical works. Electrical (Safety) Regulation 2010 is also mandatory for building design and construction. The regulation refers to the several electrical codes of practice (ECPs) (Energy Safety of New Zealand 2012). These include ECPs for the following:

- Electrical Safe Distances (NZECP 34:2001)

- Power Systems Earthing (NZECP 35:1993)
- Harmonic Levels (NZECP 36:1993)
- High Voltage Live Line Work (NZECP 46:2003)
- Repair and Maintenance of Domestic Electrical Appliances by the Owner of the Appliance (NZECP 50:2004)
- Homeowner/Occupier's Electrical Wiring Work in Domestic Installations (NZECP 51:2004)
- Installation of Recessed Luminaires and Auxiliary Equipment (NZECP 54:2001)
- Inspection, Testing and Certification of Low Voltage A.C. Railway Signalling Control Circuits (NZECP 60:1997).

Energy. Clause H1 of the Building Code establishes a verification method for energy efficiency compliance. It enforces mandatory standards in areas such as thermal envelope, air flow, water heaters, and passive daylighting design. Many of the codes refer to or enforce New Zealand standards, which are otherwise voluntary measures.

Water and Sanitation. Requirements for plumbing and sanitation are in Sections G12 (water supplies), G13 (foul water), and G14 (industrial liquid waste) of the Building Code. The Ministry of Health administers drinking water quality standards and enforces legislation on wastewater and sewerage water standards. These are translated into building standards and applied alongside the code's standards for water quality and foul water. The objective of this legislation is to remove contaminants from the water supply and from water discharged from buildings.

Water quality control in New Zealand has three aims: (1) control the water source (below and above ground); (2) control the quality of water suppliers; (3) control the storage and distribution of water. The first aim is governed by the Resource Management Act 1991, and the last by the Building Act 2004. This Act takes over responsibility for water once it leaves a public networked supply and enters the building-owner's property (usually at the water tap), and also applies to water distributed in a building from its own self-supply (e.g., a roof tank or bore).

The Ministry of the Environment manages and enforces wastewater and stormwater regulations. The Waste Minimisation Act 2008 governs the treatment of wastewater and stormwater. Guidelines and standards include the following:

- NZS 9201: Part 23-Model Trade Waste Bylaw
- Ministry of Works Guidelines for Oxidation Ponds 1974
- Ministry of Environment's Sustainable Wastewater Management: A handbook for smaller communities, and its Wastewater Monitoring Guideline.

Mechanical Systems. The minimum code related to mechanical systems can be found in Sections G4 (ventilation) and G5 (interior environment) of the Building Code and scattered in some other sections of the code.

Indoor Air Quality. Indoor air quality standards are mandatory and part of the Building Code. They can be found in Sections G4 (ventilation) and G5 (interior environment). NZS 4303-1990 (ventilation and

indoor air quality) is cited in the code. The Ministry of the Environment continues to study air quality but does not regulate indoor air quality. It requires the reporting of outside air quality. BRANZ developed the “Designing Quality Learning Spaces: Ventilation and Indoor Air Quality” guideline for the Ministry of Education. This guideline is the more comprehensive than any other published by the government. In addition, the guidelines also recommend methods to improve the quality of indoor air in education buildings. The Ministry of Education publishes the Ambient Air Guideline that partially addresses indoor air quality (NZ Ministry of the Environment, 2010; NZ Ministry of Education, 2002)

Lighting. Minimum requirements for lighting are Sections G6 (Natural Lighting) and G7 (Artificial Lighting) of the code.

Security. There is no security code in New Zealand.

Fire. Minimum fire standards are Building Code sections C, D1, D2, F1, F6, F7, and F8.

Structural. All structural requirements are in the Building Code.

Location, Siting, Zoning, and Environment. The Ministry of the Environment established the Urban Design Protocol to improve urban planning. It represents a voluntary commitment to specific design initiatives by signatory organizations, which include central and local governments, the property sector, design professionals, professional institutes, and others. The actions of signatories can make a significant difference in the quality of urban design in towns and cities, helping them become

- Competitive places that thrive economically and facilitate creativity and innovation;
- Liveable places that provide housing, work and lifestyle options;
- Healthy environments that sustain people and nature;
- Inclusive places that offer opportunities for all citizens;
- Distinctive places that have a strong identity and sense of place; and
- Well-governed places that have a shared vision and sense of direction.

The protocol identifies seven design qualities:

1. Context: seeing that buildings, places and spaces are part of the whole town or city.
2. Character: reflecting and enhancing the distinctive character, heritage and identity of our urban environment.
3. Choice: ensuring diversity and choice for people.
4. Connections: enhancing how different networks link together for people.
5. Creativity: encouraging innovative and imaginative solutions.
6. Custodianship: ensuring design is environmentally sustainable, safe and healthy.
7. Collaboration: communicating and sharing knowledge across sectors, professions and with communities.

In addition, under the Resource Management Act the Quality Planning Act covers air quality, climate change, coastal and marine areas, communities, consultation, culture and heritage, energy, enforcement, environmental monitoring and reporting, hazards, infrastructure, legislation, Maori and treaty, natural

environment, planning, regional information, resource consents, rural areas, sustainable development, tourism, urban areas, alternative transport, cities, density, housing, peri-urban areas, public spaces, residential areas, retail, subdivision, urban regeneration, urban amenity, urban community, urban design, urban development, urban growth, waste and water.

Safety. The Building Code contains a number of safety provisions. In addition, AS/NZS 4804:2001 provides guidelines on principles, systems, and supporting techniques for occupational health and safety management. Other relevant laws include the Health and Safety in Employment Act 1992 (HSE Act) and the Hazardous Substances and New Organisms Act 1996 (HSNO Act).

Peru

1. Synopsis³⁰

NATIONAL CODE

Peru is a constitutional republic with 25 regions and it has a national mandatory code, the National Building Regulation (*Reglamento Nacional de Edificaciones*, or RNE). The RNE is a prescriptive regulation containing 69 technical and design standards and engineering details. It has technical provisions for all types of buildings and establishes criteria for safety, functionality, health, and the environment. The RNE covers administrative requirements, the regulation of the conversion of rustic or rural areas to urban areas, and the regulation of all type of buildings, addressing standards and standards for architecture, structures, sanitation, and mechanical and electrical installations.

The Ministry of Housing, Construction, and Sanitation approves and issues the RNE; local governments implement it. The municipalities, which are equivalent to urban development departments or building departments, supervise the application of standards and enforce code compliance, carrying out technical inspections, administrative verifications (plan reviews), and overseeing project revisions as necessary. Public servants and municipal technical commissions verify compliance with the RNE's technical standards for urban habilitation and building projects. These commissions usually consist of delegates from professional schools and institutions (e.g., School of Engineers and Architects). Municipalities may form joint commissions when professional delegates are scarce. Input on code development and evolution comes from multiple sources: ministries, regulatory organizations, municipalities, construction companies, manufacturers, and professional schools.

REFERENCED STANDARDS³¹

The RNE is a compendium of regulations and mandatory standards issued by the National Directorate of Construction (DNC) of the Ministry of Housing, Construction and Sanitation. The technical standards in the RNE are developed and updated by the Ministry's Vice Ministry of Housing and Urbanization and the Vice Ministry of Construction and Sanitation. The DNC develops standards for building design and construction. The National Directorate of Sanitation (DNS) is responsible for the standards for sanitation

³⁰ This chapter benefitted from review by staff at the Dirección Nacional de Construcción, Ministerio de Vivienda, Construcción y Saneamiento.

³¹ Peru uses the term *norma voluntaria* or voluntary standard and *norma obligatoria* or mandatory standard. Voluntary standards are approved by the INDECOPI (Peruvian Technical Standards) and mandatory standards are issued by ministries, Congress, etc., and are approved by ministerial resolution, supreme decree, or law. The Ministry of Housing, Construction and Sanitation sets mandatory standards for the design and construction of buildings and urban premises.

works and sanitary installations. Standards approved by the DNC and DNS are taken to RNE's Permanent Commission of Updates. Voluntary standards are developed by Peru's National Institute for the Defense of Competition and the Protection of Intellectual Property (INDECOPI).

Under the Vice Ministry of Construction and Sanitation, the DNC formulates and proposes standards and procedures related to the development and construction of infrastructure. The DNC's methodology for developing standards calls for the wide involvement of topical specialists from the public and private sectors. The Organization Supervisor of Energy and Mine Investments, the Ministry of Health, and the Ministry of Education complement the RNE's technical standards with more specific design standards.

GREEN BUILDING CODES

Peru does not have a green rating system or a green building code, but various standards address sustainability in or green aspects of the built environment. The development of green/sustainable aspects of standards presents an opportunity for a developing a green building code. Consolidating current regulations and standards would be one step. A gap analysis identifying means and infrastructure for compliance would be another. Peru can learn and benefit from the experience of other economies.

2. Code Development, Administration, and Enforcement

Peru's national mandatory code, the National Building Regulation (*Reglamento Nacional de Edificaciones*, or RNE) is a prescriptive regulation containing 69 technical and design standards and engineering details. This study refers to the RNE of 2006. It can be accessed through <http://www.vivienda.gob.pe/dnc/normas.aspx>. The RNE has technical provisions for all types of buildings. A.70 is the standard for commercial buildings. The RNE establishes criteria for safety, functionality, health, and the environment.

REFERENCED STANDARDS

The RNE is a compendium of regulations and mandatory standards issued by the National Directorate of Construction (DNC) of the Ministry of Housing, Construction and Sanitation. The technical standards in the RNE are developed and updated by the Ministry's Vice Ministry of Housing and Urbanization and the Vice Ministry of Construction and Sanitation. The DNC develops standards for building design and construction. The National Directorate of Sanitation (DNS) is responsible for the standards of Titles II.3 (sanitation works) and III.3 (sanitary installations). Standards approved by the DNC and DNS are taken to RNE's Permanent Commission of Updates. Voluntary standards are developed by Peru's National Institute for the Defense of Competition and the Protection of Intellectual Property (INDECOPI). A list of some of these standards is provided in Section 3, below.

CODE DEVELOPMENT

The Ministry of Housing, Construction, and Sanitation approves and issues the RNE, which has three main “titles”:

1. **Generalities/General Aspects.** This title presents administrative requirements of the regulation.
2. **Urban Habilitation.** This title covers urban habilitation, which is the conversion of rustic and rural areas to urban premises.
3. **Buildings.** This title regulates all type of buildings, including commercial ones, addressing standards for architecture, structures, sanitation, and mechanical and electrical installations.

Under the Vice Ministry of Construction and Sanitation, the DNC formulates and proposes standards and procedures related to the development and construction of infrastructure.³² Each year, a ministerial resolution (currently No. 020-2013-Vivienda) assigns the DNC to modify the composition of the technical committees for standardization. Directorate Resolution No. 029-2008-Vivienda/VMCS-DNC, establishes a 6-step method for developing standards that involves public and private sector specialists:

1. **Identify aspects to standardize and gather data.** In this step, the DNC’s Director of Studies and Standardization examines new standards projects, identifying thematic areas that need to be standardized, and examines modifications or updates. Data are gathered at the same time. Working sessions involve at least three specialized professionals in the field being analyzed; these persons may not be part of the DNC or the Technical Committee on Standardization (TCS). In the working sessions these professionals are encouraged to prepare proposals on specific subjects, provide opinions, testify and articulate their positions, and facilitate the acquisition of technical information. At the end of this step, the Director develops objective language stating the need for a standard, or a standards modification or update, providing the specific information. It also identifies and proposes to the DNC the structure of the TCS.
2. **Establish a technical committee of standardization.** DNC invites public and private experts in the subject to be standardized to be a part of the TCS.
3. **Evaluation by the committee.** The TCS examines the information collected by the Director of Studies and Standardization in accordance with certain rules.³³ On the basis of TCS input and discussions, the Director creates Standard Project Version 01, which the TCS then approves.
4. **Consultation with a Limited Group.** The Standard Project Version 01 is sent to a small group of people, who study and comment on the project over a period not to exceed 15 days. This group should consist of (a) professionals who participated in step 1, (b) private and public sector entities that did not participate in the TCS but who are involved in activities related to the subject, and (c) consultants and specialists. The TCS considers their comments and decides on any changes; this results in Standard Project version 02.

³² This function was assigned under Resolution 029-2008-Vivienda, of 2008, the Regulation of Organization and Functions of the Ministry of Housing, Construction and Sanitation. Decree 002-2012-Vivienda, approves the regulation of organization and functions of the ministry.

³³ The provisions for the Functionality of the TCS, approved by a Directorate Resolution No. 017-2008-VIVIENDA/VMCS-DNC.

5. **Public Consultation.** Standard Project 02 is then placed on the website of the Ministry of Housing, Construction and Sanitation for about 15 days for public review and comment.
6. **Final Revisions.** TCS then produces Standard Project Version 03 and sends it to the Vice Ministry of Construction and Sanitation for its paperwork (new standard projects and modifications of standards that are not part of the technical standards of the RNE) or to the Permanent Commission of Actualization of the RNE.

The Organization Supervisor of Energy and Mine Investments (OSINERGMIN), the Ministry of Health, and the Ministry of Education complement the RNE’s technical standards with more specific design standards. Local governments supervise compliance with the code. On matters related to gas, the authority on code compliance is OSINERGMIN.

CODE ADMINISTRATION AND ENFORCEMENT

The RNE is a normative document of national application. Municipalities, which are equivalent to urban development departments or building departments, supervise the application of the standards and enforce code compliance, carrying out technical inspections, administrative verifications (plan reviews), and overseeing project revisions as necessary. Chapter 4 of Title I of the RNE lists all the responsibilities of municipalities.

Local governments develop municipal ordinances. At the design level, the “Certificate of Urban Parameters” is the most important document because it defines all aspects of what is to be built including number of parking lots per building, streets and avenues of the district.

The RNE aims to regulate criteria and minimum requirements for the design and construction of urban habitations and buildings (including commercial ones). The Ministry of Housing and Sanitation administers the code, but implementation is by local government. Public servants and municipal technical commissions verify compliance with the RNE’s technical standards for urban habilitation and building projects. These commissions usually consist of delegates from professional schools and institutions. In the absence of such delegates for a municipality, neighboring municipalities can agree to form joint commissions.

Municipalities should:

- Have planning tools that allow them to define urban and building parameters.
- Make available to the general public technical tools for planning and building and administrative tools for urban habilitation and buildings.
- Expedite and simplify administrative processes for building permits. To do this, they should have professionals carry out technical and administrative functions. They can also delegate this to third party.
- Issue the certificate of urban and building parameters.
- Suspend authorization for the execution of work.
- Designate municipal technical inspectors to carry out urban control.

- Have qualified professionals inspect and verify the compliance of approved works in their jurisdictions.
- Confirm that projects have followed approved plans and specifications, and when they do, provide certification of work finalization and certificates of occupancy.
- Order and execute partial or total demolition of works not in accordance with approved project.
- Maintain public space.
- Supervise adequate use and maintenance of buildings.

Overall, municipalities are responsible for compliance with the RNE. By law (*Ley Organica de Municipalidades*), they are responsible for approving projects, supervising construction, and verifying maintenance.

GREEN BUILDING CODES

Peru does not have a green rating system or a green building code, but various mandatory and voluntary standards address sustainability in or green aspects of the built environment. These are detailed in the section below. The development of green/sustainable aspects of standards presents an opportunity for a developing a green building code. Consolidating current regulations and standards would be one step. A gap analysis identifying means and infrastructure for compliance would be another. Peru can learn and benefit from the experience of other economies.

3. Code Details

MINIMUM CRITERIA

Minimum code criteria are established on the basis of the mandatory standards developed by the Ministry of Housing, Construction, and Sanitation and the voluntary standards of INDECOPI.

Electrical.

- National Electric Code – Supply (2001)
- National Electric Code – Use (2006)
- Modifications to the National Electric Code –Use (2008)

HVAC or Mechanical Codes. There is no mandatory mechanical code.

Energy Efficiency. There are 47 voluntary standards for energy efficiency (*normas técnicas Peruanas – NTP*) up to December 2012 (see the attached list).

- Promotion of Energy Efficient Use Law (Law 27345)
- Promotion of Energy Efficient Use Bylaw (Supreme Decree 053-2007-EM)
- Energy saving measures in public sector (Supreme Decree 034-2008-EM)

- Energy consumption indicators and monitoring methodology (Ministerial Decree 038-2009-EM/DM)
- Energy Efficient Use Referential Plan 2009 –2018 (Ministerial Decree 496-2009-EM/DM)
- Renewable Energy
 - Standard Em.080 Energía Solar
 - Standards EM 090 Energía Eólica
- Investment Promotion of Energy Generation with Renewable Energy Law (Law 1002)
- Energy Generation with Renewable Energy Bylaw (Supreme Decree 050-2008-EM)

Water.

- Title II.3 of the RNE
- Sanitation Works (Obras de Saneamiento—OS) Standards
 - OS.010 Capture and conveyance of water for human consumption human
 - OS.020 Water treatment plants for human consumption
 - OS.030 Water Storage for Human Consumption
 - OS.040 Pumping stations for drinking water
 - OS.050 Distribution networks for drinking water
 - OS.060 Urban storm drainage
 - OS.070 Sewage Nets
 - OS.080 Pumping stations for wastewater
 - OS.090 wastewater treatment plants
 - OS.100 Basic design considerations of sanitary infrastructure

Sanitation (instalaciones sanitarias)

- Title III.3 of the RNE
- IS.010 Sanitary Installations for Buildings
- IS.020 Septic Tanks

Structural and Construction Materials

- Title III.2 of the RNE
- E.010 Wood
- E.020 Loads
- E.030 Seismic Resistant Design – currently under revision
- E.040 Glass
- E.050 Soil and Foundation – currently under revision
- E.060 Reinforced Concrete
- E.070 Masonry
- E.080 Adobe
- E.090 Steel Structures

Mechanical and Installation Systems.

- Title III.4 Instalaciones Eléctricas y Mecánicas (EM)
- EM.010 Interior Electric Installations
- EM.020 Communication Installations

- EM.030 Ventilation Installations
- EM.040 Gas Installations
- EM.050 Air Conditioning Installation
- EM.060 Fireplaces
- EM.070 Mechanical Transportation
- EM.080 Solar Energy Installations
- EM.090 Wind Energy Installations
- EM.100 High Risk Installations

Standards under Development.

Currently, the following standards are under development or are being revised:

- Architectural
- A.030 Lodging
- E.050 Soils and Foundations
- E.030 Seismic Resistant Design
- EM 110 Energy Efficient Thermic and Light Fittings

Standards to be updated in 2013

- General Considerations (G)
- G.050 Safety during Construction
- EM 020 Communication Installations

Voluntary Standards of INDECOPI: Normas Técnicas Peruanas (NTP) Aprobadas

01 NTP IEC 60034-2:2001 Máquinas Eléctricas Rotativas. Métodos de Ensayo

02 NTP IEC 60034-2/A2 Addenda 2 Máquinas Eléctricas Rotativas. Métodos de Ensayo (Parte 2)

03 NTP 399.450.2003 Eficiencia Energética de motores tipo jaula de ardilla. Límites y Etiquetado.

Motores Eléctricos

04 NTP 399.450:2008 (Eficiencia energética de motores de corriente alterna, trifásicos, de inducción, tipo jaula de ardilla, de propósito general, potencia nominal de 0,746 kW a 149,2 kW. Límites y Etiquetado.

05 NTP 350.300.2002 Calderas Industriales. Procedimiento determinación de eficiencia energética.

06 NTP 350.301.2004 Calderas Industriales. Niveles mínimos de eficiencia térmica.

07 NTP 350.300:2008 Calderas Industriales. Procedimiento para la determinación de la eficiencia térmica de calderas industriales.

08 NTP 350.301:2008 Calderas Industriales. Estándares de eficiencia térmica (combustible/vapor) y etiquetado.

Calderas Industriales

09 NTP 350.302:2009 Eficiencia Energética. Calderas industriales. Proyecto de instalación de calderas con reducción de emisiones. Requisitos básicos.

10 NTP ISO 7371:2002 Refrigeradores con o sin compartimiento de alimentos de baja temperatura. Característica y métodos de ensayo.

11 NTP ISO 8561:2003 Artefactos de almacenamiento de alimentos congelados y congeladores de alimentos. Características y métodos de ensayo.

12 NTP 399.483 2007 Eficiencia energética en artefactos refrigeradores, refrigeradores-congeladores y congeladores para uso doméstico

Refrigeración

13 NTP ISO 5155:2007 Artefactos de Refrigeración Domésticos. Artefactos para almacenamiento de alimentos congelados y congeladores. Características y métodos de ensayo.

14 NTP 399.400.2001 Colectores solares. Métodos de ensayo para determinar la eficiencia.

15 NTP 399.403.2006 Sistemas Fotovoltaicos hasta 500 Wp. Especificaciones técnicas y método para calificación energética.

16 NTP 399.404.2006 Sistemas de Calentamiento de Agua con Energía Solar. Fundamentos para su dimensionamiento eficiente.

17 NTP 399.482.2007 Sistemas de Calentamiento de Agua con Energía Solar. Procedimiento para su instalación eficiente.

18 NTP 399.405:2007 Sistemas de Calentamiento de Agua con Energía Solar. Definición y pronóstico anual de su rendimiento mediante ensayos en exterior.

Sistemas Solares

19 NTP 399.484:2008 Sistemas de calentamiento de agua con energía solar (SCAES). Límites y Etiquetado.

20 NTP 370.100.2000 Lámparas Fluorescentes compactas (LFCs). Definiciones, requisitos y rotulado.

21 NTP 370.101.2003 Etiquetado de eficiencia energética para lámparas de uso doméstico.

22 NTP IEC 60921.2005 Balastos para lámparas fluorescentes tubulares. Requerimiento de funcionamiento.

23 NTP IEC 61347-1.2006 Dispositivos de control de lámpara. Parte 1: Requisitos generales y requisitos de seguridad.

24 NTP IEC 61347-2-8.2006 Dispositivos de control de lámpara. Parte 2-8: Requisitos particulares para balastos para lámparas fluorescentes.

25 NTP IEC 61347-2-9.2006 Dispositivos de control de lámpara. Parte 2-9: Requisitos particulares para balastos para lámparas de descarga (excepto lámparas fluorescentes).

Iluminación

26 NTP IEC 60923.2006 Auxiliares para lámparas. Balastos para lámparas de descarga (excluyendo las lámparas fluorescentes tubulares). Requerimientos de funcionamiento. SUB-COMITÉ Item Id de Norma NOMBRE DE LA NORMA

27 NTP IEC 50294.2006 Método de medida de la potencia total de entrada de los circuitos balastos-lámparas.

28 NTP IEC 61347-2-3.2007 Dispositivos de control de lámpara. Parte 2-3: Requisitos particulares para balastos electrónicos alimentados en corriente alterna para lámparas fluorescentes.

29 NTP IEC 60598-2-22.2007 Luminarias. Parte 2-22: Requisitos particulares. Luminarias para alumbrado de emergencia.

30 NTP IEC 60929-2007 Balastos electrónicos alimentados en corriente alterna para lámparas fluorescentes tubulares. Requisitos de funcionamiento. Primera Edición

31 NTP IEC 60155 2008 Arrancadores de encendido para lámparas fluorescentes

32 NTP IEC 61347-2-1: 2008 Dispositivos de control de lámpara. Parte 2-1: Requisitos particulares para ignitores (excepto arrancadores para lámparas fluorescentes)

33 NTP IEC 61048:2008 Auxiliares para lámparas. Condensadores para uso en los circuitos de lámparas fluorescentes tubulares y otras lámparas de descarga. Requerimientos generales y seguridad

34 NTP IEC 61049:2008 Condensadores para usar en lámparas fluorescentes tubulares y otros circuitos de lámparas de descarga. Requerimientos de desempeño

35 NTP 370.102:2008 Dispositivos de control de lámpara. Balastos para lámparas fluorescentes – Sistema de Codificación Energética

36 NTP 370.100:2008 Uso Racional de Energía. Lámparas fluorescentes compactas integradas (LFCIs) –Definiciones, requisitos y rotulado.

37 NTP 370.101-1:2008 Etiquetado de eficiencia energética para lámparas incandescentes y similares de uso doméstico.

38 NTP 370.101-2:2008 Etiquetado de eficiencia energética para lámparas fluorescentes compactas, circulares, lineales y similares de uso doméstico.

39 NTP IEC 60969:2008 Lámparas Fluorescentes Compactas Integradas para Servicios Generales de Iluminación. Requerimientos de Funcionamiento.

40 NTP IEC 60064:2009 Lámparas de filamento de wolframio para uso doméstico y alumbrado general similar. Requisitos de funcionamiento

41 NTP IEC 60081 2009 Lámparas Fluorescentes de Doble Casquillo – Requisitos de Funcionamiento.

42 NTP IEC 60379.2006 Métodos para medir eficiencia de calentadores de agua eléctricos de acumulación para uso doméstico.

43 NTP 370.500.2007 Artefactos de Gas. Gases normales de ensayo. Terminología. Clasificación y Especificaciones.

44 NTP 370.501.2008 Artefactos a Gas – Metodología para determinar la eficiencia de calentadores de agua por paso continuo que utilizan combustibles gaseosos

45 NTP 370.502:2009 Eficiencia energética en calentadores de agua eléctricos tipo con tanque de almacenamiento para propósitos domésticos. Rangos de eficiencia y etiquetado.

46 NTP 370.503:2009 Artefactos a Gas. Estándares de eficiencia y etiquetado de calentadores de agua por paso continuo que utilizan combustibles gaseosos

Calentadores de Agua

47 NTP 370.504:2009 Eficiencia Energética. Artefactos eléctricos fijos de calentamiento instantáneo de agua para uso doméstico. Clasificación del consumo energético y etiquetado

GREEN BUILDING CODES

Various standards address sustainability in or green aspects of the built environment. These include EM.080 (on solar energy installations), EM.090 (on wind energy installations), and EM 110 (energy efficient thermic and light fittings), which will unify codes for building envelope that are currently dispersed in national standards or that are lacking in the overall building regulatory framework. The following are INDECOPI's standards on environmental management and life cycle management:

- NTP ISO 14040:1998 (principles and framework)
- NTP ISO 14041:1999 (goal and scope definition and inventory analysis)
- NTP ISO 14042:2001 (life cycle impact assessment)

The Philippines

1. Synopsis

CODE DEVELOPMENT AND ADMINISTRATION

The Philippines takes a centralized approach to code development and administration. The Central Government has full control over code development, administration, and enforcement, through the Secretary of Public Works, Transportation and Communication, and other agencies. The Secretary appoints consultants to review and revise the codes and determines the time period for revision. Municipalities enforce the codes, providing inspection services and issuing permits and certificates. Building officials appointed by the Secretary of Public Works conduct building inspections and issue permits. Any laws are passed by the Senate and House, before the Secretary converts them into enforceable codes.

REFERENCE STANDARDS

The Building Code of Philippines references the Philippines National Standards (PNS) and other international standards.. The Bureau of Product Standards administers the national standards, maintains international standards that are used in and/or affect the economy of the Philippines, and establishes an expert panel to review the standards every three to five years. Members of the expert panel are engaged as consultants and work alongside Bureau employees.

PATHWAYS TO GREEN: BETTER BUILDING PERFORMANCE

There is no mandatory green building code in Philippines, and there is no green feature in the mandatory codes. Efforts to go green lie mainly with the government. There are government efforts to develop mandatory green building codes, and there are several bills in the Senate waiting to be passed. The Central Government and local governments have developed programs and policies to encourage the use of green features in buildings

2. Code Development, Administration, and Enforcement

CODE DEVELOPMENT AND ADMINISTRATION

The National Building Code of the Philippines is the mandatory building code used in the Philippines. It is administered and enforced by the Secretary of Public Works, Transportation and Communication. The Secretary (1) formulates, issues, promulgates, and evaluates, policies, plans, standards, and guidelines pertaining to building design and construction; (2) evaluates, take actions on, and approves codes or the incorporation of standards, guidelines, and information into the codes; and (3), prescribe fee schedules for building code enforcement. The development, review, and revision of the code are carried out by professionals employed by the Department of Public Works, Transportation and Communication's laboratories and engineering/design sections. The Secretary also engages consultants from other government agencies and private consultants to administer, develop, review, and revise codes and standards. The consultants are selected for their expertise.

CODE ADOPTION AND ENFORCEMENT

Any municipal government with annual revenue of more than Peso 2.99 million (about US\$74,000) is required to comply with the code. While the Philippines is organized into provinces, cities, municipalities, and barangays, enforcement of the code (plan checking, inspection, and issuance of permits and certificates) is the responsibility of the municipality and its municipal government. Low-income municipal governments that chose to enforce the code receive aid from the Philippines Government.

BUILDING OFFICIALS

The Secretary of Public Works, Transportation and Communication designates building officials, and may designate district engineers, city engineers and municipal engineers to be building officials. Building officials enforce the code. Most are mostly public employees but can also be private sector employees. The Secretary has the authority to designate private sector officials.

REFERENCE STANDARDS

The Building Code of Philippines references other national codes, such as the National Electrical Code, National Structural Code, and National Mechanical Code. The codes reference standards from the Philippines National Standards (PNS), ASTM International, ASHRAE, and American Concrete Institute, International Association of Plumbing and Mechanical Officials, ISO, and the American Society for Safety Engineers. Most of these codes reference North American and European codes and standards development organizations.

The Bureau of Product Standards administers the national standards, maintains international standards that are used in and/or affect the economy of the Philippines, and establishes an expert panel to review the standards every three to five years. Members of the expert panel are engaged as consultants and work alongside Bureau employees.

GREEN FEATURES OF THE MANDATORY CODES

There is no green feature in the mandatory codes.

TYPES OF BUILDINGS

The code covers buildings by material type: wood, wood with some fire-resistant materials, masonry and wood, and iron, steel, concrete and masonry construction. It also covers them by use: Group A—Residential dwellings; Group B—Residential, Hotels, and Apartments; Group C—Education and Recreations; Group D—Institutional; Group E—Business and Mercantile; Group F—Financial; Group G—Storage and Hazardous; Group H—Assembly; Group I—Large Assembly; and Group J—Accessory (parking, garages, and tanks).

3. Code Details

MINIMUM CODES

Electrical. The Philippines Electrical Code is a mandatory code. Chapter 13, Rule IX, NBC Memorandum Order 77-4 of the National Building Code states the enforcement of the electrical code. The electrical code references mostly North American standards (e.g., NFPA 262, NFPA 70E, ANSI Z535.4, IEEE 142-1991, IEEE 62.1, ASHRAE 15, ASHRAE Handbook on Fundamentals).

Energy. The Philippines National Building Code contains only voluntary standards on energy efficiency for building shells, lighting, HVAC, and water heating. Such information cannot be found in the actual code. The PNS do have standards for energy efficiency but they are not mandatory (IEEJ 2010).

The Philippines Government launched the National Energy Efficiency and Conservation Program (NEECP) in 2004 to promote energy efficiency and conservation throughout the economy. The program is administered by the Department of Energy. There are plans to incorporate energy efficiency and conservation practices in all sectors of the economy by 2014. The program has had success in developing and elaborating appliance and equipment energy standards and labeling implementation of building energy usage standards, and has not yet started on the development of energy efficiency standards for building.

Water and Sanitation. The Philippines has two mandatory sanitation codes, the Civil Code of the Philippines on Property, Ownership and the National Sanitation Code of the Philippine (PD 856). The Plumbing Code of the Philippines is the mandatory plumbing code. The Clean Water Act (covering water quality, sanitation and sewerage treatment generated by buildings), and the Water Code are the two mandatory codes pertaining to water in the Philippines.

Mechanical Systems. The Philippines Mechanical Code is mandatory. It references standards from the Philippines and from North American and European codes and standards organizations.

Indoor Air Quality. The National Building Code has a section on light and ventilation but nothing on indoor air quality, just minimum air ventilation in buildings. The Clean Air Act of the Department of Environment and Natural Resources (Environmental Management Bureau) includes national emission standards for source specific air pollutants (NESSAP) and national ambient air quality standards (NAAQS).

Lighting. The Philippine National Energy Efficiency and Conservation Program has developed labeling for energy efficiency of lighting, and lighting equipment.

Security. There is no mandatory security code in Philippines.

Fire. The National Building Code has extensive fire design requirements and standards.

Structural. The Board of Civil Engineering of the Professional Regulation Commission's National Structural Code is the mandatory structural code in the Philippines. The code references ASTM International, American Concrete Institute Standards, and the PNS.

Location/Siting/Zoning and Environment. Pollution Control Decree of 1978 (Presidential Decree 984) is a national policy to prevent, abate, and control pollution of water, air, and land. It is administered by the Environmental Management of the Bureau Department of Environment and Natural Resources (DENR). The Toxic Substances, Hazardous and Nuclear Wastes Control Act of 1990 (RA 6969) is implemented by DENR through Administrative Order No. 29 of 1992. That order provides guidelines for implementation of Title II toxic chemical substances and Title III hazardous and nuclear wastes. The Ecological Solid Wastes Management Act of 2000 (RA 9003) provides for an ecological solid wastes management program, creates the necessary institutional mechanism and incentives, prohibits certain acts, and provides penalties and appropriate funds thereof and for other purposes.

Safety. The National Building Code addresses safety during construction; the safety of electrical and mechanical systems and of dangerous buildings; fire safety; emergencies; the appointment of safety officers; safety equipment; design for safety; explosives; and safety inspect.

GREEN BUILDING CODES

Green Features and Codes. There is no mandatory green building code in Philippines, and there is no green feature in the mandatory codes.

Plans to Establish Green Building Code. Efforts to develop mandatory green building codes in Philippines include the following:

- Senate Bill 2574: Act to create Green Building Code Commission to Draft the National Green Building Code.
- Senate Bill 1799: Act establishing a Green Energy for Homes and Buildings Program in the Department of Energy.
- Green Building Act (2009) requiring government buildings to follow green building practices and use environmentally responsible materials in its construction.

Local Green Regulations and Voluntary System. Quezon City has implemented the Green Roof Ordinance to encourage the use of green roof in the city. The Building for Ecologically Responsive Design Excellence (BERDE) system is a voluntary standard in the Philippine. It will, however, be mandatory for government buildings. Criteria include management of environmental performance of the building (throughout its life cycle), land use and ecology, water conservation and efficiency, energy efficiency, transportation, indoor environmental quality, materials and resources, waste management, heritage protection, and innovation. The current rating system covers new construction, building retrofitting, operations, and existing building; the future system will also cover education institutions, communities, and residential development. BERDE is only applicable to commercial and government buildings at this time. BERDE also trains and certifies professionals and assessors. Professionals are those who carry out work to attain the relevant credit from the system; assessors are those who verify, inspect, and certify projects.

BERDE standards are adapted from the following:

- American Society for Heating, Refrigerating, and Air-conditioning Engineers
- Chartered Institution of Building Services Engineers
- PD 859–Code of Sanitation of the Philippines
- National Fire Protection Agency
- National Structural Code of the Philippines
- Philippine Electrical Code
- Philippine Society of Mechanical Engineers Code
- Philippine Society of Ventilation
- Air-conditioning and Refrigeration Engineers Code
- National Building Code of the Philippines
- Fire Code of the Philippines
- International Standard Organization
- DOLE of the OSHA
- Philippine Environmental Code
- Environmental Impact Statement System
- National Integrated Protected Areas System Act
- Special Economic Zone Act
- Uniform Plumbing Code.

The BERDE website does not mention levels of certification as the rating system is still very new.

Singapore

1. Synopsis

Singapore's building regulatory system is very similar to Hong Kong's, Malaysia's, and Brunei's. Codes, standards and supporting standards, codes of practice, design manuals, design guidelines, and handbooks all support the enforcement of regulations and building acts.³⁴ None are mandatory if designers and engineers prove that they are using equivalent standards. Standards will become mandatory if a disaster occurs. The entire system relies heavily on the private sector to design well and independent private parties to check designs. Some codes are mandatory and enforced, such as the fire code, while others are voluntary and not enforced, such as the code of accessibility in the built environment.

All acts and some standards are legal requirements and enforced by designated government agencies for specific purposes (such as green building standards). The agency may impose a fine for failure to comply with the less critical mandatory codes (such as the codes related to water efficiency). Other punishments for noncompliance include withdrawal of licenses or delay in the issuance of permit. Compliance with some voluntary standards may result in financial and/or non-financial reward(s). Such standards are normally voluntary and are mandatory when companies choose to comply with them. Nonfinancial incentives include certifications and awards, and financial incentives include tax breaks. Recommended codes are not mandatory and an engineer or architect may choose to use similar codes from alternative sources. The chosen code becomes mandatory once the engineer or architect chooses it. For example, if a code requires the use of a particular Singapore Standard, an alternative equivalent may be used instead, at which point it becomes mandatory.

REFERENCE STANDARDS

Most of the building code of the Building and Construction Authority (BCA) is developed by the authority itself. Some BCA codes reference the Singapore Standards, British Standards, Australian and New Zealand Standards, Japanese Standards, American Standards, European Standards and Chinese Standards. Singapore, like Hong Kong, Malaysia and Brunei, allows the use of equivalent standards in place of the referenced standards in the regulations, codes of practices, etc.

GREEN FEATURES AND GREEN CODES

Green Mark is mandatory in Singapore even though it is a rating system. Its standards are therefore considered partly mandatory, while required standards are mandatory. Mandatory standards include the BCA code on envelope thermal performance on building, ASHRAE 90.1, AHRI 550/590, and various

³⁴ Codes in these economies may also mean codes of practice, which are akin to guidelines or best practices.

Green Mark standards for energy modeling, use, and ventilation. Green Mark also has standards not found in other standard documents. Other than the Republic of Korea, Singapore is the only other economy with a green building regulation or code.

2. Code Development, Administration, and Enforcement

ORGANIZATIONS

Building acts and regulations are part of Singapore's statutes or legislation passed by the parliament and are enforced by designated government agencies. The Building and Construction Authority (BCA) adopts, develops, manages, updates, and enforces codes, acts, and regulations related to building operation, maintenance, and construction. BCA works hand in hand with government agencies, SPRING Singapore, and the private sector to develop, manage and update codes. Regulations can also be enforced by other government agencies; for example the Civil Defense force enforces the fire code and the National Environment Agency enforces the code on environmental pollution. Amendments enforceable by BCA must be approved or passed by the parliament. BCA submits recommendations to the Ministry of National Development for drafting into amendments for acts; the Minister then presents the amendments to parliament for debate and to secure votes needed order to make the amendments into laws. BCA then converts the laws into codes for enforcement.

BCA administers and enforces most mandatory regulations while other agencies develop supporting codes. These agencies include the Singapore Civil Defense Force, the Singapore Police Force, the Urban Redevelopment Authority, Jurong Town Corporation, the Housing and Development Board, the Land Transport Authority, etc. The Internal Security Department, for example, developed the guideline for preventing terrorist attacks and BCA adopted it to help make buildings less vulnerable to attack.

STANDARDS ESTABLISHMENT

Singapore Standards (SS) are the de facto standards in Singapore. SPRING Singapore, a government agency, manages SS. It invites experts from academia, industry, and other government agencies to form committees for various standards. BCA selects and modifies SS for use in its building code, and often involves academia, industry, and public agencies in developing and modifying those codes.

SS can be replaced by an equivalent foreign standard if a company prefers. If the SS code is mandatory, then the foreign code becomes mandatory once it replaces the SS code. Committees are set up to develop, maintain, and manage the SS. These include committees on building and construction standards, on electrical and electronic standards, on energy standards, on environmental standards, and on general engineering and safety.

Companies are encouraged to adopt standards from other sources such as the ASTM International, BSI British Standards, German Institute for Standardization, Japanese Standards Association, and International Organization for Standardization (ISO). The BCA has also adopted standards from other economies such as China, Korea, and Australia.

BCA's Building Control Division handles development and enforcement of most minimum codes, standards, codes of practice, design guidelines, and best practices through three groups (Building and Construction Authority of Singapore 2012):

- The ***Building Plan and Management Group*** develops and enforces policies related to the design phase of a project, such as inspection and approval of architecture and engineering design, continuous checks on changes in design, licensing, building management and control, and building plan enforcement.
- The ***Building Engineering Group*** develops and enforces policies related the construction phase of a project and nonstructural elements, such as construction safety enforcement, steel and concrete construction inspection, deep excavation and geotechnical engineering design, strategic engineering projects (military or unique structures), and licensing.
- The ***Special Function Group*** develops and enforces policies related to shelters or elements that do not involve heavy civil and building engineering works, such as civil defense shelter, transit shelter, structures for noncritical elements, and coastal projects.

MANDATORY BUILDING CODES

Building Control Act. The Act covers the process of plan submission, design, inspection, and control in building design and construction, including the following:

- Design and construction of structural elements, including elements that support mechanical and plumbing services
- Installation and design of window air-conditioning units
- Temporary works during construction
- Temporary shelters during construction
- Underground and piling works
- All fuel run equipment onsite
- Site management plan
- Sanitation and drainage plan (storm water) plan
- Required testing of materials
- Ground anchor.

The Act is enforced by the Building Control Division. The Act approves the use of codes and standards recommended, issued, or adopted by the SPRING, the British Standards Institute, and any other standards organization or body approved by the Commissioner of Building Control. As of today, approved codes are often adopted from standards developed in Singapore, Britain, Australia, the United States, Canada, and most developed economies. The Act requires engineers and architects to adopt codes with which they are familiar and that are approved by the Commissioner of Building Control. Failure to comply with

cited codes is a punishable offense in Singapore. The Act was developed and is maintained by the Building Control Division and modifications must be approved by the parliament. (BCA A 2006)

Code of Accessibility in the Built Environment. BCA developed this code with the help of other agencies, local academic institutions, and private companies.³⁵ While the code is administered by the Building Control Division, its development and modification can be by any appointed group in the division and the Services Group. The code itself is a law and prescriptive in nature. It specifies the standards and rules with which each design needs to comply; the Building Control Division enforces the code by approving or disapproving designs. In some situations the code is not mandatory. (BCA D 2007)

Code of Practice on Buildable Design. This code of practice is administered by the Buildability Development Group (under the Building Control Division) and implemented by the Building Plan and Management Group, Building Engineering Group, and Special Functions Group. Projects have to achieve a certain buildability score in order to be approved. The code was developed by the National University of Singapore and Nanyang Technological University. Modifications and updates are regularly done by a committee of academics and representatives of BCA divisions/groups, other government agencies, and the private sector. (BCA E 2004)

Design Guide on Use of Alternative Steel Materials (BS 5950) and Explanatory Notes for BC1: 2008. This guide requires engineers and architects to meet strict requirements for the procurement, design, construction, and maintenance of steel materials. Engineers and architects must understand the manufacturing process, mechanical and chemical properties, and dimensional and mass tolerances of steel materials they use on their projects. They must inspect the origins of steel materials to ensure that the materials are tested according to their individual economy's standards, and passed the required tests and/or obtained the necessary certifications. The second part of the guide directs architects and engineers in the use and design of different elements and in welding methods. Engineers and architects are also required to report the carbon emissions of the steel and those resulting from their design. The standards in this design guide include the following:

- British Standards (BS) 5950 and other non-cited BS
- ASTM standards for structural steel (A36, 242, 501, 572, 588, 709, 792, 852, 875, 913, 945, 992, 1008, and 1011)
- American Plastic Institute (API) Standard API 5L
- Japanese Institute of Steel (JIS) Standards SM 490A, B & C, 490YA & YB, 520 B and C, SM 570, SMA 490 BW and BP
- Australia/New Zealand Standards (AS/NZS) for structural steel, series 3678, 3679, 1163, 1397 and 1595

³⁵ Key participants in this code's development and maintenance are as follows: Housing and Development Board, Land Transport Authority, National Parks Board, Urban Renewal Authority, Ministry of Community Development, National Council of Social Services, Handicaps Welfare Association, Singapore Association for the Visually Handicapped, the Society for the Physically Disabled, the Singapore Action Group for Elders, Asian Women's Welfare Association, Singapore Institute of Architects, Singapore Institute of Landscape Architects, and the Real Estate Developers' Association of Singapore.

- Chinese Standards (CS) on bolting.

Design approaches are also drawn from BS, ASTM, API, JIS, AS/NZS and CS. (BCA Academy 2008)

BCA Code on Envelope Thermal Performance for Buildings. The code prescribes minimum thermal transfer values for envelopes, roofs, and skylights. It is not an enforcement document but a tool to help architects comply with standards for envelope thermal performance found in the Building Control Regulations (Building Control Act). (BCA D 2001)

The code also prescribes measurement and modeling approaches, such as methods to calculate U-value, surface air film resistance, air space resistance, shading coefficient of sun shading devices, and solar correction methods. Architects and/or engineers must comply with the code and submit relevant documents to BCA, but BCA does not require certain minimum standards to be met unless the project is seeking Green Mark certification. This submission process is managed by the Building Control Division, while code development and management is by the Green Building Policy Group of the Technology Development Division. The code gets feedback from industry, and BCA often involves academia in updating the code.

Guide to High Strength Concrete to Singapore Standard CP65 (BC2:2008). This guide draws its standards from SS CP65. It is administered by the Building Control Division. (BCA Academy 2007).

Legislation on Air-conditioner Support. This legislation prescribes the method of designing air condition supports, the need for a licensed installer to carry out the work, and post-installation reporting procedures. It is enforced by BCA.

Legislation on Windows Safety. SS 212 is the standard required by this legislation, which also prescribes the use of a licensed contractor to install windows.

Public and Private Shelters. Standards for shelters are similar to structural standards. Shelter standards are managed by the Special Function Group of the Building Control Division.

Fire Code 2007 Master Version. The fire code is administered and enforced by the Singapore Civil Defense (SCD). The code includes SCD best practices, SS CP 2 (installation, operation, and maintenance of electrical passenger and goods life), SS CP 10 (fire alarm system), and SS CP 19 (evacuation lighting system). This is the only code that is very similar to the definition of codes in the United States, Canada, and Australia. (Singapore Civil Defense 2007).

Under the law, all designs and plans have to be approved by the Building Control Division. Designs and plans must be carried out by a qualified person (QP). An accredited checker (AC) double checks the work of the QP. Neither are employees of BCA. The BCA approves plans by relying on the signatures of AC and QP. BCA is only responsible to check if all designs comply with the standards.

VOLUNTARY BUILDING CODES

Because of some differences in the approach to and the application of building regulations, some BCA codes are not mandatory. BCA encourages industry to adopt all codes, mandatory or otherwise. Most codes, codes of practice, best practices, design guidelines, and handbooks are developed by BCA with the

help of academics from Singapore's two major universities. A committee of industry professionals and representatives of government agencies oversees the development of these codes. Over the years, some of the codes become mandatory.

Construction Quality Assessment System. Introduced in Singapore in 1989, CONQUAS is Singapore's system for assessing construction. It was developed by the BCA in collaboration with the two local universities, and others from the private and public sectors. It is periodically revised to keep pace with changes in technology and the demands of a more sophisticated population. In 1998, BCA introduced new features that made the scoring system more comprehensive and customer oriented. The code does not reference any other codes and standards. Contractors who comply with CONQUAS standards are rewarded with a certificate and the contractor with the highest score wins the CONQUAS award for the year. (BCA 2010)

Crime Prevention through Environmental Design. CPTED is a code developed to prevent crime through better building design. The National Crime Prevention Council developed it with the BCA. The code is regularly updated and not enforced by any agency. (National Crime Prevention Council 2003).

Enhancing Building Security. This code was developed by BCA, the Singapore Civil Defense Force, Internal Security Department, and the Singapore Police Force to prevent terrorism in buildings. It does not cite any code or standards and provides detailed recommendations on building security. (Deputy Prime Minister of Singapore 2004).

REFERENCE STANDARDS

The majority of BCA building code is developed by the authority itself. Some codes reference the Singapore Standards, British Standards, Australian and New Zealand Standards, Japanese Standards, American Standards, European Standards and Chinese Standards. Singapore, like Hong Kong, Malaysia and Brunei, allows the use of equivalent standards where they meet the desired objectives.

GREEN FEATURES OF MANDATORY LAWS

There are many green features in the building regulations. Carbon emission reporting is required by the "Design Guide on Use of Alternative Steel Materials (BS 5950) and Explanatory Notes for BC1: 2008" and BC2:2008 (guide to high strength concrete to SS CP65), and is part of the Building Control Act. The BCA code on envelope thermal performance for buildings is in the Building Control Act. And the Act now mandates GreenMark, a green building rating tool that covers all green features.

TYPES OF BUILDINGS

Building codes are divided based on the type of building: o landed residential, high-rise residential, commercial, institutional, industrial, and public.s. BCA codes are applicable to all buildings constructed in Singapore regardless of type.

3. Code Details

MINIMUM CODES

Electrical. The Energy Market Authority (EMA) (EMA 2012), in conjunction with the BCA, manages the implementation of electrical codes of practice in Singapore. Codes adopted and developed by EMA include SS CP 5: 1998 (electrical installations), SS 531-1: 2006 (lighting of work places–indoor), SS 531-2: 2008 (lighting of work places–outdoor), SS 531-3 : 2008 (lighting requirements for safety and security of outdoor work places). The Energy Market Authority of Singapore Act and the Electricity Act mandate the use of these codes of practice. Other pertinent regulations are those for electrical workers, composition of offences, cable detection workers, contestable consumers (no. 2), and electrical installations.

Energy. The BCA code on envelope thermal performance for buildings is in the Building Control Act. The EMA manages the energy code of practice with BCA and the National Environment Agency (NEA) (NEA 2012). SS 530: 2006 (energy efficiency standard for building services and equipment) is the only energy code adopted by the BCA, NEA, and EMA. It is used for Green Mark certification.

Water/Sanitation. BCA and the Public Utility Board (PUB) enforce plumbing, water, and sanitation standards through the Building Control Act and Public Utility Board Act of Singapore. The mandatory codes of practices include PUB codes of practice on sewerage and sanitary works, and on surface water drainage, SS CP 48 (water services), and PUB ABC water design guidelines.

Mechanical Systems. BCA manages and maintains mechanical systems standards, and most of the mandatory standards have been included in the Building Control Act. The mandatory standards include SS 553: 2009 (air-conditioning and mechanical ventilation in buildings), BCA envelope thermal performance on building, ASHRAE guide on advanced energy design, AHRI 550/590 performance rating of water-chilling and heat pump water-heating packages using the vapor compression cycle, and ASHRAE 90.1.

Indoor Air Quality. SS 554 (indoor air quality for air-conditioned buildings) is a required standard for Green Mark, the green rating system now mandatory in Singapore.

Lighting. The following lighting standards are required for Green Mark compliance: SS 531-1: 2006 (lighting of work places–indoor), SS 531-2: 2008 (lighting of work places–outdoor), and SS 531-3: 2008 (lighting requirements for safety and security of outdoor work places).

Security. Enhancing Building Security is a code developed by the BCA, Singapore Civil Defense Force, Internal Security Department, and the Singapore Police Force to prevent terrorism in buildings. It does not cite any standards and provides detailed recommendations on building security. This code is not mandatory, codes are normally considered design guidelines.

Fire. The Singapore Civil Defense Force manages and enforces the fire code. The code integrates SCD best practices and the fire safety codes of practice from SS, such as SS CP 2 (installation, operation, and

maintenance of electrical passenger and goods lift), SS CP 10 (fire alarm system), and SS CP 19 (evacuation lighting system). This is the only code that carries the same definitions of code as in the United States, Canada, and Australia.

Safety. Safety standards are managed by different authorities. BCA manages construction and building safety regulations and standards. Mandatory codes of practice include SS CP 20 (suspended scaffolding), SS CP 45 (Halon 1301 fire protection systems), and SS CP 79 (safety management system for construction work sites). These codes become mandatory as they are included in the Building Control Act.

The Ministry of Manpower manages workplace safety standards. Codes of practices or standards are either adopted from SS or developed by the Workplace and Safety Health Council, which is appointed by the ministry. Mandatory codes of practices include MOM (working safely at height), MOM (WSH risk management), SS 98 (industrial safety helmets), SS 473 (personal eye-protectors), SS 508 (safety colors and safety signs), SS 510 (safety in welding and cutting), SS 513 (personal protective equipment), SS 531 (lighting of work places—indoor), SS 531 (lighting of work places—outdoor), SS 531 (lighting requirements for safety and security of outdoor work places), SS 536 (safe use of mobile cranes), SS 537 (safe use of machinery), SS 548 (selection, use, and maintenance of respiratory protective devices), SS 549 (selection, use, care and maintenance of hearing protectors), SS 550 (installation, operation and maintenance of electric passenger and goods lifts), SS 550 (installation, operation and maintenance of electric passenger and goods lifts), and SS506 (occupational safety and health management system).

Location/Siting/Zoning. The Urban Redevelopment Authority (URA 2012) manages zoning in Singapore. The master plan (2008) controls and manages land use in Singapore. The functions of URA include land use planning, development control, zoning, conservation, car park development authorization, and land sales (on behalf of the Singapore government). The master plan is not a code but a regulation determining the types of development acceptable in different areas in Singapore.

Environment. The National Environment Agency develops, manages, and enforces environmental codes hand in hand with the BCA. The agency develops these codes of practice and makes some reference to the Singapore Standards. These mandatory codes of practice cover environmental health, pollution control, control of legionella bacteria in cooling towers, and piped drinking water sampling and safety plans (NEA 2012).

GREEN BUILDING CODES

Green Mark and the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) are the two most popular rating systems in Singapore, though LEED has only a 2 percent market share. Since Green Mark is a mandatory system designed for the tropical climate most of the green buildings in Singapore are certified Green Mark. BCA launched Green Mark in January 2005 to promote sustainability in the built environment of the tropics (Singapore Green Mark 2012). As a benchmarking scheme it incorporates internationally recognized best practices in environmental design and performance. It has been revised three times; the 2013 version will incorporate carbon emission calculations. Green Mark certification can have a positive effect on corporate image and the leasing and resale value of buildings. The Green Mark scheme can

- Facilitate reduction in water and energy bills,
- Reduce potential environmental impact,
- Improve indoor environmental quality for a healthy and productive workplace, and
- Provide clear direction for continual improvement.

Rating Criteria

Green Mark is applied to the following building categories: new nonresidential, new residential, existing nonresidential, existing residential, landed houses, existing schools, new and existing parks, infrastructures, rapid transit systems, district, office interior, restaurant, data center, and retail projects. The Building Control Act (2008) Code (BCA A 2006) requires all new building works greater than 2000 m² to be Green Mark certified (achieve at least 50 points):

<u>Score</u>	<u>Rating</u>
90+	Platinum
85-89	Gold Plus
75-84	Gold
50-74	Certified

Projects that achieve higher ratings qualify for financial and other incentives. Standards adopted by Green Mark are considered mandatory only for certain recognition. Green Mark integrates codes of practice from SS, ASHRAE, and AHRI with codes that BCA develops with academia and industry. The codes specify performance standards beyond BCA's base codes (i.e., the Building Control Act). The following are Green Mark standards:

Required

- Energy saving (ASHRAE 90.1 and Green Mark standard)
- Heat transmittance through building envelope (BCA code on envelope thermal performance on building)
- Prescribed design system efficiency for building cooling system (AHRI 550/590 and Green Mark standard)

For Credit

- Air conditioning system (Green Mark standard, ASHRAE 90.1, SS 553, AHRI 550/590)
- Environmental management system (Green Mark Manager and Professional, ISO 14000 and CONQUAS)
- Green transport (Green Mark standard)
- Greenery (URA zoning and master plan, and National Park Board approvals)
- Indoor air quality (SS 554 and Green Mark standard)
- Irrigation system and landscaping (Green Mark standard, PUB code of practice on surface water drainage, and PUB ABC water design guidelines)
- Lighting (Green Mark standard, SS 531-1, SS 531-2, and SS 531-3)

- Mixed natural and ventilated (prescribed by Green Mark standard)
- Natural ventilation (prescribed by Green Mark standard)
- Noise control (SS 553)
- Other mechanical systems (lift, and energy efficient practices) (EEI of the BCA, Green Mark standard)
- Refrigerant (Montreal Protocol, SCDF Fire Code, and Building Control Act - Environmental Sustainability)
- Renewable energy (*Handbook for Photovoltaic Systems in Buildings*, and *Handbook for Solar Photovoltaic Systems*)
- Storm water management (SS CP 48; PUB ABC water design guidelines; PUB codes of practice for sewerage and sanitary works and for surface water drainage; NEA codes of practice for environmental health, for pollution control, for the control of legionella bacteria in cooling towers, and for piped drinking water sampling and safety plans)
- Sustainable materials and products (nonstructural--BCA sustainable architecture and material guide and Green Mark standard; structural--Green Mark standard, and relevant structural steel and concrete design standards)
- Thermal comfort (ASHRAE 90.1, SS 554, Green Mark standard, SS 553, AHRI 550/590)
- Water efficiency (Green Mark standard, PUB codes of practice for sewerage and sanitary work, and for the control of legionella bacteria in cooling towers; SS CP 48; PUB ABC water design guidelines)
- Other green features prescribed by Green Mark.

Even though there are only three required criteria, most of the standards adopted by Green Mark are mandatory as they are enforceable under the Building Control Act and other BCA codes. The voluntary codes relate to energy modeling methods (i.e., ASHRAE 90.1 and AHRI 550/590), construction quality (CONQUAS), quality management (ISO 14000), green materials, green transport, use of renewable energy, sustainable materials and products, noise pollution and control (SS 553), and lighting (SS 531-1, SS 531-2, and SS 531-3).

Monitoring, Reviewing, and Assessing

BCA is solely responsible for developing, monitoring, reviewing, and enforcing Green Mark. The scheme is managed by BCA's Technology Development Group, which also awards projects that achieve high scores. Green Mark is updated every two to four years, and more codes become mandatory at every update.

Compliance and Verification

Developers, building owners, and government agencies submit an application to BCA to register their interest in participating in the Green Mark scheme. BCA's assessment team meets with the project team or building management team to brief it on criteria and to obtain reports and documents that substantiate subsequent submissions. Actual assessment is conducted once the team is ready. The assessment entails

design and documentary reviews and site verification. Documentary evidence is submitted at the end of the assessment. A letter of award indicating certification level is then sent to the project team.

Some Green Mark standards require evidence of physical inspection and testing. For example, an inspector will go onsite to check compliance with CONQUAS standards, and physical tests of concrete and steel are required to check compliance with structural codes. Green Mark requires that documentation of this compliance be submitted as well.

Chinese Taipei

1. Synopsis

CENTRALIZED APPROACH TO ADMINISTRATION, COMPLIANCE, AND ENFORCEMENT

Chinese Taipei takes a centralized approach to the development, adoption, administration and enforcement of mandatory building regulations. The Construction and Planning Agency administers and enforces regulations through agencies under its control, and establishes committees to update codes. Committee members are recommended by various professional institutions, academic institutions, and government agencies.

REFERENCE STANDARDS

Laws and regulations do not cite particular standards, but recommend the use of relevant standards. Most standards in Chinese Taipei are provided by the Bureau of Standards, Metrology, and Inspection. All BSMI standards are mandatory in the economy.

GREEN FEATURES

Even though there is no mandatory building code in Chinese Taipei, green features like green outdoor space, pollution reduction, and the use of environmentally friendly materials have been added to the Building Act (Taiwan Today 2012). New regulations include the Building Energy Efficiency Policy (façade only), New Energy Policy of Chinese Taipei, and the Energy Management Law (Bureau of Energy 2012; Bureau of Energy (b) 2012). In addition to the Building Act, CPAMI also enforces the Waste Disposal Act, Resource Recycling Act, Air Pollution Control Act, and Noise Control Act. Though indoor air quality is not covered in the Building Act, protecting it is mandatory in Chinese Taipei. These regulations are also considered mandatory green features.

2. Code Development, Administration and Enforcement

The Construction and Planning Agency of the Ministry of the Interior (CPAMI) develops, administers, and enforces construction regulations in Chinese Taipei. Various departments of the Ministry of Construction also administer the regulations. The Housing Department administers and enforces the Housing Act. The Building and Construction Department administers and enforces the enforcement rule of the Architects Act, Construction Industry Act, Building Act, and Architects Act. The National Parks Department administers and enforces the National Park Law. The Urban Regeneration Department administers and enforces the Urban Renewal Act. The Public Works Department administers and enforces the Notes to Design Standards of Urban Roads and Accessory Works, Urban Road Act, and the enforcement rule for the Sewerage Law. Land development and building construction in new towns is administered and enforced by the New Town Construction Department under the Regulation of Use Control of Lands and Buildings in New Town, and New Town Development Act.

CPAMI has four offices (Secretariat, accounting, civil service ethics, and personnel), 14 divisions,³⁶ five temporary divisions for specific tasks,³⁷ and another four branches that handle planning, design and construction.³⁸ The Central Region office has four divisions (construction management, urban and rural planning, plan reviewing, and administrative management). Subordinate agencies include the headquarters for national parks (Kenting, Yushan, Yangmingshan, Taroko, Shei-Pa, Kinmen, Marine, Taijiang) and the Urban and Rural Development Branch. CPAMI is also responsible for the administrative tasks of various committees and commissions.³⁹ Other tasks include the following:

- Plan, review, and supervise national comprehensive development and regional plans.
- Review and supervise urban planning, urban regeneration, and new town development.
- Form, revise, and manage policies on housing, public housing, and subsidies.
- Plan, form, supervise, and manage national parks and metropolitan parks.

³⁶ The 14 divisions are as follows: Planning, urban planning, public housing, national parks, building administration, public works, building engineering, road engineering, environmental engineering, construction, planning administration, management administration, land administration, finance administration.

³⁷ The five temporary divisions are as follows: new town construction, urban regeneration, office of senior technician, information management, and public relations.

³⁸ The branches are as follows: Northern Engineering Office, Central Engineering Office, Southern Engineering Office, and the Sewerage System Office.

³⁹ Regional Plan Committee, Urban Planning Commission, National Park Planning Committee, Disciplinary Committee for Architects, Building Technology Review Committee, Negotiation and Direction Committee of Public Facility Reservation Land, Construction Fund Management Committee, Deliberation Committee of Urban Design in Danhai New Town and Kaohsiung New Town, Identifying Emblem to the Construction and Investment Industry Review Committee, Monument for Political Victim during the Period of Martial Law Committee, Promotion and Deliberation Committee of Broadband Channel Construction Project, Decreasing of Occupational Accidents Task Force, and Executive Yuan's Sinjhuang Office Building Committee.

- Supervise building administration, research and review building technologies and materials, and register and supervise architects.
- Supervise planning and construction of urban roads, parks, water supplies, and sewerage system and promote public and duct construction.

As indicated, all enforcement and engineering inspections are done by CPAMI. In addition, per regulations, all national standards relevant to design and construction must be met.

CODE ADOPTION AND EVOLUTION

CPAMI administers changes to regulations and adoption of standards and enforces codes through committees that also regularly review regulations. There is no fixed period for revising regulations, but reviews are conducted regularly to ensure regulations are updated. Committee members, who represent professional institutions, academic institutions, and government agencies, are invited to be on the committees. Membership changes every three to five years.

REFERENCE STANDARDS

Standards are administered by the government's Bureau of Standards, Metrology, and Inspection (BSMI). All international standards are converted into equivalent Chinese National Standards (CNS), and all standards are mandatory. The standards are updated as necessary.

GREEN FEATURES OF MANDATORY LAWS

Green outdoor space, pollution reduction, and the use of environmentally friendly materials have been added to the Building Act (Taiwan Today 2012). Building Energy Efficiency Policy (façade only), and New Energy Policy of Chinese Taipei, and the Energy Management Law are new regulations that will eventually affect the use of energy efficient façade, renewable energy use, and energy efficiency in buildings (Bureau of Energy 2012; Bureau of Energy (b) 2012).

In addition to the Building Act, CPAMI also enforces the Waste Disposal Act, Resource Recycling Act, Air Pollution Control Act, and Noise Control Act. Though indoor air quality is not covered in the Building Act, its protection is mandatory in Chinese Taipei. These regulations are also considered mandatory green features.

TYPES OF BUILDINGS

Building regulations divide building inspection and regulation enforcement into residential housing, commercial buildings, institutional building, civil and heavy infrastructures, and new town construction.

3. Code Details

MINIMUM CODES

Electrical. The Electricity Act is a mandatory regulation in Chinese Taipei (Law Database 2011).

Energy. The Building Act requires that all buildings meet building energy standards for air-conditioned nonresidential buildings, but the standards only cover façades. HVAC and lighting systems are proposed for inclusion in future editions of the Act. The following are also in the pipeline and may affect building energy use: Energy Management Law, New Energy Policy of Chinese Taipei, National Energy Conservation and Carbon Reduction Master Plan of Chinese Taipei. The Equipment Energy Efficiency Management and Promotion program encourages the use of energy efficient equipment in office buildings (Green Prospects Asia 2011).

Water and Sanitation. Plumbing and sanitation requirements are in the Building Act and Building Construction Act. Other pertinent regulations are the Sewerage Law, Enforcement Rule for Sewerage Act, Design Criteria for Common Duct, Enforcement Rules on Common Duct, Common Duct Act, and Sewer Engineering Guidelines (CPAMI 2012).

Mechanical Systems. There is no mandatory mechanical system regulation pertaining to buildings, even though there are mandatory regulations for equipment and systems used in buildings.

Indoor Air Quality. The Indoor Air Quality Act is a mandatory regulation in Chinese Taipei (R.O.C. Environmental Library 2011)

Lighting. There is no mandatory lighting regulation or code, but lighting standards may be mandatory per Bureau of Standards, Metrology, and Inspection.

Security. There is no mandatory standard for security.

Fire. Fire standards are included in Building Act and all relevant fire standards are published by the Bureau of Standards, Metrology, and Inspection.

Structural. The Seismic Design Code is also a required code in Chinese Taipei (Kenken Japan 2012).

Location/Siting/Zoning and Environment. All location, siting, and zoning laws and regulations are administered and enforced by the one of the agencies of the CPAMI. These laws and regulations include the National Park Law, Urban Renewal Act, Urban Road Act, New Town Development Act, Regulation on Use Control of Lands and Buildings within New Town Special Areas before Implementation of Overall Development, Enforcement of Regional Planning Act, Regional Planning Act, Enforcement Rules for the New Town Development Act, Wetland Protection, Urban Regeneration Projects, Waste Disposal Act, Resource Recycling Act, Air Pollution Control Act, Noise Control Act, Environmental Agents Control Act, Toxic Chemical Substances Control Act, Environmental Testing and Analysis, Green House Gas Reduction Act, and Soil and Groundwater Pollution Remediation Act (CPAMI 2012).

Safety. Mostly related to seismic design standards and fire codes.

GREEN BUILDING CODES AND GREEN FEATURES

Green Features and Regulations

Even though there is no mandatory building code in Chinese Taipei, green features like green outdoor space, pollution reduction, and the use of environmentally friendly materials have been added to the Building Act (Taiwan Today, 2012). Building Energy Efficiency Policy (façade only), and New Energy Policy of Chinese Taipei, and the Energy Management Law are new regulations that will eventually affect the use of energy efficient façade, renewable energy use, and energy efficiency in buildings. CPAMI also enforces the Waste Disposal Act, Resource Recycling Act, Air Pollution Control Act, and Noise Control Act. Though indoor air quality is not covered in the Building Act, its protection is mandatory. These regulations are also considered mandatory green features.

Green Building Rating Programs

The Green Building Label program is a rating tool operated by the Ministry of Interior's Building Research Institute. The criteria include

- Biodiversity (soil ecosystem, habitat, plant diversity, ecological network),
- Greenery (carbon absorption rate),
- Water content on site (infiltration and retention, storm water runoff management),
- Daily energy conservation (building envelope design ENVLOAD (20% higher than building regulation), and other techniques, including HVAC system, lighting, management system),
- CO₂ emission reduction (CO₂ emission of building materials (kg-CO₂/m²),
- Construction waste reduction (waste of soil, construction, destruction, use of recycled materials),
- Indoor environment (acoustics, illumination, and ventilation, interior finishing building materials),
- Water conservation (usage, hygienic instrument with water saving, grey water reuse), and
- Sewage and waste disposal facility improvement (sewer plumbing, sanitary condition for garbage gathering, compost).

The program offers multiple levels of certification (certified, bronze, silver, gold, diamond) in completed building and planning and design documentation. Certification entails technical review and label conferral. The label is valid for three years and can be renewed.

The Energy Smart Communities Initiative runs activities to help building professionals learn about green building standards. The Initiative runs a building performance rating system, develops publications and knowledge sharing platforms, and runs conferences and demonstration projects to educate professionals. The initiative plans to develop

- Green building and building material evaluation and labeling systems
- Green remodeling and HVAC projects

- Indoor environmental quality assessments and recycling building materials research and development promotion
- Green building training, education, promotion, design competition, and international exchange and cooperation
- Green building regulation and the development of the ecological community and sustainable city
- Living building challenge.

Thailand

1. Synopsis

BUILDING REGULATORY SYSTEM

Thailand does not use the code system with which the United States, Canada, and Australia are familiar, even though its latest regulation—the Building Energy Code—is named a code. Thailand’s building regulatory system is entirely top-down. Laws are made by the Central Government as Ministerial Regulations, and endorsed by the Royal Decree before being converted into enforcement and regulatory documents by agencies. The Building Control Bureau administers and enforces all building regulations, and the Ministry of the Natural Resources and Environment and the Ministry of Energy handles regulations on the environment, energy, and water.

The Bureau and responsible agencies administer regulatory review and revision. Ministries work closely with each other on review and revision, and involve building officials from local government, academics, and industry experts in the process. Procedures are established by the Bureau and responsible agencies.

Local governments are responsible for enforcing building regulations and issuing permits. The Building Control Bureau enforces regulations and issues permits in the Bangkok Metropolitan Area, even though it also has a local government.

REFERENCE STANDARDS

While most of the reference standards in the regulations are those of the Thai Industrial Standards Institute (TISI), relevant standards are also adopted from ASTM International, Uniform Building Code, American Concrete Institute, and various standard institutions around the world. Regulations contain technical information and enforcement languages .

The National Standards Act 2551 specifies the standards development procedure in Thailand. TISI works with standards institutions from around the world on standards. Standards are not mandatory until they are incorporated into ministerial regulations. Most draw from international codes and standards developing agencies, and the majority are published in Thai. The majority of Thailand standards are developed in Thailand by its own industry and academic experts

PATHWAYS TO GREEN: GOVERNMENT PROVIDES ALL DIRECTION

Thailand’s building control regulations have some green features (e.g., energy efficiency standards), while other green features are separate from the regulations and enforced by ministries (e.g., the Ministry of Natural Resources and Environment, Ministry of Energy). These features are the result of government efforts to “green” the Thailand’s construction industry and buildings. Many green standards were already

in use in the private sector before they appeared in regulations. The private sector also offers a more stringent Thai Rating of Energy and Environmental Sustainability (TREE).

2. Code Development, Administration, and Enforcement

Thailand does not use the code system with which the United States, Canada, and Australia are familiar. Its building control laws and regulations originate as ministerial regulations, and are passed by the parliament before a Royal Decree is issued to endorse the ministerial regulations. The completed ministerial regulations are known as Acts. These are then converted into enforceable regulations by the concerned government agency.

DEVELOPMENT AND ADMINISTRATION

Building Regulations of Thailand

Mandatory building codes in Thailand include the following:

- The Building Control Act (1975, amended 2006)
- Building Inspection Regulation
- Fire Safety Regulation for High-rise Buildings and Special Large Buildings
- Regulation on Fire Prevention for general buildings
- Regulation on Building Drainage Equipment
- Regulation on improvement of building in inappropriate safety condition
- Regulation on fire-resistant construction
- Regulation on seismic building design (administered by the Building Control Bureau of Department of Public Works and Town and City Planning, under the Ministry of Interior),
- Energy Conservation Promotion Act and Building Energy Code (administered by the Department of Energy).

Mandatory codes are applicable only in the Bangkok Metropolitan Municipality, districts under the Town Planning Act, and for any buildings larger than 1000 square meters or with more than 500 occupants (whichever is smaller). Provinces are required to adopt the regulations, and may introduce additional rules. Regional offices are set up to assist the provinces, municipalities, and cities. These codes are also applicable to all high-rise and large size buildings, theatres, and assemblies built in the specified regions.

Regulation Development, Review, and Revision

Ministerial regulations on building control are established under the Building Control Act. The Act and other pertinent acts are established jointly by several ministries. There are more than 200 ministerial regulations related to building control. The more important ones are as follows:

- (MR 6) Structural Design and Construction
- (MRs 48 and 56) Fire protection, Sanitary, Lighting and Ventilation
- (MR 58) Water and Waste Treatment
- (MR 49) Earthquake Resistance
- (MR 58) Mechanical Design
- (MR 55) Open Spaces, boundary, and Interval of Building Regulation
- (MR 57) Real Estate Recovery.

Building Inspection Regulation is only applied to building integrity, electrical works, fire safety, mechanical system, waste water, and structural works. The Building Control Act covers loading regulations, material regulations, design requirements and approaches, and construction documents (Technology Media of Thailand 2008; PWD Thailand 2012; PWD (b) 2012; PWD (c) Thailand 2012; DPT (Thailand) 2012; Ministry of Law (Thailand) 2012).

The Building Control Act was developed in 1975 and has been updated as necessary, most recently in 2006. There is no required time period to update the regulations. The Building Energy Conservation Act was developed in 1992 and was updated in 1995 to include the Building Energy Code and three other ministerial regulations. The code and regulations have not been updated since then because the government plans to adopt ASHRAE 90.1 as its energy code. Acts, regulations and codes are administered by ministries, and updated by committees of industry experts, academics and government officials.

Information in the Regulations. The regulations and acts are both technical and enforcement documents, and there is no code used in Thailand. They include all relevant technical information and reference TISI standards and other international standard and code development organizations.

Key Players. The Building Control Bureau of the Department of Public Works and Town and City Planning, and other relevant agencies, develop, review, and revise the regulations. Members of the review committees are usually officials from the department, bureau, and other agencies; building control officials from government branches and local governments; and invited industry experts.

Importance of the Royal Decree. The ministers are required to obtain Royal Decrees (i.e., endorsements) from the King of Thailand after the parliament passes the regulations into laws. Various ministry departments enforce the laws. For example, the Building Control Bureau of the Ministry of the Interior administers the Building Control Act and building inspection regulations, while the Energy Conservation Unit of the Ministry of Science, Technology, and Environment administers the Energy Conservation Act.

ENFORCEMENT

As discussed, local governments enforce the regulations in areas that do not fall under the control of the central government. Royal decrees must be declared (given) to the local authorities before they are allowed to enforce the regulations. Local governments normally enforce regulations through their own

building officials. The Building Control Bureau, along with the Governor of Bangkok, inspects buildings and issue permits for buildings in the Bangkok Metropolitan Area, while local governments inspect buildings and issue permits for the other areas.

Thailand's local governments include the Bangkok Governor, Mayor for the municipality, President of the Provincial Administration for the area in the Provincial Administration, Mayor of Pattaya City, and the President of a government organization (non-populated areas but controlled by government, such as nature reserve).

REFERENCE STANDARDS

While most of the reference standards in the regulations are those of the TISI, relevant standards are also adopted from ASTM International, Uniform Building Code, American Concrete Institute, and various standard institutions around the world. Regulations contain technical information and enforcement languages .

GREEN FEATURES OF MANDATORY LAWS

The Energy Conservation Promotion Act (1992) is a mandatory energy efficiency code. It includes three ministerial regulations. The first one prescribes the standards, criteria, and procedures for designated buildings. The second one prescribes forms and schedules for submitting data on energy consumption, energy conservation, criteria and procedures for recording energy consumption data, and installation or retrofitting of machinery or equipment that affect energy consumption and conservation. The third one prescribes criteria, procedures, and schedules for owners of designated buildings to establish energy conservation targets and plans in designated buildings as well as to assess and monitor the implementation of the plan.

Part of the Act includes the Building Energy Code. The code only applies to commercial and government buildings in the Bangkok Metropolitan Area and districts under the Thailand Provisional Authority. It was last updated in 1995. It covers building shell, HVAC, and lighting requirements. It is mandatory for all new construction; existing buildings were given three years to update and comply with the code by using 55 watts per square meter of floor area or less.

In 2002, Thailand began working on a new code based in part on ASHRAE 90.1, but nothing has been finalized. These regulations are considered part of the Building Control Act (1979, amended 2006) and are enforceable in the Bangkok Metropolitan Municipality and districts under the Thailand Provisional Authority. The Minister of Science, Technology, and Environment administer the acts, regulations and codes (UNESCAP 2007).

TYPES OF BUILDINGS

The codes cover only buildings taller than 23 meters and more than 10,000 square meters, buildings in the Bangkok Metropolitan Municipality, and districts under the Thailand Planning Act. Local governments are responsible for developing and enforcing their own codes. Buildings are divided into two types. Type 1 includes warehouses, hotels, condominiums, and hospitals. Type 2 includes (1) buildings that are used for commercial or business areas ranging from 80 square meters and above; (2) buildings with mill machinery from five horsepower and above; (3) study areas from 80 square meters and above; (4) older

buildings with more than 300 square meters of meeting space; and (5) office space with more than 300 square meters.

3. Code Details

MINIMUM CODES

Electrical. Mandatory standards covered by TISI (only Thai version available) are incorporated into the Building Control Act (1975, amended 2006).

Energy. The Building Energy Code of Thailand (under the Energy Conservation Promotion Act 1992) is the mandatory code in Thailand. In 2002, Thailand began working on a new code based in part on ASHRAE 90.1, but nothing has been finalized (S., P., Hien, Rugkwamsuk, & Kubaha 2007).

Water and Sanitation. Requirements for plumbing can be found in the Building Control Regulations. Other mandatory regulations include ministerial regulations on mechanical and sanitary design and on wastewater, and the guidelines of the Ministry of Natural Resources and Environment.

Mechanical Systems. The ministerial regulation on mechanical and sanitary design is mandatory in Thailand.

Indoor Air Quality. Indoor air quality is covered in the Building Energy Code. The standards cover off-gassing of particulates from chemicals and carpets in buildings, and the minimum standard for indoor air (carbon dioxide and carbon monoxide level).

Lighting. A mandatory lighting standard is included in the Building Energy Code (Royal Decree on Designated Building). The standard includes minimum and maximum lighting for different spaces, daylighting, and energy efficiency of light bulbs.

Security. There is no security regulation in Thailand.

Fire. Regulations can be found in the ministerial regulations on fire safety, the Building Control Act (2006), and the ministerial regulation on structural design.

Structural. The regulations and mandatory standards include the ministerial regulation on structural design, Building Control Act (1979), Engineering Institute of Thailand Standards, IBC, and ACI 318 – Building Code Requirements (all in Thai except ACI 381).

Location/Siting/Zoning and Environment. The regulation governing location and siting is the ministerial regulation on open space, boundary and building interval.

Environment Quality. The minimum environmental and standard in Thailand is the Promotion and Preservation Act B.E., 2535 (A.D. 1992). It is administered by the Minister of Science, Technology and Environment, and was published with the consent of the National Environment Committee and by approval of the Cabinet in September 1997. The Act designates a national environment board to oversee environmental protection in the whole of Thailand, and particularly in the province of Changwat. The board has the authority to develop plans and policy (for approval by the cabinet), prescribe environmental quality standards, set an approach for the Environmental Quality Management Plan and the Changwat Action Plan, make recommendations to the cabinets in respect to the financial, fiscal, taxation and investment measures of the policy and standards, and propose amendments or improvements to the laws. The board also acts as coordinator between various government agencies; supervises and oversees the enforcement, enactment, and approval of various bylaws; and submits reports on national environmental quality to the cabinets.

The Act covers standards such as water quality standards for catchment areas, rivers, and groundwater; atmospheric ambient air standards, ambient standards for noise and vibration; and various environmental quality standards. Some of the action plans include plans for control of pollution from point sources, wastewaters, waster matters, discharge, and various enforcement measures. The Act also prescribes land use limitations and measures for developments, and species protection. Together with the National Environment Board, the Pollution Control Department also regulates and publishes environmental codes and standards for water quality and management, air quality and noise, soil quality standards, waste utilization, hazardous materials, pollution management, and use and development of environmental technology (Ministry of Natural Resources and Environment 2012).

Safety. Mandatory safety standards are included in the Building Control Regulation.

GREEN BUILDING DEVELOPMENT IN THAILAND

Green Features and Laws

The Energy Conservation Promotion Act (1992) is a mandatory energy efficiency code. It includes three ministerial regulations. The first prescribes standards, criteria, and procedures for designated buildings. The second prescribes forms and schedules for submitting data on energy consumption, energy conservation, criteria and procedures for recording energy consumption data, and installation or retrofitting of machinery or equipment that affect energy consumption and conservation. The third prescribes criteria, procedures, and schedules for owners of designated buildings to establish energy conservation targets and plans in designated buildings as well as to assess and monitor the implementation of the plan.

Part of the Act includes the Building Energy Code. That code (Royal Decree on Designated Building 1995) is mandatory in the Bangkok Metropolitan area. It covers new and retrofitted buildings, system performance (envelop, lighting and air-conditioning), and whole building energy compliance. It specifies a minimum overall thermal transfer value (OTTV) for the following: building envelope, energy performance of lighting and air-conditioning, building design methods that enhance energy efficiency of building, energy conservation, energy modeling method, uses of day lighting, use of renewable energy, energy utilization of floor space, energy conservation potential, minimum performance of absorption

chillers, boilers and heat pump. In 2002, Thailand began working on a new code based in part on ASHRAE 90.1, but nothing has been finalized (S., P., Hien, Rugkwamsuk, & Kubaha 2007).

Water efficiency requirements are also green features introduced through the Ministry of Natural Resources and Environment. These requirements are not included in the Building Control Act.

Indoor air quality is included in the Building Code and thus is mandatory.

Various environmental protection and storm water management regulations are enforced by the Ministry of Natural Resources and Environment.

Voluntary Green Building Rating System

The Thai Green Building Institute (TGBI) launched the Thai Rating of Energy and Environmental Sustainability (TREE) system in 2012. Ratings are applied to new construction and existing buildings. Criteria include energy efficiency and atmosphere, water efficiency, site management and planning, indoor air quality, materials and resources, and innovation. Certification has four levels: platinum (61+ points), gold (46-60), silver (38-45), and certified (30-37). The documents are published in Thai (Thai Green Building Council 2012).

United States

1. Synopsis

The United States does not have a national building code. Individual jurisdictions, including states, counties, and cities, are responsible for developing, managing, and enforcing their own building codes. A building code becomes mandatory only when formally enacted by authorities, via laws, ordinances, regulations, or administrative orders. Processes for code development, adoption, and enactment vary widely among jurisdictions.

BOTTOM-UP APPROACH: FROM DEVELOPMENT TO ENFORCEMENT

The U.S. building control and regulatory system has four components: regulations, codes, model codes, and standards. Design criteria, design guidelines, rating systems, and specifications are used to guide industry practitioners to comply with codes and standards. Developing, maintaining, and updating complex building codes requires technical expertise and financial resources. The bottom-up approach adopted in the United States supports local jurisdictions by providing them with the mechanisms to develop building codes for enactment. The approach relies heavily on engaging stakeholders in the development of model building codes and voluntary consensus standards referenced in the model codes.

Regulation is the mechanism that is associated with the implementation of a legislative act passed by a legislative body (in this case, the state assembly or a city or county council, town and village boards, etc.). Some jurisdictions may have the provisions for a building code adopted by the legislative body, but administrative content is developed by an agency charged with such development.

A **code** consists of requirements and standards that a jurisdiction enforces through legislation, statutes, contracts etc. A jurisdiction can adopt a model code without changing it, modify part of the code, or develop its own code. A jurisdiction that develops its own codes sets up its own committee and relies on its own expertise to write, modify, and implement the codes. Code compliance and enforcement are facilitated by the consensus development process.

A **model code** is developed and maintained by private standards development organizations independent of the jurisdiction responsible for enacting the code. Examples of such codes include the International Building Code of the International Code Council and the NFPA 1 of the National Fire Protection Association. A model code is not enforceable until a jurisdiction enacts the code through legislation or statute or is included in a contract. Model codes often include enforcement language to facilitate the adoption and enforcement once required to be crafted by a jurisdiction or contract.

Model codes are developed via a consensus process that operates on the principles of openness, transparency, inclusiveness, and balance of interests to safeguard against special interest domination.

Many organizations develop codes in accordance with these principles, including design professionals, construction industry representatives, trade associations, manufacturers, local officials, government agency representatives, property owners, insurance companies, academics, and other stakeholders in the consensus process. As “living documents,” model codes are reviewed and updated every three to five years by technical committees of professionals attuned to technological developments and research findings.

A *standard* is promulgated by a standard developing organization, an industry, or a technical society and is intended to be voluntary and to represent a consensus and best thinking on how to approach a certain issue. Standards become mandatory if they are cited in a code. Model codes rely on reference standards for specific materials, products, and systems. The majority of published standards are developed through a consensus process, with procedural accreditation available to those groups to use the American National Standard designation.⁴⁰

Design guidelines and *rating systems* have become increasingly important to the U.S. building construction and regulatory system. Design guidelines and rating systems are not standards and are not intended to be mandatory even though some jurisdictions have made them so. They are used for establishing criteria beyond minimum codes and for addressing specific goals that might not be addressed in codes. They are assembled by experts to help industry professionals achieve the intent of the requirements found in the codes, and standards. The Leadership in Energy and Environmental Design (LEED) of the U.S. Green Building Council is an example of a rating system.

PATHWAYS TO GREEN

When seeking to increase mandatory building performance through building codes, authorities may rely on the same mechanism described above. There are three paths for this in the United States.

Integrate green elements into code. In refining standards, development organizations have focused on improving building performance in energy, water, and materials usage, indoor air quality, and reduction of impact on the environment, etc. Jurisdictions may elect to integrate new or updated green standards into their codes and enact them into law.

Develop green codes for elements for building control. Codes are developed for building elements (e.g., energy conservation, solar energy system, water and plumbing, mechanical, location, lighting). These codes are separate from green building codes and could be implemented and enforced with other codes. Standards for recycled materials may be introduced into structural codes in the future.

⁴⁰ ANSI coordinates the U.S. system of voluntary standards bodies and offers procedural accreditation. Accreditation signifies that the procedures used to develop American National Standards meet requirements for openness, balance, consensus, and due process. ANSI also accredits programs that assess conformance to standards around the world, and organizations that carry out product or personnel certification in accordance with requirements defined in international standards. The National Technology Transfer and Advancement Act (NTTAA), which became law in the United States in March 1996, directs the U.S. Federal Government to (1) use standards developed by private sector standards organizations whenever practical, (2) participate in the development of standards, and (3) notify an appropriate government office when it does not or cannot comply with the first provision (NIST 2010).

Develop green building codes. Comprehensive green construction codes reflect stakeholder consensus and guidance on design, specifications, methods, and technologies. They offer jurisdictions what they need to shape, require, and enforce greener construction practices. In the United States, the first such code was published in 2012.

2. Code Development, Adoption, and Enforcement

Model building codes are developed primarily by private sector codes and standards organizations, through a comment-driven process open to interested parties and the general public. Members of these organizations include a wide variety of stakeholders from the construction community. Codes and standards so developed are adopted by state or local governments, as well as tribes, and are often modified to meet local needs. The codes are enforced by local building departments. Enforceable codes and standards become laws in the jurisdictions.

CODES

Codes are divided into different elements of building control (e.g., electrical, energy, water, sanitation and plumbing). Multiple minimum codes may exist for each element. For example, NFPA 1 of the National Fire Protection Association (NFPA) and the International Fire Code (IFC) of the International Code Council (ICC) are both used in the United States. The Uniform Plumbing Code (UPC) of the International Association of Plumbing and Mechanical Officials (IAPMO) and the International Plumbing Code (IPC) of the ICC are the two most widely accepted minimum plumbing codes in the United States. The National Electrical Code (NEC) is the most widely adopted model electrical code in all states for building construction but some states have adopted the National Electrical Safety Code (NESC) Standard C2 of the IEEE as their minimum for site work and environmental electrical safety outside structures.

CODE DEVELOPMENT

Most U.S. jurisdictions adopt model codes developed by private organizations and enact the codes through legislation, statute, contract, etc. Model codes are popular in the United States because there is no national code and the cost of developing codes from scratch is extremely high. Certain jurisdictions, such as New York City and the state of California, have developed their own codes. These jurisdictions usually develop codes in much the same manner as private sector code and standards developers and rely heavily on building control officials and private sector practitioners for input. Enforcement is mainly the responsibility state or local jurisdictions.

Even though most codes and standards are privately developed, government officials are involved. Codes are usually developed on a three-year cycle. Standards are usually updated or reaffirmed on a three to five-year cycle, but can be revised sooner if necessary.

The ICC, IAPMO, NFPA, and ASHRAE are four widely recognized code development organizations in the United States. ICC publishes 15 model codes, including the International Building Code (IBC), NFPA 363 codes and standards, and IAPMO 85 codes and standards. These codes cite references from the 600+ codes and standards developing organizations throughout the United States and Canada. IBC is also administered in parts of all 50 states. Most state and local governments pass laws to adopt the IBC as their base or minimum code, and building departments administer and enforce IBC and related codes.

Professional licenses, like those for engineers and architects, are often tied to code compliance even though compliance is only one of the many responsibilities of a licensed professional engineer or architect.

ADOPTION AND EVOLUTION OF MINIMUM AND MANDATORY CODES

Private Organizations

Guided by an organization's by-laws and rules on consensus development, volunteers representing a variety of viewpoints and interests form committees to achieve consensus on particular practices. Committee members are typically a balance of representatives from the construction community as well as researchers and academics from universities and research laboratories. Committees consisting of 5-40 volunteers draft code provisions based on the consensus of the members.

The ICC maintains code committees with differing construction expertise. Hearings are conducted to confirm new code language or modify existing code provisions. Hearings provide a venue for public comment and suggestions for code language. Government officials have the final vote on acceptance of code language. NFPA technical committees and code making panels develop and regularly update codes and standards using an ANSI approved consensus process. Committees and panels are appointed by the Standards Council and usually consist of no more than 30 voting members representing a balance of interests. Technical committees are comprised of volunteers selected for their technical expertise, professional standing, commitment to public safety, and ability to represent a point of view. Each technical committee is constituted to contain a balance of interests, with no more than one-third from the same interest category. The committee must reach a consensus to take action on an item.

Federal Agencies

The US General Services Administration (GSA) manages and acquires buildings and real estate for many other federal agencies. GSA is required by law to adopt nationally accepted building codes and therefore does not develop its own building code. The IBC and many codes published by the ICC are mandatory for most federal buildings. The GSA also adopts standards developed by private, voluntary standards developing organizations, and may develop standards for federal buildings. GSA is also required to use regional codes and the standards contained in such regional codes. The U.S. Department of Defense (DOD) develops the most codes and standards of all federal agencies. It takes the same approach to development as ICC and NFPA, except that all committee members are DOD personnel, and its codes may be updated every three years. The DOD chooses the IBC as a primary reference in its Unified Facilities Criteria (DOD 2011).

While federal agencies do not develop national building codes, they do implement laws through regulation that impact the design and construction of buildings. Many of them cover “green” related considerations.

If a federal law mandates a standard, the standard is enforced as a code. For example, federal law mandates ASHRAE Standard 90.1 as the basis for state energy codes. The standard ASHRAE 90.1 may be considered a code in this case (ASHRAE Report 2013).

Federal and state governments often regulate activities that affect human safety and health and develop regulations to limit human impact on the environment and vice versa. Some of these include U.S. Environmental Protection Agency (EPA) regulations on asbestos, national emissions on hazardous air pollutants, ozone layer protection, federal environmental requirements for construction, lead in paint, dust and soil, construction and demolition wastes, storm water discharges from construction activities, and effluent limitation guidelines (EPA 2012.)

Other Jurisdictions

Adoption procedures vary by state and jurisdiction, and most jurisdictions have great degree of freedom to adopt or modify model codes. In some states, local jurisdictions are required to adopt the state’s minimum. A large majority of jurisdictions adopt IBC and other ICC codes, as well as the National Electrical Code (NFPA 70) and the Uniform Plumbing Code (UPC) as their base or minimum code, and building departments administer and enforce IBC and related codes.

The IBC references ASHRAE 90.1, so jurisdictions that adopt IBC may enforce the standard by reference. By federal law, jurisdictions that do not adopt IBC or any model code that requires ASHRAE 90.1 are required to adopt ASHRAE 90.1 directly.

CODE ENFORCEMENT

Code enforcement is the responsibility of federal, state, and local authorities. The federal government enforces its building codes for federal facilities through the GSA and federal agency powers. Codes for state buildings and facilities are enforced by state agencies. States have fire departments, marshals, and building departments and inspectors who enforce mandatory and minimum codes. State codes are typically mandatory for cities though many states allow cities to adopt alternative codes or modify codes for local conditions. City governments regulate construction that complies with the local codes, regulations, and ordinances. Some cities enforce green building codes, some enforce them only loosely, and still others provide incentives for their use.

Building inspectors, fire marshals, or officials appointed by the jurisdiction evaluate compliance. Inspections are divided by project phase. In the design phase, construction documents are checked before building permits are issued. In the construction phase, inspections ensure compliance and assurance that construction matches plans. A final inspection is required before a certificate of occupancy is issued. The local government authority implements codes and standards for the buildings and structures within their jurisdiction.

GREEN BUILDING CODES AND STANDARDS, RATING SYSTEMS, AND FEATURES

Current green codes and standards set forth provisions for energy use and conservation, climate change, water use and conservation, renewable energy, materials and resources, indoor environmental quality, and external environmental and social impact. Some green building regulations (e.g., EPA regulations referenced by a green rating system) and standards (e.g., ASHRAE 90.1) were developed long before rating systems were, while some standards—usually performance-based—are specified in the rating systems themselves.

Development and Adoption

Like mandatory building codes and standards, green standards were developed in response to social and environmental needs. ASHRAE 90 was developed in response to the oil crisis and ASHRAE 62 targeted the sick building syndrome that became prominent in the 1970s. The United States has no nationally mandated green building code or standards but some are widely accepted. ASHRAE 90.1 is the minimum energy standard in all but a handful of states because of a federal law mandating ASHRAE 90.1 or similar standard (NAIMA 2012). Many federal agencies, state governments and their agencies, city governments and their agencies, and public school districts have adopted minimum and/or mandatory green building design standards and/or guidelines (USGBC 2012). California has its own green building code (CALgreen.) Five U.S. states have adopted the International Green Construction Code (IgCC) as a compliance pathway for their green requirements on a statewide basis. Local jurisdictions in three other states have adopted part or all of the IgCC as their green code or compliance path. The U.S. Army Corp of Engineers requires compliance with parts of ASHRAE 189.1. Mandating a green code and standard is different than mandating a rating system (i.e., LEED).

Evolution

Green codes and standards evolved through various means. Laws and regulations are often a reaction to societal demand to counter various conditions, and standards are often developed to provide measurement science to meet the intent of those laws and regulations. ASHRAE 90 was first published in 1975, and then evolved into ASHRAE 90.1, the nationally accepted minimum requirements for energy efficient design, largely due to the Energy Policy Act of 1992 (EPAct 1992). That act addresses renewable energy development, utilities, and the efficiency of equipment, appliances, and water-consuming fixtures. Subsequent legislation has mandated the development of performance standards for green buildings.

Many environmental laws and regulations have also evolved into nationally accepted minimum standards and have driven the development of guidelines. The Occupational Safety and Health Administration (OSHA) part of the Department of Labor has developed many nationally accepted industry health and safety standards and guidelines pertinent to the health and safety of building occupants. Examples include OSHA Technical Manual on Indoor Air Quality (OSHA IAQ 1999) and the EPA IAQ Information Database (EPA 2012). These guidelines are also developed to support the use of ASHRAE 62.1 (ventilation for acceptable indoor air quality). The Pollution Prevention Act of 1990 drives the development of construction waste management procedures that minimize pollution due to such wastes. OSHA's mission for workplace safety has also driven the development of many guidelines for waste reduction, construction and demolition debris by contractors, trade associations (AGC 2012), and governments (Iowa Department of Natural Resources 2008).

Rating Systems and Green Features

Some local governments have integrated green rating systems into building codes. For example, some now require government buildings to meet high performance standards (e.g., LEED). The government of Colorado requires new or renovated government buildings to be designed and built to a high performance green standard. Some city governments now require their new buildings and renovations to achieve green building certifications. Many jurisdictions develop legislation, executive orders, resolutions, ordinances, policies and incentives that address green building standards.

Green features like energy and water conservation, and gray water plumbing and renewable energy systems have become integral parts of model building, mechanical and plumbing codes. Integrating these features into codes is easier as they are either less complicated or there are already established standards or codes in these areas. ASHRAE 90.1 is referenced extensively in UMC while IECC is referenced in IMC and IBC. Other green features that are more complicated or do not have established standards require the development of separate and dedicated codes and standards. See DSIRE (www.dsireusa.org) for some incentive programs.

TYPES OF BUILDINGS

The IBC categorizes building into ten types: assembly, business, educational, factory and industrial, high hazard, institutional, mercantile, residential, storage, and utility and miscellaneous. Other ICC codes are applicable to nonresidential buildings higher than three stories (except for the IRC, residential code). ASHRAE 90.1 (cited in IBC, IgCC, and IEC) is to be used for high-rise nonresidential buildings, while ASHRAE 90.2 is to be used for low-rise residential buildings. The scope of ASHRAE 189.1 excludes single family houses, multifamily structures of three stories or fewer, manufactured mobile and modular houses, and buildings that do not use electricity, fossil fuel, or water.

NFPA 1 categorizes building types into airport terminal, apartment, attached, existing, high-rise, mini-storage, satellite, special amusement, and storage tank buildings. In general, buildings are grouped by their occupancy or use. For uses, they are normally grouped into residential, commercial, institutional, agriculture, and other special uses (aviation and military). Both the IBC and NFPA establish building construction types, i.e. non-combustible (Type I and II) and combustible (III, IV, V) elements (Technical Services Information Bureau 2008).

3. Code Details

MINIMUM CODES

This section highlights some minimum and/or mandatory codes common to many jurisdictions. Some elements of minimum code requirements may also contribute to energy or other resource savings and can be considered green elements and will be noted in the discussion below. Unique, additional green elements will also be addressed in this section.

Electrical

Electrical codes can be a green feature if the code stipulates energy conservation requirements such as requirements for PV and battery storage installations and renewable energy safety requirements;. Most building departments have adopted NFPA 70, also known as the National Electrical Code (NEC) and the National Electrical Safety Code (NESC) published by the Institute of Electrical and Electronic Engineer (IEEE). 70

Some aspects of electrical safety are covered in other mandatory codes, such as the ICC's International Fire Code (IFC) and NFPA 1. The IFC, IBC, IPC, also contain some language on electrical works. References in NFPA 70 include the International Society of Automation, Underwriter Laboratories (UL), IEEE, and Canadian Standards Association (CSA). These references are mainly associated with materials.

Energy (Green Component)

The energy code is widely accepted as a required component of green building. ICC's International Energy Conservation Code (IECC) is in use or adopted in 46 states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands (administered statewide in 35 states and the District of Columbia). Ten states and territories do not have statewide energy codes. As mentioned, even though the federal law mandates ASHRAE 90.1 as the basis for state energy codes for larger buildings (ASHRAE Report 2013), state and local governments may adopt equivalents. ASHRAE 90.1 is considered a standard and not a code, per the Department of Energy (DOE).

In a recent study, the DOE identified differences and similarities in the IECC and ASHRAE 90.1 (Eric, Williamson, & Makela 2011). Some similarities are as follows:

- ASHRAE 90.1 is equivalent to IECC in the scope of code and the type of projects it is applied to.
- Both contain similar language dealing with safety, health, and environmental requirements.
- Both require that additions, alterations, and repairs comply with current code.

Some differences include the following:

- In addition to covering building envelope, lighting system, service water heating and mechanical systems, ASHRAE 90.1 also covers power and other equipment.
- ASHRAE 90.1-2010 is flexible in allowing modifications to buildings to offset portions of the addition that do not comply with the code, while IECC does not.
- Section C101.4 of the 2012 IECC would dictate that an exemption for compliance with an alteration found in the Standard 90.1-10 that was not found in the 2012 IECC would be superseded if both the 2012 IECC and Standard 90.1-10 were in effect.

ASHRAE 90.1 and IECC both aim to establish energy efficiency requirements for buildings. ASHRAE 90.1 targets commercial buildings and 90.2 targets low-rise residential buildings; IECC targets both commercial and low-rise residential. Both codes address thermal transmittance and insulation of exterior elements (façade, window, skylight etc.), energy-consuming fixtures (lighting, water heating, HVAC etc.), energy modeling methods, solar reflectance measurement, air leakage, temperature measurement, etc. Both can be used to measure energy use and to determine approaches to reduce energy consumptions.

Water and Sanitation (Green Component)

The plumbing code is considered a green component of green buildings. As noted earlier, IAPMO's UPC and the ICC's IPC are the two most widely used plumbing codes in the United States.

The IPC regulates the design and installation of plumbing systems, including plumbing fixtures in all types of buildings—except detached one- and two-family dwellings and townhouses that are not more than three stories above grade. The regulations for plumbing systems for low-rise residential homes are covered by chapters 25 through 33 of the International Residential Code (IRC). The IPC addresses general plumbing regulations, fixture requirements, water heater installations and systems for water distribution, sanitary drainage, special wastes, venting, storm drainage and medical gases. Unlike the UPC, the IPC does not address fuel gas piping systems. (gas systems are covered by the International Fuel Gas Code ,IFGC). Nor does the IPC regulate swimming pool piping systems, process piping systems, or utility-owned piping and systems.

The purpose of the IPC is to the establish the minimum acceptable level of safety to protect life, health and property from dangers associated with supplying potable water to plumbing fixtures and outlets and the conveyance of bacteria-laden waste water from plumbing fixtures. The IPC is primarily a specification-oriented (prescriptive) plumbing code with some performance-oriented text.. UPC has minimized specific references to where product standards should apply in the code body, preferring to simply list the standards. IPC covers fixtures, faucets and fixture fittings, water heating, supply and distribution, sanitary drainage, indirect/special waste, vents, traps, interceptors, separators, storm drainage, special piping and storage systems, and gray water recycling system. UPC does have a additional chapter on fire stop systems.

Mechanical Systems (Green Features)

The mechanical code can contain green features that require energy and water efficiency of equipment. Both IMC and UMC contain energy and water efficiency requirements.

Mechanical System Codes

The ICC's International Mechanical Code (IMC) is in use or adopted in 46 states, the District of Columbia, New York City, Guam, Puerto Rico, and the U.S. Virgin Islands. IAPMO's Uniform Mechanical Code (UMC) is also another widely adopted code in the United States. IMC covers

- Appliance ventilation
- Boiler systems
- Chimneys
- Combustion air provisions
- Cooling systems
- Duct systems
- Exhaust systems
- Fireplaces
- Fuel burning appliances
- Fuel oil piping
- Heating systems
- Hydronic systems

- Location and protection of appliances etc.
- Refrigeration
- Solar systems.

IMC does not include fuel gas piping as it is included in the International Fuel Gas Code. UMC covers

- Chimneys and vents
- Combustion air
- Commercial hoods and kitchen ventilation
- Cooling towers
- Duct systems
- Exhaust systems
- Fuel gas piping
- Hydronics
- Process piping
- Refrigeration
- Solar systems
- Specific appliances
- Steam and hot water boilers
- Ventilation air supply.

There are differences between the codes, for example, the IMC cites references from 21 code and standards developing organizations; UMC also cites references from 21 organizations, however many of the referenced standards are from different sources.

Frequently Referenced and Adopted Mechanical System Standards

The American Society for Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) has also established standards on mechanical systems used in buildings that are frequently used in many jurisdictions. Examples of such standards include the following:

- 15 (safety standards for refrigeration systems)
- 16-1983 (RA 2009) (testing for rating room air conditioners and packaged terminal air conditioners)
- 17-2008 (testing capacity of thermostatic refrigerant expansion valves)
- 18-2008 (testing for rating drinking-water coolers with self-contained mechanical refrigeration)
- 22-2007 (testing for rating water-cooled refrigerant condensers)
- 23.1-2010 (testing for rating the performance of positive displacement refrigerant compressors and condensing units that operate at subcritical temperatures)
- 24-2009 (testing for rating liquid coolers)
- 25-2001 (RA 2006) (testing forced convection and natural convection air coolers for refrigeration)
- 28-1996 (RA 2010) (testing flow capacity of refrigerant capillary tubes)
- 29-2009 (testing automatic ice makers)
- 30-1995 (testing liquid-chilling packages)
- 33-2000 (testing forced circulation air cooling and air heating coils)
- 35-2010 (testing desiccants for refrigerant drying)
- 37-2009 (testing for rating electrically driven unitary air-conditioning and heat pump equipment)

- 40-2002 (RA 2006) (testing for rating heat-operated unitary air-conditioning and heat-pump equipment)
- 41.1-1986 (RA 2006) (standard method for temperature measurement).

ASTM International develops standards that support plumbing and mechanical equipment and systems use in buildings. These standards cover testing methods for building mechanical systems, construction risk and management, guidelines to prevent moisture penetration, air pressure and permeability testing, economics, technology selection, installation methods, specifications, density control, testing, leaks, flow, and terminology. ASME develops and manages safety codes and standards related to mechanical and plumbing products and systems used in buildings.

Indoor Air Quality (Green Component)

Even though there is no specific national model code for indoor air quality (IAQ), there are some state IAQ regulations and codes. The Washington State Ventilation and Indoor Air Quality Code regulates the maximum amount of indoor chemical emissions, mechanical ventilation criteria, duct sizing, air supply, and other mechanical systems that affect indoor air quality (Washington State Department of Health 2012). The focus on the code is to ensure sufficient supply of outdoor air to reduce or thin down bad quality air. Massachusetts has integrated its IAQ standards into its building code. The state building code mandates the minimum ventilation rates for different room types, unless a room has operable windows. The building code also covers indoor air pollutants, and referenced guidelines and standards from other states (Massachusetts Government 2013). California and New Jersey are the only states that have official indoor air regulations or codes (OSHA IAQ 2006).

IAQ requirements are set forth or referenced in various energy codes and standards (i.e., IECC and ASHRAE 90.1). ASHRAE 62.1 (ventilation for acceptable indoor air quality), and 62.2 (ventilation for acceptable indoor air quality for low-rise residential building) address IAQ extensively, and are incorporated into other codes. They cover outdoor air quality, whole-building ventilation, local exhaust, air-moving equipment, air-flow rate, and climate data. ASHRAE 62.1 references standards and publications from various sources including the SMACNA, UL, ASTM, NFPA, AMCA, ANSI, and ASHRAE itself. Examples include the UL's 1995 heating and cool equipment textbook, ASHRAE 52.2 (method of testing general ventilation air cleaning devices for removal efficiency by particle size), and AMCA 511 (certified rating program of air control devices).

The OSHA IAQ Technical Manual (1999), U.S. Environmental Protection Agency (EPA IAQ 2012), and ASHRAE 62.1 (TRANE 2002) are widely referenced in the IAQ guides, codes, or regulations of various states and jurisdictions.

Lighting (Green Component and Feature)

Lighting codes can have green components and green features. Lighting pollution (exterior) is a green component while energy efficient lighting is a green feature. Lighting codes and standards can be separated into outdoor and interior lighting. The main purpose of outdoor lighting code requirements is to limit obtrusive aspects of lighting. Outdoor lighting provisions are often set forth in a chapter of the zoning or land use code, or incorporated into other codes. The IDSA-IES model lighting zone ordinance

(IDSA-IESNA 2011) is the only model outdoor lighting code in the United States. There are two guidelines on outdoor lighting code, both by the International Dark Sky Association (IDSA): lighting zones for codes and ordinance (IDSA 2, 2012) and the Outdoor Lighting Code Handbook, which suggests ordinances for small communities, urban neighborhoods, and subdivisions (IDSA 2012). Several cities in Arizona have outdoor lighting codes. Tucson regulates illumination levels, shielding requirements, and sign lighting and lighting for recreational facilities, special use areas, and rights-of-way (City of Tucson 2012).

Indoor lighting code requirements aim to enhance comfort and safety. Indoor lighting requirements have been incorporated into various building, fire, and energy codes and standards. Such requirements can be found in

- ASHRAE 90.1 Addenda I (documented lighting zone) (ASHRAE 2012)
- ASHRAE 189.1 (in chapters 5, 7, and 8)
- ICC IECC (in chapter 4)
- NFPA 1 (throughout)
- NFPA 70 (in chapter 4 section 410)
- IBC (chapter 12).

NFPA 1 and IBC both require 1 foot candle minimum along the path of egress; ASME requires 10 foot candle at the sill of elevators; NFPA 1 requires 10 foot candle minimum on existing stair treads.

Various jurisdictions have also incorporated lighting design guidelines for building types. Hospitals often use the AIA Guidelines for Design and Construction of Healthcare Facilities 2006 (AIA 2006). The IESNA Lighting Handbook (2012), and the IESNA RP-33 on lighting zones are frequently incorporated into building codes. AIA, ASME, ASHRAE, ICC, IESNA, USGBC, and NFPA are also involved in establishing minimum lighting standards, and have integrated IESNA standards into their codes. In addition, the Energy Policy Act of 1992 and the Energy Independence and Security Act of 2007 contain regulations that target lighting. Zoning codes also contain some guidelines for outdoor and indoor lighting. Part of the zoning code of Richmond, California, addresses lighting and glare (City of Richmond 2011).

Security

Security code deals with safety of building occupants and thus do not contain any green features.

Private and Noncritical Government Buildings

The last version of the Uniform Security Code was published in 1997 and has been widely adopted in the United States. The IBC, NFPA 1, NFPA 70, and IFC contain some building security requirements. Section 408 of the IBC covers locking mechanisms, security measures of egress, and security glazing; and section 1008 covers security features of entrance. IFC and NFPA 1 cover entrance security, security gates, and security enhanced lighting.

Fire

A fire code is primarily a safety requirement, although there can be some green impacts with regard to materials, suppression systems and resilience. The ICC International Fire Code (IFC) and NFPA 1 Fire

Code (NFPA 1 2012) are both the minimum and most frequently used fire codes in the United States. Both the IFC and NFPA 1 fire codes are adopted by many state and local jurisdictions. Both model documents contain provisions on topics such as

- Combustible dust production
- Construction requirements
- Design for fire accesses
- Design of facilities with flammable finishes
- Design of means of escape
- Designs of aviation
- Dry cleaning facilities
- Emergency planning and preparation
- Enhanced fire-rated construction
- Fire prevention design of building services and systems
- Fire protection systems
- Fire rating of interior finishes
- Means and designs of egress
- Measures to contain combustible materials and liquid
- Methods of fire protection and prevention
- Organic coating manufacturing
- Reduction of combustion probability
- Semiconductor, lumberyard and wood-treatment.

Structural

The structural code is primarily considered a safety requirement.

The IBC contains structural design requirements and references extensive standards for major materials (steel, concrete, cement, wood, aluminum, masonry, glass and glazing), design loads, building height and areas, types of construction, fire and smoke protection, egress, structural design, soils and foundation, tests and inspections, existing structures, safety during construction, and temporary structures.

NFPA 5000 Building Construction and Safety Code references and integrates structural provisions from the 2010 ASCE/SEI 7 (minimum design loads of buildings and other structures), which also covers design in seismic wind and snow loads.

Like the model building codes, many material and structural design standards are developed and written in a form that allows them to be adopted by reference in a general building code. Some widely used material codes include ACI 318 (structural concrete), ACI 530/ASCE 5/TMS 402 (masonry structures), AISC (manual of steel construction), AWS D1.1 (structural welding code-steel), AASHTO/AWS D1.5 (bridge welding code), National Design Specification® for Wood Construction, PS 20 American Softwood Lumber Standard, SEI/ASCE 7 (minimum design loads for buildings and other structures), and SEI/ASCE 37 (design loads on structures during construction).

Efforts to Include Green Features in Structural Code

Reference standards used in structural codes for buildings may soon introduce design and construction standards for recycled materials. These standards have been applied in highway design and construction. The following institutions and associations are beginning to look into green features for their standards:

- American Concrete Institute (ACI) provides extensive codes, standards, and references for the design and construction of concrete and masonry elements. Its design handbooks are considered minimum standards for concrete design in the economy. A committee has been set up to review green features in ACI standards.
- American Institute of Steel Construction provides extensive codes, standards, and references for construction of structural steel elements in buildings. Standards for recycled steel are being investigated.
- American Iron and Steel Institute develops standards and references for the manufacturing, design, installation and construction of steel elements. Standards for recycled steel are being investigated.
- The American Wood Protection Association, APA - Engineered Wood Association, and American Institute of Timber Construction provide standards and reference for the manufacture, design, installation, and construction of wood elements. Standards for recycled and certified wood are being investigated.
- The American Society for Civil Engineers (ASCE) and the ASCE Structural Engineers Institute (SEI) provide minimum design loads, specifications, calculation methods, etc. for structural engineering calculations. Sustainability standards have been developed for infrastructure and structural sustainability standards are being investigated.
- ASTM International provides extensive testing, specification, and practices references and standards to determine the quality of structural materials.
- The Association of the Wall and Ceiling Industry provides testing and inspection methods for wall and ceiling materials.
- The American Welding Society provides welding standards for structural steel.

Location/Siting/Zoning

Zoning is a component of green building applicable to the building site. Zoning also addresses density, neighborhood development and transit-oriented development.

Private Sector Codes

The ICC's International Zoning Code (IZC), and the International Wild-Urban Interface Code (IWUIC) are not widely used. IZC covers zoning for different development types (commercial, industrial, residential, agriculture), while IWUIC covers the impact of development on wild life (such as water use, fire protection etc.). IZC does not reference any standards outside of ICC, while IWUIC references standards from the ASTM International, UL, and NFPA on the testing of combustion of various materials (wood, asphalt, etc.). IgCC contains provisions on storm water management and land use that affect zoning and land use planning.

Government Zoning Regulations

The U.S. EPA provides comprehensive regulations and model ordinances pertaining to zoning, land use and siting. These regulations include

- Brownfields and Land Revitalization program (EPA Brownfield 2012) via the Brownfield Recovery Act (EPA provides extensive technical services and information on brownfield redevelopment).
- EPA Wetland Program (EPA Wetland 2012).
- Fish and Wildlife Service's and the National Oceanic and Atmospheric Administration's Endangered Species Act (Federal Wildlife Services 2012).
- EPA Smart Growth Zoning for Urban and Rural Areas (EPA Smart Growth 1 2009; EPA Smart Growth 2 2012).
- EPA National Pollutant Discharge Elimination System (EPA Storm water 2012).
- EPA Land Use Guidelines (EPA Land Use 2011).
- EPA Superfund (EPA Superfund 2012).
- EPA Dredge and Fill Activities (via Clean Water Act).

Other EPA programs (air quality, heat islands, land use, greenhouse gas strategy, local government climate and energy strategy series, waste management, waste water, energy efficiency etc.) directly and indirectly affect code development in various jurisdictions. These guidelines, regulations, and laws directly and indirectly affect development and projects, and influence land use, zoning, and siting codes in various jurisdictions (EPA Community Planning 2012). EPA also provides model ordinances to help communities develop zoning codes. For example, model ordinances to prevent and control nonpoint source pollution target aquatic buffers, erosion and sediment control, open space development, storm water control operation and maintenance, illicit discharges, and post-construction control (EPA Ordinances 2012).

Safety

NFPA 101 Life Safety Code is widely used in the United States. The code focuses on construction, protection, and occupancy features necessary to minimize danger to life from fire, including smoke, fumes, or panic. The code does not address fire prevention as this is already covered by NFPA 1 and the IFC; however the Life Safety Code is applicable to existing and new buildings. The code also deals with hazards in building, public conveyances and occupations. vulnerability as well as egress, features of fire protection, building services and fire protection equipment, special structures, and identifies features for different types of occupancies (new assembly, education, daycare etc.)

GREEN FEATURES IN MODEL CODES

Many code provisions address features considered green. These include energy and water conservation, and gray water and renewable energy systems. The use and disposal of hazardous materials and energy efficiency are the two green features in IBC. In addition, the IBC has a chapter on energy conservation. ICC's International Plumbing Code and IAPMO's Uniform Plumbing Code include design standards for gray water recycling systems. Both have a chapter on the design of such systems, and UPC has integrated

such systems into its water supply and distribution chapter. ICC's International Mechanical Code includes design and installation requirements for solar systems, energy efficiency requirements for hydronic piping, and the International Energy Conservation Code. The ICC's IECC contains extensive energy design requirements for building envelope, mechanical systems, service water heating, electrical power and lighting, renewable energy, commissioning etc. that are similar to the scope of ASHRAE 90.1 although there are many dissimilarities while UMC references ASHRAE 90.1 and 90.2 extensively. Uniform Mechanical Code (UMC) has green features like integrated energy efficiency ratio (ieer), seasonal energy efficiency ratio (seer), a/c filters requirements (minimum efficiency reporting value (MERV), and water conservation and efficiency.

GREEN BUILDING CODES

IgCC and ASHRAE 189.1 are the two green building codes in the United States. IgCC is in use or adopted in 10 states while the Army Corp of Engineers adopts ASHRAE 189.1 as its green building code. Both codes focus on the five categories of sustainability (site sustainability, water use efficiency, energy efficiency, indoor environmental quality, and materials and resources). Both also have sections on operation and maintenance. With the publication of IgCC 2012, a building designer may now choose to comply with its requirements or those of 189.1 (earlier editions limited this decision to jurisdictions).

The IgCC uses EPA and FEMA regulations and guidelines on plant and animal species protection and land use restrictions, and sets its rules on these restrictions (such as spaces between the protection zones and development, and restriction of development in protected zones). IgCC storm water requirements are also based on EPA guidelines. IgCC establishes requirements for soil and erosion control, and incorporates standards from the ASTM (D 2974 on organic matters of soil), and ASAE and ASTM standards on its soil restoration requirements. IgCC construction waste management requirements are based on EPA guidelines for industrial wastes management and its recycling requirements are based on ASTM D 6866 (bio-based content), FSC standards (wood-based products), and USDA 7CFR Part 2902. Its solar reflectance value and measurement are based on ASTM E 1918/1980. Its light pollution requirement (glare, backlight and lighting zone) is based on IESNA TM-15-07.

IgCC allows the calculation of carbon emissions generated by building energy use or eliminated through renewable energy use. It provides a carbon emissions calculation method, and the equivalent carbon emissions from electricity generation in different states. The IgCC also sets forth requirements for

- Acoustics (various ASTM and ASA standards)
- Commissioning, energy modeling (ASHRAE 90.1)
- Composite product emissions (ASTM E 1333 or ASTM D 6007)
- Day lighting (NOAA)
- Duct tightness, sealing and testing (IECC and SMACNA HVAC Air Duct Leakage Test manual),
- Indoor air quality during construction (ASHRAE 52.2)
- Indoor emissions testing method (CDPH/EHLB/standard method V.1.1: standard method for testing VOC emissions from indoor sources)
- Metering methods, air tightness requirement (ASTM E 779)
- Post- and pre-construction IAQ plans (ASTM D 6196, ASTM D 5466, ASTM D 5197, ASTM D, 6345, and ISO 7708)

- Prohibited materials (California code of regulation airborne toxic, control measure to reduce formaldehyde emissions from composite wood products)
- Rainwater disinfection (ASTM D 1253)
- Rainwater plumbing (IPC)
- Reclaimed water systems (ASTM E 2635)
- Renewable energy system (NREL SERI TR- 642-761)
- Various energy consuming equipment (Energy Star)
- Water consuming fixtures (ASSE 1016, ASME A112.18.1/CSA B125.1)
- Water treatment devices and equipment (NSF 44, NSF 58, NSF 350, and IPC)

There are several differences between ASHRAE 189.1 and IgCC, especially in their energy efficiency sections. With all energy units converted to Btus, IgCC is based on source energy use, while 189.1 is based on site energy cost. As a result, a model executed according to the calculations of one code cannot easily be compared to the other. A section of the IgCC also requires that the person performing the energy simulation be a professional engineer or architect in the state where the project is being constructed. 189.1 has no such requirement. The IgCC has detailed requirements for building energy metering and demand response, while 189.1 has detailed sections on fan power and demand controlled ventilation. If a project requires compliance with IgCC, there is always the option of using either IgCC or 189.1 Overall, using ASHRAE 189.1 as a compliance path may minimize modeling time and increase cost-based savings.

In addition, IgCC offers IMC or ASHRAE 62.1 as two options for indoor air ventilation, while ASHRAE 189.1 requires ASHRAE 62.1. In fact, the entire section on the indoor air ventilation in ASHRAE 189.1 is based on ASHRAE 62.1. ASHRAE 189.1 references used on its indoor air quality section are more diverse, citing references from ASTM, SCAQMD, and Green Seal. There are also other requirements and design methods differences between both codes.

Green Feature of Codes and Standards

Energy Conservation. ICC IECC has extensive energy design requirements (for building envelope, mechanical systems, service water heating, electrical power and lighting, renewable energy, commissioning etc.) and its approach is very similar to that of ASHRAE 90.1.

Plumbing. IAPMO developed the 2012 Green Plumbing and Mechanical Code Supplement to supplement the green features of UPC and UMC. The supplement has requirements for water efficiency and conservation for most plumbing fixtures and systems, HVAC systems, landscaping fixture and systems, irrigation fixtures and systems, heating systems, renewable energy systems, and indoor environmental quality. The supplement enhances the “greenness” of UPC and UMC.

Solar Energy Systems. IAPMO’s Uniform Solar Energy Code establishes requirements for the design, installation, and operation of solar energy systems.

Sustainability. Code and standard developing organizations also create other sustainability standards (e.g., ASTM’s international standards for green roofs, life cycle assessment, cleaning, maintenance, earthen wall, water reclamation, wastewater, and rainwater quality, among others.

Environmental Protection Regulations. As a federally designated environmental administrator, the EPA has extensive acts and statutes on “green” or “sustainability” matters.⁴¹ These govern land use, material use and conservation, toxic and hazardous chemical use, energy use and conservation, species protection, health and safety of occupants and children, air and water pollutions, formaldehyde, and polychlorinated biphenyls (EPA Regulations 2012). In addition, federal law mandates the use of ASHRAE 90.1. As a result, many of these codes do not need to include these green features as they are mandatory by federal regulations.

⁴¹ These include the Clean Air Act, Clean Water Act, Endangered Species Act, Energy Independence and Security Act, Comprehensive Environmental Response, Compensation and Liability Act (Superfund), Energy Policy Act, Protection of Children From Environmental Health Risks and Safety Risks, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use, National Environmental Policy Act, Noise Control Act, Occupational Safety and Health Act, Pollution Prevention Act, Resource Conservation and Recovery Act, Safe Drinking Water Act, and Toxic Substances Control Act, Environmental Response.

1. Synopsis

CENTRALIZED BUILDING REGULATORY SYSTEM

Vietnam takes a centralized approach to its building and construction regulatory system. The central government issues building and construction decrees and the Ministry of Construction converts them into building codes. The Ministry administers decrees, codes, and construction standards through its employees and through consultants. Other ministries whose functions affect building controls provide input as well. For example, some building permits are issued only after the codes of the Ministry of Health and the Ministry of Environment are complied with. Building code enforcers are involved in the revision of codes, standards, and decrees. The building code is enforced by the Provincial People's Committees. Enforcement includes employing and/or contracting building officials, issuing permits, and issuing approvals, etc. The People's Committees may not modify the code but propose local modifications to the Ministry of Construction and develop approved modifications into Local National Technical Regulations for local enforcement.

REFERENCE STANDARDS

There are four levels of reference standards in Vietnam: (1) national standards, national technical standards, and local technical standards administered by the Vietnam Standards and Quality Institute (Directorate for Standards, Metrology and Quality); (2) construction standards administered by the Ministry of Construction; (3) ministerial standards administered by the central government; and (4) international codes and standards. These standards can replace any Vietnam Standards or be used where there is no applicable Vietnam Standard.

GREENING OF BUILDING CODES IN VIETNAM

Energy efficiency is already part of Vietnam's building code, and is introduced into the code by a decree of the central government. The central government has made extensive plans to introduce green standards into future building codes in the form of national laws and regulations that affect all industries. Vietnam also has a voluntary green building rating system driven by the private sector and government.

2. Code Development, Administration, and Enforcement

Building regulations in Vietnam are called building decrees. A decree is issued by the Prime Minister. A construction control decree is converted into building construction codes by the Ministry of Construction. The Ministry is responsible for building and construction control functions. It develops, reviews, revises, and issues construction and design codes and guidelines; issues licenses and permits pertaining to building and construction; enforces building decrees; applies technology to ensure uniform implementation across the economy; organizes training, testing, and inspection to validate code conformance; enforces building code compliance, conducting violation inspections and imposing penalties; and reviews building permits for the entire economy.

Other ministries work hand in hand with the Ministry to draft, review, and modify the decree and codes. They provide opinions in their particular fields that would affect building permits and codes, and check and recommend to the local government (People's Committee) potential suspension of licenses and revocation of building permits. The Ministry of Natural Resources and Environment approves or rejects land use for development, and the Ministry of Construction approves or rejects building permits accordingly.

PROVINCIAL PEOPLE'S COMMITTEES

Local governments, the provincial People's Committees, have the authority to (1) enforce building codes and issue permits and licenses through their own licensing authorities; (2) coordinate implementation and enforcement of building codes, assigning responsibility to local agencies and/or individuals to issue construction and building permits; (3) manage the content and order of permits; (4) stipulate size, areas, duration, and other specific requirements of work permits; (5) develop organizational structures for agencies; (6) conduct training on regulations and codes with the assistance of the Ministry of Construction; (7) manage violations, inspections, organizations, and permit issuance; and (8) report permit issuance to the Ministry of Construction. Local government engineers carry out inspections and certify works through a division of "construction inspectorate." While the central government is responsible for delivering regulations, the construction inspectorate is responsible for carrying out inspections and rectifying problems.

REGULATIONS AND MANDATORY CODES

The central government issues a construction decree, essentially a construction and building regulation. This regulation designates the coding authority and enforcement structures of Vietnam. The Ministry is charged with developing the mandatory construction codes for Vietnam. It also works closely with other ministries to assist them in developing codes that are applicable to building construction works. Some of the codes that the other ministries handle involve the environment and water (Ministry of Natural Resources and Environment) and workplace injury prevention (Ministry of Health). The Decree is not updated on a regular basis, and the code is updated as needed (no time frame specified).

STRUCTURE OF BUILDING REGULATIONS

The Building Control Decree states that the Building Code of Vietnam (BCV) is the mandatory code. The code is divided into the following:

- BCV part 1, 2, and 3 (structural, mechanical, plumbing and excavation)
- Construction accessibility for people with disabilities
- Natural physical and climatic data for construction
- Urban underground structures
- Classifications and grading of civil and industrial buildings and urban infrastructures.

REFERENCE STANDARDS

The building codes reference both Vietnam and international codes and standards. The types of standards in Vietnam are national, construction, and ministerial.

National standards, also known as Vietnam Standards (TCVN), and national/local technical standards are issued by the Vietnam Standards and Quality Institute (Directorate for Standards, Metrology and Quality, or STAMEQ). All national standards are ISO conforming. These standards are voluntary but become mandatory when incorporated into codes. While national technical standards are mandatory throughout Vietnam, local technical standards are mandatory only in specific regions/provinces. Construction standards (TCXDVN) are administered and developed by the Ministry of Construction. Construction standards are best practices on technical standards, work execution, technical indicators, and indicators of construction activities. They do not cover best practices on materials as those are part of the national standards. Construction standards include criteria for mandatory and voluntary standards. Ministerial standards are administered and developed by the Minister for administrative purposes. National standards are updated every three to five years, while construction and ministerial standards are updated as needed (STAMEQ 2012).

The building codes accept equivalent national and international standards. Thus, Vietnamese national and construction standards can draw upon international standards and no national equivalent exists. The codes also specify the use of equivalent international standards for fire safety design and structural design for earthquake zones when there are no equivalent Vietnamese national or construction standards.

GREEN FEATURES OF MANDATORY LAWS

Energy efficiency is incorporated into the Building Code through Decree No. 102/2003/ND-CP on thrifty and efficient use of energy.

TYPES OF BUILDINGS

Buildings are divided by type of use: hotels, high-grade office, foreign affairs office, retail, high-grade condominium, dwelling houses, public buildings (education buildings, cultural buildings, medical buildings, sports buildings, commercial buildings, and office buildings), and industrial buildings.

3. Code Details

MINIMUM CODES

Electrical. The mandatory electrical codes in Vietnam are as follows:

- Code on Electric Facility- Part I: General Regulation
- Code on Electric Facility- Part II: Electric Network
- Code on Electric Facility- Part III: Distribution Facility & Transformer Station
- Code on Electric Facility- Part IV: Protection & Automatic.

The mandatory technical codes include national codes for operation and maintenance of power system facilities, and for low-voltage electric network (technical codes specify installation methods and working procedures). Mandatory national technical regulations cover electric safety and safe work for electric welding and welding jobs.

Energy. Energy efficiency is incorporated into the Building Code of Vietnam through Decree No. 102/2003/ND-CP on thrifty and efficient use of energy.

Water and Sanitation. Plumbing requirements and standards are incorporated into the building codes. Other codes pertaining to water cover the internal water supply and drainage systems. Relevant technical regulations include national technical regulations on surface water quality, on underground water quality, on domestic wastewater, on drinking water quality, on domestic water quality, on wastewater of solid waste landfill sites, on health care wastewater, and on industrial wastewater.

Mechanical Systems. Requirements and standards pertaining to mechanical systems are included in the building codes. Other requirements include national technical regulations on safe work of steam boiler and pressure vessel, and on safe work for electric lift.

Indoor Air Quality. IAQ regulations include national technical regulations on ambient air quality, on hazardous substances in ambient air, and on industrial emission of organic substances.

Lighting. There is no mandatory lighting code or standards, but there are several voluntary national standards for lighting.

Security. There is no mandatory security code or standard; the Vietnam Building Code has some building security requirements.

Fire. Fire safety requirements and standards can be found in the Building Code, and the building code on fire safety of buildings. Many fire safety requirements are also in other electrical and mechanical codes, and national technical standards.

Structural. The Building Code contains extensive structural standards and requirements. Other codes with structural requirements are building codes for urban underground structures, for classifications and grading of civil and industrial buildings and urban infrastructures, and for urban engineering infrastructures.

Location/Siting/Zoning and Environment. Vietnam's building code has requirements and standards for regional and urban planning and rural residential planning. It also has extensive standards for city planning and zoning. The Government of Vietnam has also developed extensive national technical regulations on the following: effluents of the natural rubber processing industry, emissions of health care solid waste incinerators, allowable limits of heavy metals in the soils, effluents of the aquatic products processing industry, pesticide residue in the soil, hazardous waste thresholds, industrial emissions of inorganic substances and dusts, and emissions of the thermal power industry.

Safety. The Ministry of Health administers the Dwellings and Public Buildings - Occupational Health and Safety Regulation. Even if the Building Code does not mention this regulation, building permits are only issued if the regulation is complied with.

GREEN BUILDING CODES IN VIETNAM

Green Features in Mandatory Code

Energy efficiency requirements have been incorporated into the Building Code through Decree No. 102/2003/ND-CP on thrifty and efficient use of energy.

Other Green Features Affecting Buildings

In 2004, Viet Nam agenda 21 was approved and the National Sustainable Development Council was established. In 2008, Vietnam began its climate change response, which initially focused on NTP-RCC and development of provincial and sector action plans. In 2011, the government initiated development of a climate change strategy, the Vietnam Green Growth Strategy. The strategy is driven by the national policy agenda and Vietnam's desire to support international efforts to combat climate change. It is administered by the Ministry of Planning and Investment. The building and construction industry is one focus of the strategy. Its agenda includes biodiversity conservation, innovation in the efficient use of natural resources, and energy security. It is a means to accelerate economic restructuring for the efficient use of natural resources, reduce greenhouse gas emissions through research and application of modern technologies, develop infrastructure to improve economic efficiency, cope with climate change, reduce poverty, and support sustainable economic growth. This strategy may lead to development of mandatory green building standards in Vietnam.

Green Building Rating Tool

The Green Building Council's LOTUS is a voluntary rating tool applicable in two versions, one for residential buildings and the other for nonresidential buildings. (A third tool for building in operation will be released in 2013.) Both versions cover nine categories: energy, water, materials, ecology, waste and pollution, health and comfort, adaptation and mitigation, community and management. An "innovation" category rewards exceptional performance or initiatives not specifically addressed by LOTUS. Each category carries a number of credits and each credit has criteria that carry individual scoring points. Many credits have mandatory prerequisites for achieving any rating. The three levels of certification (certified, silver and gold) are based on the number of points a project receives (Vietnam Green Building Council 2012).

Bibliography

- AIA. (2006). *Guidelines for Design & Construction of Health Care Facilities (2006 edition)*. Washington D.C.: American Institute of Architects.
- APEC (2009), Voluntary Commercial Energy Codes in 1992,
http://www.egeec.apec.org/www/UploadFile/Building_Energy_Codes_Best_Practice%20_Summary_ReportAPECfinal.pdf
- APEC. (2010). *Brunei Energy Efficiency*. Retrieved 2010, from IEEE of Japan:
http://www.ieej.or.jp/aperc/CEEP/2010/Brunei_2010.pdf
- ASHRAE. (2012, June). *Standards & Guidelines*. Retrieved December 2012, from American Society for Heating, Refrigeration, Air-conditioning Engineers: <http://www.ashrae.org/standards-research-technology/standards--guidelines>
- ASME (A). (2012, June). *Fossil Energy*. Retrieved December 2012, from ASME Standards & Certification Energy-Related Products and Services: <http://www.asme.org/kb/standards/asme-energy-standards--certification---training-pr>
- ASTM International 1. (2012, November). *Sustainability Standards*. Retrieved December 2012, from ASTM International: <http://www.astm.org/Standards/sustainability-standards.html>
- ASTM International. (2012, June). *Adhesive Standards*. Retrieved December 2012, from ASTM International Standards: <http://www.astm.org/Standards/adhesive-standards.html>
- Attorney's General Office of South Australia. (2002, December). *Energy Products (Safety and Efficiency) Act 2000*. Retrieved December 2012, from South Australian Legislation:
[http://www.legislation.sa.gov.au/LZ/C/A/ENERGY%20PRODUCTS%20\(SAFETY%20AND%20EFFICIENCY\)%20ACT%202000.aspx](http://www.legislation.sa.gov.au/LZ/C/A/ENERGY%20PRODUCTS%20(SAFETY%20AND%20EFFICIENCY)%20ACT%202000.aspx)
- Australian Energy Market Commission. (2011, June). *National Electricity Rules: Current Rules*. Retrieved December 2012, from Australian Energy Market Commission:
<http://www.aemc.gov.au/Electricity/National-Electricity-Rules/Current-Rules.html>
- Australian Government. (2012, September 25). *Greenhouse and Energy Minimum Standards Act 2012*. Retrieved December 2012, from Australian Government ComLaw:
<http://www.comlaw.gov.au/Details/C2012A00132>
- BCA A. (2006, June). *Building Control Act*. Retrieved December 2012, from BCA:
http://www.bca.gov.sg/BuildingControlAct/building_control_act.html
- BCA Academy. (2007). *Design Guide of High Strength Concrete to Singapore Standard CP 65*. Singapore: BCA Academy.
- BCA Academy. (2008). *BC 1: 2008 Design Guide on Use of Alternative Steel Materials to BS 5950*. Singapore: BCA Academy.

- BCA B. (2006, June). *Building Maintenance and Strata Management Act/Regulation*. Retrieved December 2012, from BCA: <http://www.bca.gov.sg/publications/BMSM/BMSM.html>
- BCA C. (2011, November). *Building and Construction Industry Security of Payment Act/Regulations*. Retrieved December 2012, from BCA: http://www.bca.gov.sg/publications/SecurityofPayment/sop_act.html
- BCA D. (2001). *Code on Envelope Thermal Performance for Buildings*. Singapore: BCA.
- BCA D. (2007). *Code on Accessibility in the Built Environment*. Singapore: Building and Construction Authority.
- BCA E. (2004). *Code of Practice on Buildable Design*. Singapore: BCA.
- BCA. (2010). *Construction Quality Assessment System (CONQUAS)*. Singapore: BCA Academy.
- Brunei Department of Electricity (2012), Electrical Act 1973, http://www.des.gov.bn/bdes/index.php?option=com_content&task=view&id=19&Itemid=40
- Brunei Ministry of Development (2011). Qualified Person, <http://www.mod.gov.bn/abci/images/stories/forms/Lampiran1.pdf>
- Brunei Ministry of Development (2012). Planning Guidelines and Standards for Commercial Development, <http://www.tcp.gov.bn/index.php/79-buku/97-buku-planning-guidelines-and-standards-for-commercial-development>
- Brunei Ministry of Development (A) (2011). Planning Guidelines and Standards for Earthwork Development, <http://www.tcp.gov.bn/index.php/79-buku/111-buku-planning-guidelines-and-standards-for-earthwork-development>
- Brunei Ministry of Development (B) (2011). Guidelines for Planning Permission Application of Land and Buildings, <http://www.tcp.gov.bn/index.php/79-buku/112-buku-garispenduan-kebenaran-perancangan-bagi-permohonan-kemajuan-tanah-dan-bangunan>
- Brunei Ministry of Development (C) (2011). internal (Brunei) and International Fire Codes, http://www.mod.gov.bn/abci/index.php?option=com_content&view=article&id=7&Itemid=17
- Brunei Public Works Department (2012), Water Quality Guidelines, <http://www.pwd.gov.bn/index.php/water>
- Brunei Standards Agency (2012). Brunei Standards, http://www.mod.gov.bn/forms/List_of_PBD_&_GD.pdf
- Building and Construction Authority of Singapore. (2012, June). *BCA Organization Chart*. Retrieved December 2012, from BCA: http://www.bca.gov.sg/AboutUs/others/org_structure.pdf

- Buildings Authority I. (2011, April). *Comprehensive Environmental Performance Assessment Scheme for Buildings*. Retrieved December 2012, from Buildings Department:
http://www.bd.gov.hk/english/documents/index_CEPAS.html
- Buildings Department A. (2005, June). *Code of Practice of Steel Construction in Hong Kong*. Retrieved December 2012, from Buildings Dept.:
<http://www.bd.gov.hk/english/documents/code/steel/SUOS2005.pdf>
- Buildings Department A. (2012, October). *Pre-accepted Structural Programme*. Retrieved December 2012, from Buildings Department: http://www.bd.gov.hk/english/inform/comprogram/asp_p.pdf
- Buildings Department B. (2012, October). *Pre-accepted Geotechnical Programme*. Retrieved December 2012, from Buildings Department: <http://www.bd.gov.hk/english/inform/comprogram/agp.pdf>
- Buildings Department C. (2012, October). *Pre-accepted Miscellaneous Programme*. Retrieved December 2012, from Buildings Department: <http://www.bd.gov.hk/english/inform/comprogram/amp.pdf>
- Buildings Department D. (2012, January). *Operation Building Bright*. Retrieved December 2012, from Buildings Department: http://www.bd.gov.hk/english/documents/OBB/OBB_e.pdf
- Buildings Department E. (2012, June). *Minor Work Control Scheme*. Retrieved December 2012, from Buildings Department: http://www.bd.gov.hk/english/documents/index_cglist.html
- Buildings Department F. (2012, January). *Make Sure Bamboo Scaffolds are Safe Against Wind*. Retrieved December 2012, from Buildings Department:
http://www.bd.gov.hk/english/documents/pamphlet/wind_e.pdf
- Buildings Department G. (2012, January). *Codes of Practice and Design Manuals*. Retrieved December 2012, from EMSD: http://www.bd.gov.hk/english/documents/index_crlist.html
- Canadian Standards Agency (2012), CSA standards,
<http://www.csa.ca/cm/ca/en/standards/products/occupational-health-and-safety>
- Catálogo de Normas Técnicas Peruanas. INDECOPI. Website. February 7, 2013.
- Christopher, D. L. (2010, June). *Building Better Cities with BERDE*. Retrieved December 2012, from League of Cities of the Philippines: http://www.lcp.org.ph/ea_convention/BS-05-04-C_DelaCruz.pdf
- City of Irvine, CA. (2008, June). *Uniform Security Code*. Retrieved December 2012, from City of Irvine:
<http://www.cityofirvine.org/civica/filebank/blobload.asp?BlobID=6579>
- City of San Mateo, CA. (2008, June). *23.54 Building Security Code*. Retrieved December 2012, from City of San Mateo, California: <http://www.cityofsanmateo.org/index.aspx?NID=739>
- Construction and Planning Agency (2012). Building Act,
http://www.cpami.gov.tw/english/index.php?option=com_content&view=article&id=10789&Itemid=15

- Construction and Planning Agency (A0 (2012). Construction Industry Act, http://www.cpami.gov.tw/english/index.php?option=com_content&view=article&id=10788&Itemid=15
- D.F.L 458 de 1975 Ley General de Urbanismo y Construcciones- updated by Law 20599, published in the official paper of June 11 2012. http://www.minvu.cl/opensite_20070404173759.aspx
- Department of Building and Housing of New Zealand (2012). Department of Building and Housing, <http://www.dbh.govt.nz/>
- Department of Electrical Services. (1973). *Electrical Act 1973*. Retrieved 1973, from Prime Minister's Office: <http://www.des.gov.bn/bdes/documents/Electrical%20Act%20Order%201973.pdf>
- Department of Occupational Health and Safety of Malaysia (2011). Code of Practice (COP) on Indoor Air Quality, <http://www.dosh.gov.my/doshv2/phocadownload/CodeOfPractice/codeofpracticeonindoorairquality.pdf>
- Department of Occupational Health and Safety of Malaysia (B) (2011). Code of Practice (COP) on Occupational Safety and Health, <http://www.dosh.gov.my/doshv2/phocadownload/guidelines/garispenduan33.pdf>
- Department of Occupational Health and Safety of Malaysia (B) (2011). Code of Practice (COP) on Occupational Safety and Health, <http://www.dosh.gov.my/doshv2/phocadownload/guidelines/garispenduan33.pdf>
- Department of Occupational Health and Safety of Malaysia (C) (2011). Guidelines for Public Safety and Health at Construction Site, http://www.dosh.gov.my/doshV2/phocadownload/guidelines/gl_construction_site_bi.pdf
- Department of Occupational Health and Safety of Malaysia (D) (2011). Code of Practice for Safe Working in a Confined Space, http://www.dosh.gov.my/doshv2/phocadownload/CodeOfPractice/ve_conf_space.pdf
- Department of Planning (New Zealand) (2012). Quality Planning Act, <http://qualityplanning.org.nz/qplibrary/index.php?browse=subject&subjectid=304#Urban+areas>
- Deputy Prime Minister of Singapore. (2004). *Enhancing Building Security: Useful and Practical Measures*. Singapore: Singapore Government.
- DOD 1. (2012, February 9). UFC 4-010-01: Unified Facilities Criteria (UFC) DoD Minimum Antiterrorism Standards for Buildings. Washington, District of Columbia, USA. Retrieved from http://www.wbdg.org/ccb/DOD/UFC/ufc_4_010_01.pdf
- DoD. (2006). *Standard Practice for Unified Facilities Criteria and Unified Facilities Guide Specifications*. Washington D.C.: Department of Defense.

- DOE-2. (2012, June). *The Home of DOE-2 Based Building Energy Use and Cost Analysis Software*. Retrieved December 2012, from DOE-2: <http://doe2.com/>
- DPT (Thailand). (2012, June). *Law Database*. Retrieved December 2012, from Department of Public Works and Town & Country Planning: <http://www.dpt.go.th/index.php>
- Electrical Safety Office of Queensland. (2010, October). *Electrical Safety Code of Practice 2010*. Retrieved December 2012, from Department of Justice and Attorney-General of Queensland: http://www.justice.qld.gov.au/__data/assets/pdf_file/0009/8919/eso-cop-exposed-live-parts-collated.pdf
- EMA. (2012, November). *Energy Market Authority*. Retrieved December 2012, from Energy Market Authority: <http://www.ema.gov.sg/>
- EMSD A. (2012, February). *Guidelines on Energy Audit*. Retrieved December 2012, from EMSD: http://www.emsd.gov.hk/emsd/e_download/pee/Guidelines_on_Energy_Audit.pdf
- EMSD B. (2012, June). *Code of Practice for Energy Efficiency of Building Services Installation*. Retrieved December 2012, from EMSD: http://www.beeo.emsd.gov.hk/en/pee/BEC_2012.pdf
- EMSD H. (2005, September). *Code of Practice for Energy Efficiency of Lighting Installations*. Retrieved December 2012, from EMSD: http://www.emsd.gov.hk/emsd/e_download/pee/lightingcop.pdf
- EMSD. (2009, June). *Code of Practice for the Electricity (Wiring) Regulations*. Retrieved December 2012, from EMSD: http://www.emsd.gov.hk/emsd/e_download/pps/pub/COP_E.pdf
- EMSD. (2012, January). *Energy Consumption Indicators and Benchmarks for Residential, Commercial and Transport Sectors*. Retrieved December 2012, from EMSD: <http://ecib.emsd.gov.hk/en/index00.htm>
- EMSD. (2012, June). *Electrical and Mechanical Services Department*. Retrieved December 2012, from EMSD: <http://www.emsd.gov.hk/emsd/eng/welcome/index.shtml>
- Energy Rating of Australia. (2012, October). *Australian GEMS Regulator*. Retrieved December 2012, from Equipment Energy Efficiency: <http://www.energyrating.gov.au/regulations/regulators/>
- Energy Safety of New Zealand (2012). *Electrical Codes of Practice*, <http://www.med.govt.nz/energysafety/legislation-policy/electricity-acts-regulations-codes/standards-and-codes-of-practice/new-zealand-electrical-codes-of-practice>
- Environment Australia. (2011, June). *Department of Sustainability, Environment, Water, Population and Communities*. Retrieved December 2012, from Department of Sustainability, Environment, Water, Population and Communities: <http://www.environment.gov.au/>
- Environment Australia. (2012, October 27). *Water legislation*. Retrieved December 2012, from Australian Commonwealth Government's Environmental Australia: <http://www.environment.gov.au/water/australia/water-act/index.html>

- Environment Canada (1999). Canadian Environmental Protection Act 1999, <http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=E00B5BD8-1>
- Environment Protection Agency of Taiwan (2010). Indoor Air Quality Act, <http://law.epa.gov.tw/en/laws/502150009.html>
- Environmental Bureau. (2012, June). *Guidelines on Industry Best Practices for External Lighting Installations*. Retrieved December 2012, from Environmental Bureau: http://www.enb.gov.hk/en/resources_publications/guidelines/files/guidelines_ex_lighting_install_eng.pdf
- Environmental Protection Department. (2011, December). *Law and Regulations: Environmental Legislation*. Retrieved December 1, 2012, from Environmental Protection Department: http://www.epd.gov.hk/epd/english/laws_regulations/envir_legislation/laws_maincontent_lor.html
- EPA Brownfield. (2012, October 26). *Brownfields and Land Revitalization*. Retrieved December 1, 2012, from USEPA: <http://www.epa.gov/brownfields/>
- EPA Community Planning. (2012, January). *Community Action for Environmental Public Health*. Retrieved December 1, 2012, from EPA: <http://www.epa.gov/communityhealth/landuse.html>
- EPA IAQ. (2012, November). *Indoor Air Quality*. Retrieved December 2012, from EPA IAQ Website: <http://www.epa.gov/iaq/>
- EPA Land Use. (2011, November). *Land Use*. Retrieved December 1, 2012, from EPA: <http://cfpub.epa.gov/eroe/index.cfm?fuseaction=list.listBySubTopic&ch=48&s=225>
- EPA Polluted Runoff Program. (2012, November 7). *Polluted Runoff (Nonpoint Source Pollution)*. Retrieved December 1, 2012, from EPA Polluted Runoff Programs: http://www.epa.gov/owow_keep/NPS/index.html
- EPA Regulations. (2012, October). *Regulatory Topics*. Retrieved December 1, 2012, from EPA Laws and Regulations: <http://www.epa.gov/lawsregulations/topics/index.html>
- EPA Smart Growth 1. (2009, November). *Essential Smart Growth Fixes for Urban and Suburban Zoning Codes*. Retrieved December 1, 2012, from Environmental Protection Agency: http://www.epa.gov/smartgrowth/pdf/2009_essential_fixes.pdf
- EPA Smart Growth 2. (2012, February). *Essential Smart Growth Fixes for Rural Planning, Zoning, and Development Codes*. Retrieved December 2012, from Environmental Protection Agency: http://www.epa.gov/smartgrowth/pdf/rural_essential_fixes_508_030612.pdf
- EPA Stormwater Program. (2012, April 16). *Authorization Status for EPA's Stormwater Construction and Industrial Programs*. Retrieved December 3, 2012, from National Pollutant Discharge Elimination System (NPDES): <http://cfpub.epa.gov/npdes/stormwater/authorizationstatus.cfm>

- EPA Stormwater. (2012, February). *National Pollutant Discharge Elimination System (NPDES)*. Retrieved December 2012, from EPA: http://cfpub.epa.gov/npdes/home.cfm?program_id=6
- EPA Superfund. (2012, January). *Cleaning up the Nation's Hazardous Wastes Sites*. Retrieved December 1, 2012, from EPA: <http://www.epa.gov/superfund/policy/index.htm>
- EPA UIC. (2012, September 12). *Underground Injection Control Program*. Retrieved December 2, 2012, from Water: Underground Injection Control: <http://www.epa.gov/ogwdw/uic/>
- EPA Wastewater Management Program. (2012, October 12). *Wastewater Management*. Retrieved December 2, 2012, from Water: Wastewater Programs: <http://water.epa.gov/polwaste/wastewater/>
- EPA Water (A). (2012, November 29). *Laws & Executive Orders*. Retrieved December 2, 2012, from EPA Water Division: <http://water.epa.gov/lawsregulations/lawsguidance/index.cfm>
- EPA Water (C). (2012, March 6). *Safe Drinking Water Act (SDWA)*. Retrieved December 2, 2012, from EPA Water Division: <http://water.epa.gov/lawsregulations/rulesregulations/sdwa/index.cfm>
- EPA Water (E). (2012, December 4). *Low Impact Development (LID)*. Retrieved December 4, 2012, from Water: Low Impact Development: <http://water.epa.gov/polwaste/green/>
- EPA Water Program (D). (2012, January 31). *Sediments*. Retrieved December 4, 2012, from EPA Water Program: <http://water.epa.gov/polwaste/sediments/>
- EPA Water. (2012, October 17). *State, Tribal & Territorial Standards: Water Quality Standards Repository*. Retrieved December 1, 2012, from EPA Water Standards: <http://water.epa.gov/scitech/swguidance/standards/wqslibrary/index.cfm>
- EPA Wetland. (2012, October 9). *Wetlands*. Retrieved December 1, 2012, from Environmental Protection Agency: <http://water.epa.gov/type/wetlands/>
- EPD A. (2012, November 6). *Non-Statutory Environmental Standards and Guidelines*. Retrieved December 4, 2012, from Environmental Protection Department: http://www.epd.gov.hk/epd/english/envir_standards/non_statutory/esg_non_stat.html
- EPD. (2012, November 28). *Statutory Environmental Standards and Guidelines*. Retrieved December 1, 2012, from Environmental Protection Department: http://www.epd.gov.hk/epd/english/envir_standards/statutory/esg_stat.html
- FAO (2010), National Energy Policy, <http://faolex.fao.org/docs/pdf/ins64284.pdf>
- Federal Government of Malaysia (2011). Tenth Malaysia Plan, http://www.epu.gov.my/html/themes/epu/html/RMKE10/rmke10_english.html
- Federal Regulations Services Administration. (2006). 10-CFR 434). In *10-CFR 434* (pp. 348 - 414). Washington D.C.: Federal Regulations Services Administration.

- Federal Wildlife Services. (2012, June). *Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service: Endangered Species Act of 1973*. Retrieved 2012 1, December, from Federal Wildlife Services: <http://www.fws.gov/laws/lawsdigest/esact.html>
- General Services Administration. (1995, September). METRIC DESIGN GUIDE (PBS-PQ260). Washington D.C., District of Columbia, USA. Retrieved from <http://www.wbdg.org/ccb/GSAMAN/mdg.pdf>
- Government of Canada. (2012, June). *CCBFC Standing Committee Activities*. Retrieved December 2012, from Government of Canada: http://www.nationalcodes.nrc.gc.ca/eng/ccbfc/committee_activities.shtml
- Government of Canada. (2012, June). *CCBFC Standing Committee Activities*. Retrieved December 2012, from Government of Canada: http://www.nationalcodes.nrc.gc.ca/eng/ccbfc/committee_activities.shtml
- Green Building Index of Malaysia (2012), [Green Building Index](#), <http://www.greenbuildingindex.org/Resources/GBI%20Documents/GBI%20Explanatory%20Booklet%202012%2003.pdf>
- GSA 1. (2010). *Facilities Standards for the Public Buildings Service*,. Washington D.C.: General Services Administration Press.
- GSA. (2012, June). *Policy Guides*. Retrieved December 2012, from U.S. General Services Administration: <http://www.gsa.gov/portal/content/280533>
- Hab, R. (2011, January 11). *DES publishes electrical safety guide*. Retrieved December 2012, from The Brunei Times: <http://www.bt.com.bn/news-national/2011/01/11/des-publishes-electrical-safety-guide>
- Hkbcxc. (2012, March). *Management Practice Guidance Note on Air Duct Cleaning*. Retrieved December 2012, from Hong Kong Building Commissioning Center: http://www.hkbcxc.org/pdf/GN_Air_Duct_Cleaning_v2-0-11-C.pdf
- Hong Kong Legislation. (2011, March). *Building Energy Efficiency Ordinance*. Retrieved December 2012, from Hong Kong Legislature: http://www.legislation.gov.hk/blis_ind.nsf/WebView?OpenAgent&vwpg=CurAllEngDoc*607*100*607.1#607.1
- Hong Kong SAR. (2012, September). Building Ordinance of Hong Kong. *Ordinance of Hong Kong* .
- IANZ (2012). International Accreditation New Zealand (IANZ), <http://www.ianz.govt.nz/about2/about.htm>
- IDSA 2. (2012, March). IDA Suggested Lighting Zones for Codes and Ordinances. Tucson, Arizona, USA. Retrieved from <http://www.darksky.org/outdoorlighting/175-recommended-lighting-zones>

- IDSAs. (2000). Outdoor Lighting Code Handbook Version 1.14. Tucson, Arizona, USA. Retrieved from <http://www.darksky.org/assets/documents/Lighting%20Code%20Handbook.pdf>
- IDSAs. (2012, June). *SIMPLE GUIDELINES FOR LIGHTING REGULATIONS for Small Communities, Urban Neighborhoods, and Subdivisions*. Retrieved December 2, 2012, from IDSA: <http://www.darksky.org/outdoorlighting/80-simple-guidelines>
- IDSAs-IESNA. (2011, June 15). *JOINT IDA - IES MLO*. Retrieved December 12, 2012, from IDSA: http://www.darksky.org/assets/documents/MLO/MLO_FINAL_June2011.pdf
- IEEE (2007), International Energy Use, <http://www.eccj.or.jp/cooperation/2-1-3/2009-2010/em.pdf>
- IEEE. (2012, June). *National Electrical Safety Code® (NEC®)*. Retrieved December 2012, from IEEE Standards Association: <http://standards.ieee.org/about/nesc/index.html>
- IESNA. (2012, November). *Lighting Handbook*. Retrieved December 2012, from IESNA: <http://www.ies.org/handbook/pdf/>
- Implementation of Latin America's First Certification System. APEC Presentation by Chie. Green Buildings and Green Growth: The Enabling Role of Standards and Trade. Housing and Urban Ministry. Government of Chile. Washington, D.C., United States 3-4 March 2011.
- Indoor Air Quality A. (2003, September). *Guidance Notes for the Management of Indoor Air Quality in Offices and Public Places*. Retrieved December 2012, from IAQ Office: http://www.iaq.gov.hk/guidance/doc/gn_eng.pdf
- Indoor Air Quality B. (2003, September). *A Guide on Indoor Air Quality Certification Scheme for Offices and Public Places*. Retrieved December 2012, from IAQ: <http://www.iaq.gov.hk/%5Ccert%5Cdoc%5CCertGuide-eng.pdf>
- Instituto Nacional de Normalizacion (INN) Online Catalogue. http://www.inn.cl/pdfs/catalogonormas/Catalogo_2012%2012_Diciembre.pdf, February 7, 2013.
- Jee, Y. J. (2005). Recently issues on Indoor air quality in Korea. *Department of Occupational and Environment Health* .
- KATS. (2012, December). *Korean Agency of Technology and Science*. Retrieved December 2012, from Ministry of Knowledge Economy: <http://www.kats.go.kr/english/index.asp>
- Korea Concrete Institute. (2012, June). *Publications*. Retrieved December 2012, from Korea Concrete Institute: <http://www.kci.or.kr/eng/introduce4.asp>
- Korea Energy Management Corporation (a). (2012, June). *Building Certification System*. Retrieved December 2012, from Korea Energy Management Corporation: http://www.kemco.or.kr/new_eng/pg02/pg02010100.asp

- Korea Energy Management Corporation (b). (2012, June). *Energy Audit*. Retrieved December 2012, from Korea Energy Management Corporation: http://www.kemco.or.kr/new_eng/pg02/pg02060000.asp
- Korea Energy Management Corporation. (2012, June). *Energy Saving Criteria for Buildings*. Retrieved December 2012, from Korea Energy Management Corporation: http://www.kemco.or.kr/new_eng/pg02/pg02010200.asp
- Korea Green Building Council. (2012, June). *Green Building Certification Criteria*. Retrieved December 2012, from Korea Green Building Council: http://www.greenbuilding.or.kr/eng/html/sub02_2.jsp
- Korean Society of Steel Construction. (2012, December). *Standards*. Retrieved December 2012, from Korean Society of Steel Construction: <http://www.kssc.or.kr/english/introduction/sub03.asp>
- KRISS. (2012, June). *Korean Research Institute of Standards and Science*. Retrieved December 2012, from KRISS: <http://www.kriss.re.kr/eng/main/index.html>
- Law of Brunei. (2011). *Electricity Act of 2011*. Retrieved December 2012, from Department of Energy: <http://www.energy.gov.bn/info/Text%20Of%20Actz/Electricity%20-%20Chapter%2071.pdf>
- Law Society of Korea. (2012, June). *Construction Laws and Ordinance*. Retrieved December 2012, from Law Society of Korea: <http://www.law.go.kr/lstAstSc.do?menuId=9&tabNo=1#AJAX>
- Laws of Malaysia (1976). Town and Country Planning Act, <http://www.agc.gov.my/Akta/Vol.%204/Act%20172.pdf>
- Metodología para Elaboración de Normas. Ministerio de Vivienda, Construcción y Saneamiento. 2008.
- Ministry of Construction of Vietnam. (2012, June). *Ministry of Construction*. Retrieved December 2012, from Ministry of Construction: <http://www.xaydung.gov.vn/>
- Ministry of Environment (a). (2012, June). *Environmental Laws*. Retrieved December 2012, from Ministry of Environment: <http://www.env.go.jp/en/laws/>
- Ministry of Environment of Japan (b). (2012, June). *Environmental Quality Standards of Japan*. Retrieved December 2012, from Ministry of Environmen: <http://www.env.go.jp/en/standards/>
- Ministry of Environment. (2012, June). *Indoor Air Quality Control in Public Use Facilities, etc, Act*. Retrieved December 2012, from Ministry of Environment: http://eng.me.go.kr/content.do?method=moveContent&menuCode=pol_hnc_liv_ind_contents
- Ministry of Law (2012). Electricity Act, <http://law.moj.gov.tw/Eng/LawClass/LawAll.aspx?PCode=J0030011>
- Ministry of Law (Thailand). (2012, June). *Building Control Act*. Retrieved December 2012, from Ministerial Regulations: <http://61.19.54.137/law/dpmlaw/main/content.php?page=sub&category=307&id=1066>

- Ministry of Natural Resources and Environment. (2012, June). *Environmental Standards*. Retrieved December 2012, from Pollution Control Department: <http://www.pcd.go.th/indexEng.cfm>
- MLTM (b). (2012, June). *Statute and Acts*. Retrieved December 2012, from Ministry of Land, Transport and Maritime: http://mltm.go.kr/USR/ordinance/m_15019/1st.jsp
- MLTM (c). (2012, June). *Building Control Act*. Retrieved December 2012, from Ministry of Labor, Transport and Maritime Affairs: http://english.mltm.go.kr/upload/eng_law/20110310143848551_BUILDING%20ACT.pdf
- MLTM. (2012, June). *Building Laws and Regulations*. Retrieved December 2012, from Ministry of Land, Transport and Maritime: http://mltm.go.kr/USR/WPGE0201/m_9302/DTL.jsp
- National Academy of Sciences. (2003). *ISC Security Design Criteria for New Federal Office Buildings and Major Modernization Projects: A Review and Commentary*. Washington D.C.: National Academy of Sciences.
- National Crime Prevention Council. (2003). *Crime Prevention Through Environmental Design*. Singapore: NCPC.
- NEA. (2012, June). *National Environment Agency*. Retrieved December 2012, from National Environment Agency: <http://app2.nea.gov.sg/index.aspx>
- NEA. (2012, September). *Codes and Best Practices of the NEA*. Retrieved December 2012, from National Environment Agency: <http://app2.nea.gov.sg/codeofpractice.aspx>
- NECA. (2012, June). *National Electrical Installation Standards*. Retrieved December 2012, from National Electrical Installation Standards: <http://www.neca-neis.org/>
- New Zealand Legislature (1991). Resource Management Act 1991, <http://www.legislation.govt.nz/act/public/1991/0069/latest/DLM230265.html><http://www.legislation.govt.nz/act/public/1991/0069/latest/DLM230265.html>
- NFPA 1. (2012, June). *NFPA 1: FIRE CODE*. Retrieved December 1, 2012, from National Fire Protection Association: <http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=1>
- NFPA 2. (2012, November). *LIST OF NFPA CODES & STANDARDS*. Retrieved December 2012, from National Fire Protection Association: http://www.nfpa.org/aboutthecodes/list_of_codes_and_standards.asp?cookie_test=1
- NFPA. (2011, January 10). *NFPA 70: NATIONAL ELECTRICAL CODE®*. Retrieved December 2012, from National Fire Protection Association: <http://www.nfpa.org/AboutTheCodes/AboutTheCodes.asp?docnum=70&tab=docinfo>
- NIST GCR 12-917-18. Comparison of US and Chilean Building Code Requirements and Seismic Design Practice 1985-2010. NEHRP Consultants Joint Venture. A partnership of the Applied Technology Council and the Consortium of Universities for Research in Earthquake Engineering. October 2012.

- Oficina Económica y Comercial de la Embajada de España en Santiago de Chile. El sector de la Ingeniería y de Construcción en Chile. Instituto Espanol de Comercio Exterior ICEX. Octubre 2011.
- OSHA IAQ. (2006, June). *Indoor Air Quality*. Retrieved December 2012, from Occupational Safety and Health Administration: <http://www.osha.gov/SLTC/indoorairquality/>
- OSHA Technical Manual. (1999, January). *OSHA Technical Manual*. Retrieved December 2012, from OSHA: http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_2.html#5
- OSHC. (2012, September). *Construction Safety Handbook*. Retrieved December 2012, from Occupational Safety and Health Council: <http://www.oshc.org.hk/eng/media/communicate.asp?page=2>
- Proyecto. Ampliacion del Estudio sobre la Observancia del Reglamento de Construcciones en las Edificaciones Nuevas del Distrito Federal. Instituto de Ingenieria de la UNAM. Diciembre 2009.
- PUB. (2012, December). *Public Utilities Board*. Retrieved December 2012, from Public Utilities Board: <http://www.pub.gov.sg/Pages/default.aspx>
- Public Works Department of Malaysia (2006). Guidelines for mechanical system design and installation, [http://ratol.jkr.gov.my/cawmekanikal/images/stories/zoo/uploads/muat-turun/garis-panduan/ckm/BUKU%20HIJAU\(Mechanical%20System%20Design%20and%20Installation%20Guidelines%20for%20Architects%20and%20Engineers-2011\)%20Edited.pdf](http://ratol.jkr.gov.my/cawmekanikal/images/stories/zoo/uploads/muat-turun/garis-panduan/ckm/BUKU%20HIJAU(Mechanical%20System%20Design%20and%20Installation%20Guidelines%20for%20Architects%20and%20Engineers-2011)%20Edited.pdf)
- Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/tal.676
- PWD (b). (2012, June). *Building Control*. Retrieved December 2012, from Ministry of the Interior: <http://www.dpt.go.th/knowledges/firesafety/section01.htm>
- PWD (c) Thailand. (2012, December). *Department of Public Works and Town and Country Planning*. Retrieved December 2012, from Department of Public Works and Town and Country Planning: <http://www.dpt.go.th/index.php>
- PWD Thailand. (2012, June). *Fire Safety of Buildings*. Retrieved December 2012, from Department of Public Works and Town and City Planning: <http://www.dpt.go.th/knowledges/firesafety/index.htm>
- REDAS and HKCA. (2005, June). *Construction Site Safety Handbook*. Retrieved December 2012, from Safety Partnering of Hong Kong: http://www.safetypartnering.com/smd/pdf/handbook_e.pdf
- Reglamento Nacional de Edificaciones (RNE). Version 2006. Ministerio de Vivienda, Construcción y Saneamiento.
- S., C., P., C., Hien, V., Rugkwamsuk, P., & Kubaha, K. (2007). Revised Building Energy Code of Thailand: Potential Energy and Power Demand Savings. *Proceedings of the Joint International Conference on Sustainable Energy and Environment* . 2, pp. 1-10. State College, PA: ASCE.
- Security Bureau A. (2010, June). *Manual for Security Personnel* . Retrieved December 2012, from Security Bureau: <http://www.sb.gov.hk/eng/links/sgsia/pdf/Manual%20Eng.pdf>

- Security Bureau B. (2012, September). *Aide-Mémoire Suspicious Objects and Bombs*. Retrieved December 2012, from Security Bureau: <http://www.sb.gov.hk/eng/emergency/advice/security1.pdf>
- Seumteo. (2012, June). *Information on Construction, Business and Buildings*. Retrieved December 2012, from Seumto: <http://www.eais.go.kr/>
- Singapore Civil Defense. (2007). *Fire Code 2007 Master Version*. Singapore: Singapore Civil Defense.
- Singapore Green Mark. (2012, November). *Singapore Green Mark*. Retrieved December 2012, from Building and Construction Authority: http://www.bca.gov.sg/greenmark/green_mark_buildings.html
- SPRING Singapore. (2012, November). *SPRING Singapore*. Retrieved December 2012, from SPRING Singapore: <http://www.spring.gov.sg/Pages/homepage.aspx>
- STAMEQ. (2012, March). *Directorate for Standards, Metrology and Quality*. Retrieved December 2012, from STAMEQ: <http://en.tcvn.vn/>
- Tahan Government. (2010, June). *Brunei Land Use Syposium*. Retrieved December 2012, from Brunei Government: <http://www.tanah.gov.bn/Symposium/Hj%20Othman%20-%20SIMPOSIUM%20PAPER%20FINAL.pdf>
- Taiwan Green Building Label (2012). Green Building Labels, http://green.abri.gov.tw/art_1-2-en.php
- Taiwan Green Building Promotion (2012). Green Building Promotion Program in Chinese Taipei, <http://esci-ksp.org/?project=green-buildings-promotion-program-in-chinese-taipei>
- Taiwan Today (2009). Green outdoor space, reduction of pollution, and use of environmentally friendly materials, <http://taiwantoday.tw/ct.asp?xItem=191160&ctNode=413>
- Technical Services Information Bureau. (2008, September). *IBC Building Types*. Retrieved December 2012, from TSIB: http://www.tsib.org/pdf/technical/10-101_Building_Codes.pdf
- Technical Services Information Bureau. (2008, September). *IBC Building Types*. Retrieved December 2012, from TSIB: http://www.tsib.org/pdf/technical/10-101_Building_Codes.pdf
- Technology Media of Thailand. (2008, March). *Building Control Regulations of Thailand*. Retrieved December 2012, from Technology: http://www.technologymedia.co.th/PDF/etoday63_51/049-053.pdf
- Thai Green Building Council. (2012, June). *Thai Green Building Council*. Retrieved December 2012, from <http://www.tgbi.or.th/intro.php>
- The Building Center of Japan. (2012, June). *Building Standard Law of Japan*. Retrieved December 2012, from Building Center of Japan: http://www.bcj.or.jp/c20_international/baseline/src/2011kokuji-e.pdf
- The Energy Conservation Center of Japan. (2010, March). *The Energy Conservation Center of Japan*. Retrieved December 2012, from <http://www.eccj.or.jp/cooperation/2-1-3/2009-2010/em.pdf>

- The Structural Design of Tall and Special Buildings *Struct. Design Tall Spec. Build.* 19, 853–865 (2010)
- TISI (Thailand). (2012, June). *Thailand Industrial Standards Institute*. Retrieved December 2012, from Thailand Industrial Standards Institute: <http://www.tisi.go.th/>
- TRANE. (2002). *Indoor Air Quality - A Guide to Understanding ASHRAE Standards 62.1*. American Standards Incorporated.
- U.S. Environmental Protection Agency. (2004). *Guidelines for Water Reuse*. Office of Wastewater Management, Office of Water, Municipal Support Division. Washington DC: U.S. EPA.
- UNESCAP. (2007, June). *Selected National and State Laws and Regulations for Promotion of Energy Conservation and Efficiency in Countries of the Asia and Pacific Region*. Retrieved December 2012, from Compendium on Energy Conservation Legislation and Countries of the Asia and Pacific Region: <http://www.unescap.org/esd/publications/energy/compend/ceccpart4chapter10.htm>
- URA. (2012, December). *Urban Redevelopment Authority*. Retrieved December 2012, from URA: <http://www.ura.gov.sg/>
- Urban Renewal Authority A. (2012, November). *Our Projects*. Retrieved December 2012, from URA: <http://www.ura.org.hk/en/projects/heritage-preservation-and-revitalisation.aspx>
- Urban Renewal Authority. (2012, November). *Urban Renewal Strategy (URS)*. Retrieved 2012 December, from URA: <http://www.ura.org.hk/en/about-ura/strategy-and-planning/urban-renewal-strategy.aspx>
- Urban Renewal Strategy Review. (2008, July). *Welcome Message*. Retrieved December 2012, from Urban Renewal Strategy Review: <http://www.ursreview.gov.hk/eng/home.html>
- Vietnam Green Building Council. (2012, June). *LOTUS*. Retrieved December 2012, from Vietnam Green Building Council: www.vgbc.org.vn/
- Water Department of Brunei. (2012, December). *Water Quality Standards of Brunei*. Retrieved December 2012, from Public Works Department: <http://www.pwd.gov.bn/index.php/water>
- WBDG. (2012, December). *Security for Building Occupants and Assets*. Retrieved December 1, 2012, from National Institute of Building Sciences: http://www.wbdg.org/design/provide_security.php
- World Bank Paper No. 204, Mainstreaming Building Energy Efficiency Codes in Developing Countries. 2010. The International Bank for Reconstruction and Development/The World Bank
- World Health Organization (2010), WHO Guidelines, http://www.wsp.org/sites/wsp.org/files/publications/esi_indonesia.pdf
- World Health Organization. (2012, December). *Code of Practices for Plumbing*. Retrieved December 2012, from World Health Organization: Water: http://www.who.int/water_sanitation_health/hygiene/plumbing7.pdf

Yu, Ning (2007). Equipment Energy Efficiency Management and Promotion,
<http://www.greenprospectsasia.com/content/carrot-and-big-stick-taiwan's-energy-efficiency-promotion>