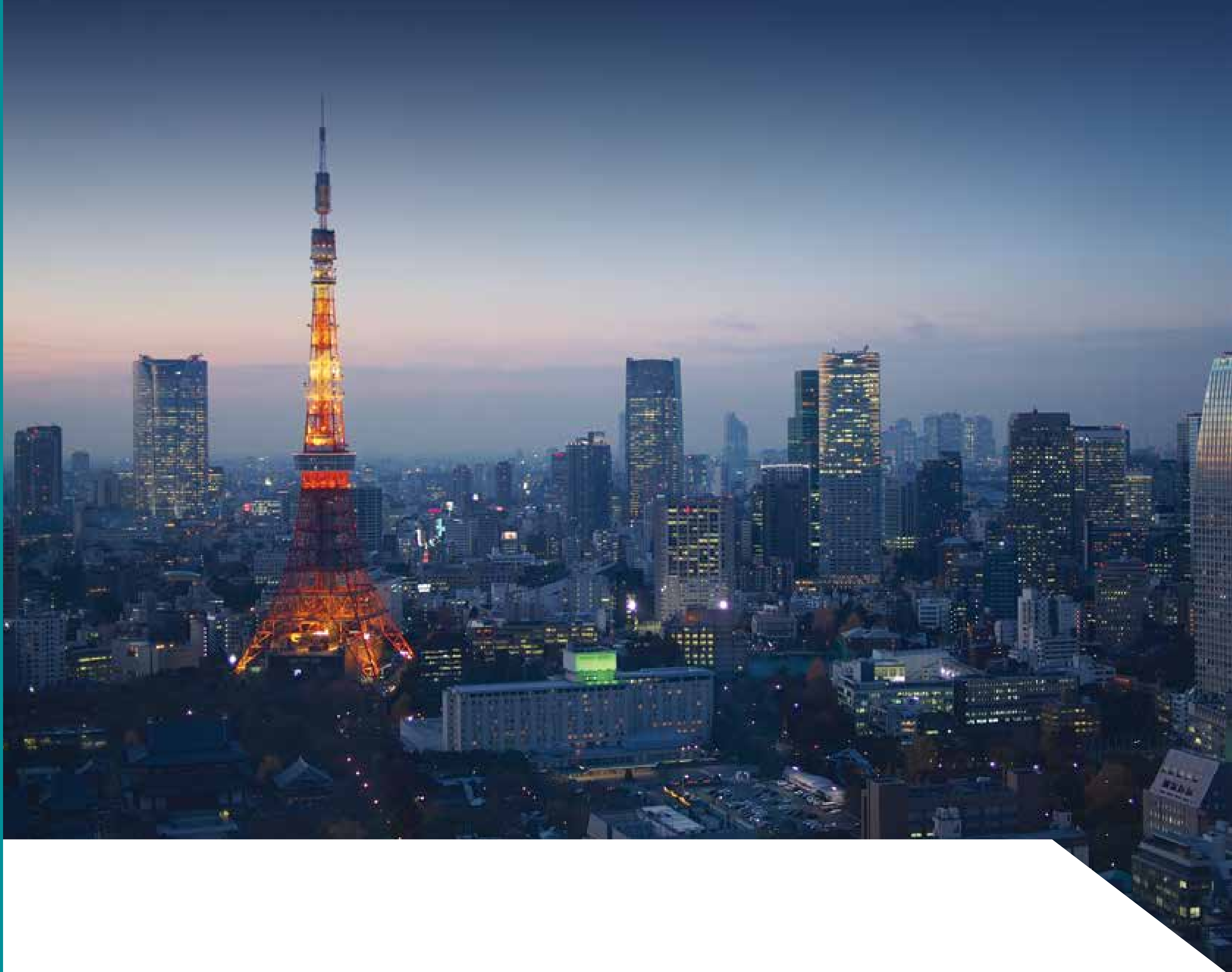

BUILDING REGULATION FOR RESILIENCE

Converting Disaster Experience into a Safer Built Environment:

The Case of Japan

THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

GFDRR
Global Facility for Disaster Reduction and Recovery

Contents

Abbreviations

APSRB	Act on Promotion of Seismic Retrofitting of Buildings
BSL	Building Standard Law
CISMID	Center for Earthquake Engineering and Disaster Mitigation
CLITT	College of Land, Infrastructure, Transport and Tourism
CPA	City Planning Act
FAR	floor area ratio
GFDRR	Global Facility for Disaster Reduction and Recovery
GHLC	Government Housing Loan Corporation
ISO	International Organization for Standardization
JAS	Japanese Agricultural Standards
JASS	Japanese Architectural Standard Specifications
JESJ	Japanese Engineering Standards
JHF	Japan Housing Finance Agency
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
JMA	Japan Meteorological Agency
MEP	mechanical, electrical, and plumbing
MEXT	Ministry of Education, Culture, Sports, Science and Technology
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
RC	reinforced concrete

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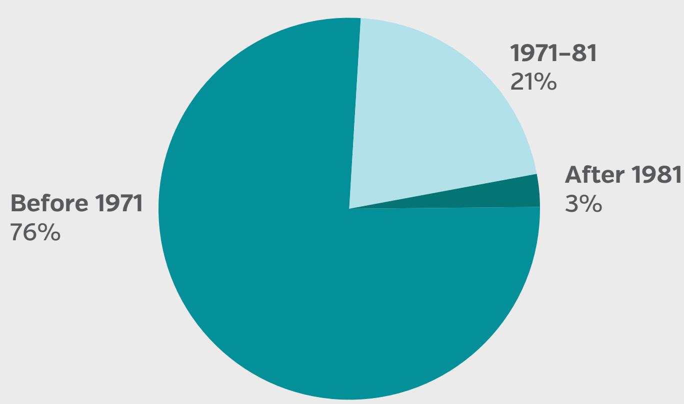
[1] *www.gfdrr.org*

1
Introduction

1.1 Japan's approach to building safety has been repeatedly tested—and proven effective

On January 17, 1995, the devastating Great Hanshin-Awaji Earthquake struck southern Hyogo Prefecture, causing 6,437 deaths and the collapse of about 100,000 houses. When the post-disaster damage analysis was complete, it showed something remarkable: the large majority of collapsed buildings—76 percent—had been constructed before 1971. A much smaller share—21 percent—had been constructed between 1971 and 1981. Buildings built after 1981 accounted for just 3 percent of the collapsed buildings (figure 1.1). A detailed survey of damaged wooden houses and reinforced concrete (RC) buildings in two areas affected by the earthquake supported this trend: the severe damage declined significantly as the construction year became more recent (figure 1.2). This pattern was highly significant because it demonstrated the effectiveness of Japan's seismic design standards and their continuous improvement. The standard had major revisions in 1971 and again in 1981. Buildings constructed to the 1971 standard performed far better than those built to an earlier standard; and buildings constructed to the 1981 standard performed best of all, with only a very small share suffering collapse.

Figure 1.1 Buildings Damaged in the Great Hanshin-Awaji Earthquake, by Year of Construction

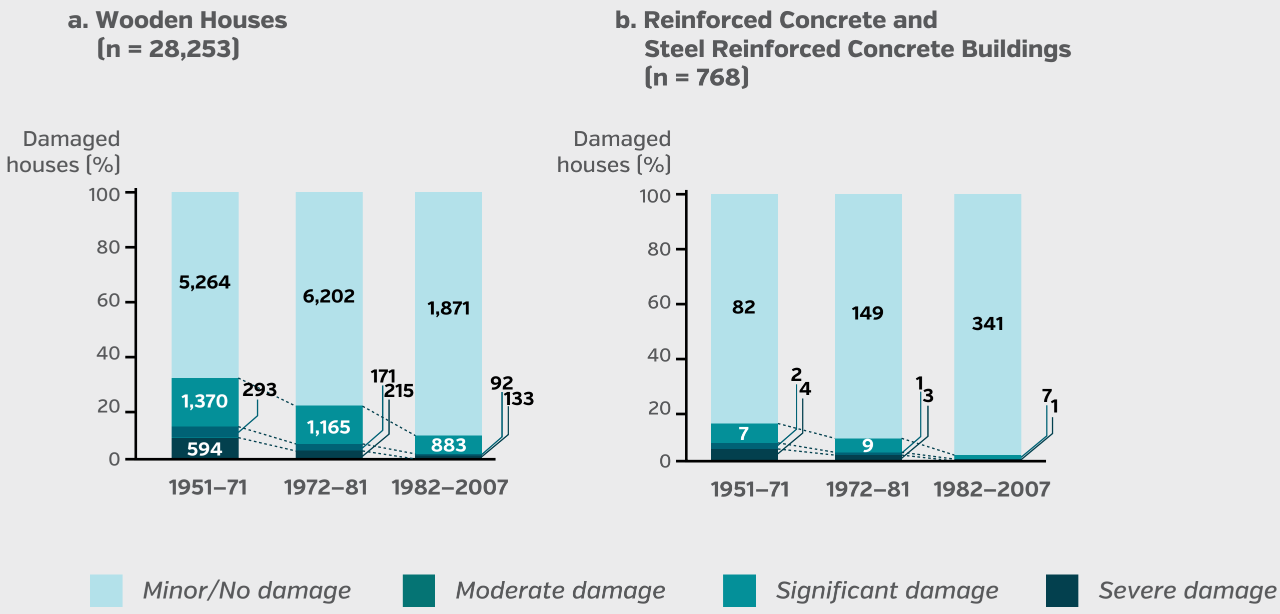


Source: Ranghieri and Ishiwatari 2014 using data from MLIT.

Figure 1.2 Damage to Building Structures in the Great Hanshin-Awaji Earthquake, by Period of Construction

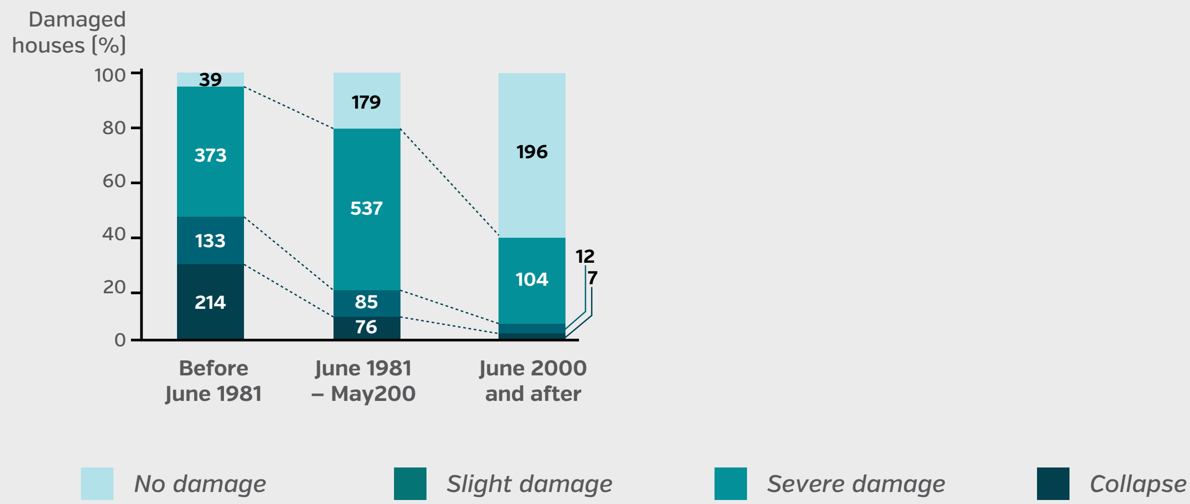
Source: Nagao, Yamazaki, and Inoguchi 2010; Yamaguchi and Yamazaki 2000a, 2000b; Yamazaki and Murao 2000.

Figure 1.3 Damage to Kashiwazaki City Building Structures in the Niigata-Chuetsu-Oki Earthquake, by Period of Construction



Source: *Nagao, Yamazaki, and Inoguchi 2010.*

Figure 1.4 Damage to Building Structures in the Kumamoto Earthquake, by Period of Construction



Source: Kumamoto Earthquake Building Damage Investigation Committee.

But this damage pattern demonstrates more than the effectiveness of the 1981 seismic standard. More broadly, it demonstrates the effectiveness of the Japanese approach to building quality assurance and to achieving a high level of success in the implementation, support to compliance and enforcement of building regulation. Over the course of a century, Japan has worked incrementally to improve building safety by gradually amending building laws in response to successive earthquakes and socioeconomic and demographic changes. Today, in spite of its high exposure to earthquakes and other hazards such as tsunamis, tropical cyclones (typhoons), and flooding, Japan has a built environment that is among the safest and most disaster resilient in the world.

1.2 Japan's incremental, context-specific approach is relevant for developing countries

This report describes Japan's incremental approach to developing, implementing, and facilitating compliance with building regulation over many decades. It explains Japan's unique path to developing a policy and legal framework as well as compliance mechanisms that grow out of this framework and that function within Japan's risk profile and climate, culture, and construction practices. Although Japan is well known for its advanced engineering knowledge and for employing engineering solutions in disaster risk management, it also relies on nontechnical approaches and has created a legal and quality management ecosystem for buildings within which those technical solutions can be successful.

The lessons this report highlights are relevant for policy makers, building governance practitioners, and project managers in developing countries who are interested in creating a safer built environment.[2] The lessons grow out of Japan's incremental, context-specific approach to building safety—an approach that is driven by and responds to Japan's specific hazard profile, geophysical characteristics, climate, culture, construction practices, and legal system. Countries facing different hazards, using different construction practices and materials, and operating under different laws can nonetheless apply the experience-based, step-by-step approach to their own context.

Notably, Japan's approach is aligned with that of the Sendai Framework for Disaster Risk Reduction 2015–2030, which is now guiding signatory countries in disaster reduction approaches.[3] The disproportionate impact of disasters on developing countries is well documented. As the 2015 Global Assessment Report on Disaster Risk Reduction (GAR) indicates: "Between 1980 and 2012, 42 million life years were lost in internationally reported disasters each year. Over 80 per cent of the total life years lost in disasters are spread across low and middle-income countries, representing a serious setback to social and economic development" (UNISDR 2015a).

This report focuses on seismic risk in part because earthquakes have been important in driving Japan's building safety regime, but also because there are rich data on the impact of, response to, and increasing resilience to earthquakes. The report does not address Japan's efforts to improve resilience to fire, tropical cyclone (typhoon), and other hazards and should therefore not be considered exhaustive.

The abundant earthquake data—shown in table 1.1 for select damaging earthquakes from 1999 to the present—make strikingly clear that Japan suffers far less loss of life and property than developing countries in earthquakes of comparable magnitude.

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[2] *For a discussion of efforts to create safer schools in particular, see another case study of Japan, World Bank and GFDRR (2016).*

[3] *The Sendai Framework's priorities include strengthening disaster risk governance (Priority 2) and investing in disaster risk reduction for resilience (Priority 3). See UNISDR (2015b).*

Table 1.1 Japan's Resilience to Earthquakes versus Experience of Selected Countries with Recent Large-Scale Events

Country	Earthquake	Maximum Intensity (MMI)[a]	Magnitude[b]	Deaths (no.)[c]	Injured (no.)	Buildings damaged (no.)[d]
Japan	1995 (Hyogo-ken Nanbu)	>X	7.3	6,437	43,792	249,180
	2004 (Niigata-ken Chuetu)	>X	6.8	68	4,805	16,985
	2011 (Great East Japan)[e]	>X	9.0	22,010	6,220	400,305
	2016 (Kumamoto)	>X	7.3	154	2,654	186,669
Turkey	1999	IX	7.6	17,118	50,000	155,000
Iran	2003	IX	6.6	31,000	30,000	18,000
Pakistan	2005	VIII	7.6	86,000	69,000	32,335
Indonesia	2006	IX	6.3	5,749	38,568	578,000
China	2008	XI	7.9	87,587	374,177	no official figures
Haiti	2010	VIII	7.0	316,000	300,000	285,667
Nepal	2015	IX	7.8	8,790	22,300	755,549

Sources: Data for Japan are from the JMA (Japan Meteorological Agency) website at www.data.jma.go.jp/svd/eqev/data/higai/higai1996-new.html; data for deaths in Nepal are from Government of Nepal (2015); data for deaths in countries other than Japan and Nepal are from the U.S. Geological Survey, "Earthquake Statistics," https://earthquakeusgs.gov/earthquakes/world/world_death.php; data on building damage in Iran are from UN OCHA (2004); data on building damage in Turkey are from NOAA (2000).

a. Japan measures earthquake intensity on a JMA intensity scale (roman numerals), as explained at http://www.jma.go.jp/jma/en Activities/ inttable.html. The table here provides MMI (Modified Mercalli Intensity) values (arabic numerals) for ease of comparison, though there is no exact correspondence between the scales. See Kunugi (2000, figure 4) for a chart that helps to clarify the complex correspondence.

b. Magnitude and intensity measure different characteristics of earthquakes; the U.S. Geological Survey website (https://earthquake.usgs.gov/learn/topics/mag_vs_int.php) has a good explanation. Since intensity has direct impacts on building damages, this report uses intensity as the seismic scale. It converts the JMA intensity to MMI based on the correspondence chart presented by Kunugi (2000, figure 4), and on scientific studies on specific events when available (e.g., Sokejima et al. [2004]).

c. Deaths also include numbers of missing individuals.

d. Damaged buildings include those with partial as well as total damage.

e. Most of the deaths and damage caused by the Great East Japan Earthquake were the result of the associated tsunami. It is estimated that about 800 deaths were caused by building damage.

1.3 Japan's unique path to improved building safety can be emulated

Following upon the GFDRR's (2016) flagship report Building Regulation for Resilience[4], this report offers an in-depth case study on the experience of Japan. It is structured around the three key components laid out in the flagship report as forming the framework for the Building Regulation for Resilience Program : namely (1) national level legislation and institutions; (2) building code development and maintenance; and (3) local level institutions and implementation. It shares Japan's historical experience in building code regulation, including the development of policy, establishment of enabling enforcement mechanisms, building of capacity across public and private sectors, and advancement of engineering knowledge.[5] Japan took unique steps to develop building regulations and building quality assurance mechanisms that cater to the specific Japanese context, as highlighted below. At the same time, the philosophy behind the policies, and lessons learned from implementing the policies, provide relevant insights for countries facing similar challenges.

Legal framework. Japan has uniform national building standards that are implemented by both the national government and local governments. Unlike many developed countries, which separate regulations from the laws that require them, Japan comprehensively defines its building standards under the Building Standard Law (BSL). Chapter 2 describes the legal framework, along with the background to and process for developing this law.

Building code. Japan's building code is recognized as a minimum standard. Originally prescriptive, the code was amended to performance-based in principle in 1998 (enforced in 2000), but some specific provisions remain as prescriptive for the convenience of architects, engineers and small and medium builders. Japan continues to amend its code, based on accumulated knowledge gained from analyzing building damage after each disaster, and over time it has achieved a highly resilient built environment. Chapter 3 describes this incremental approach to improving building safety. It looks at the contents and development of Japan's code, including efforts to ensure a reasonable and resilient enough seismic performance, the code's inclusion of non-engineered structures (conventional wooden houses), and the consultation process used in updating building standards, which solicits input from the private sector and the general public.

Quality assurance mechanisms. Japan employs quality assurance mechanisms across all phases of a building's life cycle, including (1) planning, (2) design, (3) construction of new buildings, and (4) maintenance or retrofit of existing buildings. Chapter 4 describes mechanisms for the first three phases. It looks specifically at oversight of and requirements for *Kenchikushi*, the Japanese building professionals who combine the knowledge of architects and engineers. It also explains Japan's building approval process, which involves "confirmation" that the building design complies with technical requirements, and which gives individual inspectors far less discretion than systems that depend on "permission." Finally, it explains the private sector's involvement in building inspection as well as the role played by financial institutions in assuring building quality. Chapter 5 addresses quality assurance mechanisms for the fourth phase of the building life cycle, maintenance and retrofit. It also looks more broadly at Japanese policy instruments designed to improve housing quality voluntarily.

[4] *https://openknowledge.worldbank.org/bitstream/handle/10986/24438/Buildingoregulosksoforosaferocities.pdf*

[5] *The terms regulation, code, and standard (all used in this report) are related but not interchangeable. Regulation refers broadly to rules and rule-making; a code is set of rules that a government adopts and enforces; and a standard is a specific technical specification for a material or process.*

1.4 Japan's experience offers key takeaways for developing countries

Japan's incremental, context-specific approach to improving building safety includes robust implementation and enforcement of building regulations. The resulting high level of compliance has helped reduce disaster risks and created a high degree of seismic resilience. The lessons learned in Japan over the course of a century are widely applicable. They are discussed in chapter 6 and summarized here:

1. Regulation should be understood as a tool to guide and support the safety of the built environment; though it combines controlling and enabling elements, it should not be seen principally as a means of exerting control.
2. Countries need a clear understanding of their available human, technical, and financial capacity in order to develop an effective approach to building safety.
3. Proactive support for compliance with building regulations—through education and training, financial incentives, and other mechanisms that engage stakeholders—helps create an effective and enabling regulatory environment.
4. Safe construction information, technical services, and professional expertise should be available to anyone who seeks them.
5. Formal regulatory systems should recognize prevalent construction practices, including non-engineered construction, and the risks associated with them.
6. An effective regulatory regime is based on science and requires the participation of academia.
7. Governments can strengthen their regulatory regimes by coordinating action with the building industry.
8. The private sector can play an important role in effective enforcement of building regulation, but only where mechanisms for oversight, fairness, and conflict resolution are robust.
9. Financial mechanisms can play a key role in promoting safety and overall quality in the built environment.
10. A resilient built environment can be achieved through an incremental approach—one that ensures regular impact monitoring, promotes learning and improvement, and serves as the basis for consistent policy updates.

2
Legal and Institutional Framework for Building Regulation

Key takeaways

- Building regulatory reform is an incremental process, and sustainable and periodic reforms create opportunities to respond to changing societal needs in accordance with a country's development stage.
- Understanding a country's or city's implementation capacity (both public and private) is critical for regulatory reform planning.

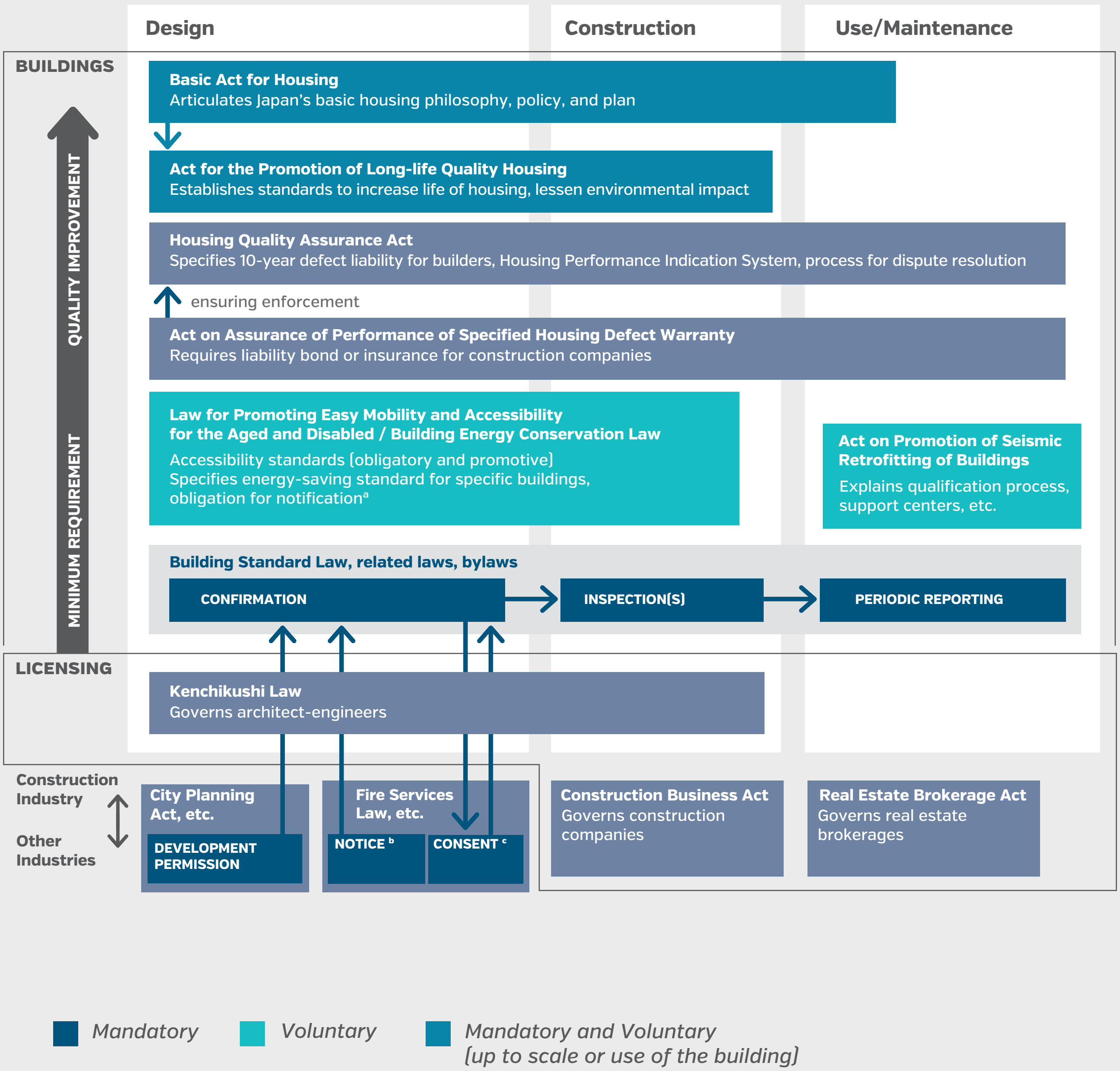
Japan's legal and institutional framework for building regulation, developed over the course of a century, has been essential to its success in creating a safe and resilient built environment. This chapter begins with a brief overview of the legal framework, goes on to describe the participating institutions, and then offers a detailed account of how laws in Japan have developed over time to mitigate disaster risk and meet changing socioeconomic needs. This description of the Japanese legal and institutional framework is not meant to serve as a template for developing countries, whose frameworks must reflect their own capacity and needs. But it sheds light on the incremental process of creating a framework and on the types of challenges that countries are likely to confront.

2.1 Overview of the Current Legal Framework

Japan's current legal framework for building quality assurance is composed of the Building Standard Law (BSL)—enacted in 1950 and amended multiple times since—and a group of laws covering building construction and safety. The objective of the BSL is "to safeguard the life, health, and property of people by providing minimum standards concerning the site, construction, equipment, and use of buildings, and thereby to contribute to the furtherance of the public welfare". The earlier Urban Building Law (1919) imposed regulations on six large cities only, reflecting the government capacity at that time. The BSL applies nationwide.

The laws covering building construction and safety (shown in figure 2.1) indicate mandatory minimum standards for urban planning, licensing of building professionals, fire safety, and consumer protection. Some recent laws also include incentives for exceeding minimum requirements for safety, building life, energy use, and accessibility for elderly and disabled persons (see annex 5D).

Figure 2.1 Overview of Major Laws on Building Construction and Safety



a. The law requires owners of specified buildings to notify the government that certain energy-saving measures are in place.
b. Notice applies to small-scale housing.
c. Consent applies to fire-prevention districts and mid-scale housing.

Unlike some other countries, Japan has a legal framework that includes building standards within laws. In countries like the United States and Canada, laws describe a regulatory framework, objectives, performance requirements, and solutions, but the technical standards themselves are drafted by nongovernmental technical associations and included in separate documents. Each type of framework has both advantages and disadvantages (table 2.1); for example, Japan's approach facilitates compliance for regulators and builders alike, but makes revising the standards more time-consuming. Policy makers and researchers need to discuss and determine what level of standard should be included in the law as mandate, and how much flexibility and discretion the regulatory system should allow designers and builders.

Tablet 2.1 Two Types of Regulatory Frameworks: Standards Included within Law versus Separate from Law

Approach	Sample countries	Advantages	Disadvantages
Building standards contained within the law	Chile, China, Indonesia, Japan, Republic of Korea, Vietnam	Facilitates compliance and control, especially in low-capacity environments; ensures minimum specification for safety	Makes revision more difficult and time-consuming
Building standards developed by nongovernmental bodies	Australia, Canada, United States	Makes revision easier; allows greater discretion in design	Requires controlling authority to have clear understanding of compliance framework and associated technical details

2.2 Stakeholders and Their Roles

In Japan, both public sector and private sector stakeholders are involved in building quality assurance, including central and local governments, a variety of private sector actors handling confirmation and inspection (referred to in Japan as "designated bodies"), and the licensed *Kenchikushi*, who act as architect-engineers. The major functions of these stakeholders are shown in figure 2.2. For a mapping of stakeholder relationships, see annex 2A; for more detail on specific stakeholders' roles, see annex 2B.

In the **central government**, the key actor is the Ministry of Land, Infrastructure, Transport and Tourism (MLIT); it is the ministry responsible for developing the BSL and other laws relating to housing quality, accessibility, energy efficiency, and retrofitting. The quality of building materials is dictated by the Japanese Industrial Standards (JIS) and Japanese Agricultural Standards (JAS), which are maintained by the Ministry of Economy, Trade and Industry and Ministry of Agriculture, Forestry and Fisheries, respectively. Through dedicated research arms, such as the state-owned National Institute for Land and Infrastructure Management and Building Research Institute, the central government also carries out research and development relevant to new building technology and policy.

Local governments also play a role in building quality assurance:[6] they are responsible for carrying out building confirmation, structural review, and inspection; for handling development permissions; for creating bylaws appropriate for their region;[7] for issuing citations for building code violations; and for handling retrofit subsidies. Since 1998, local governments have allowed private sector designated bodies to carry out design confirmation and construction inspection (see section 4.3 and 4.4 for more information)[8].

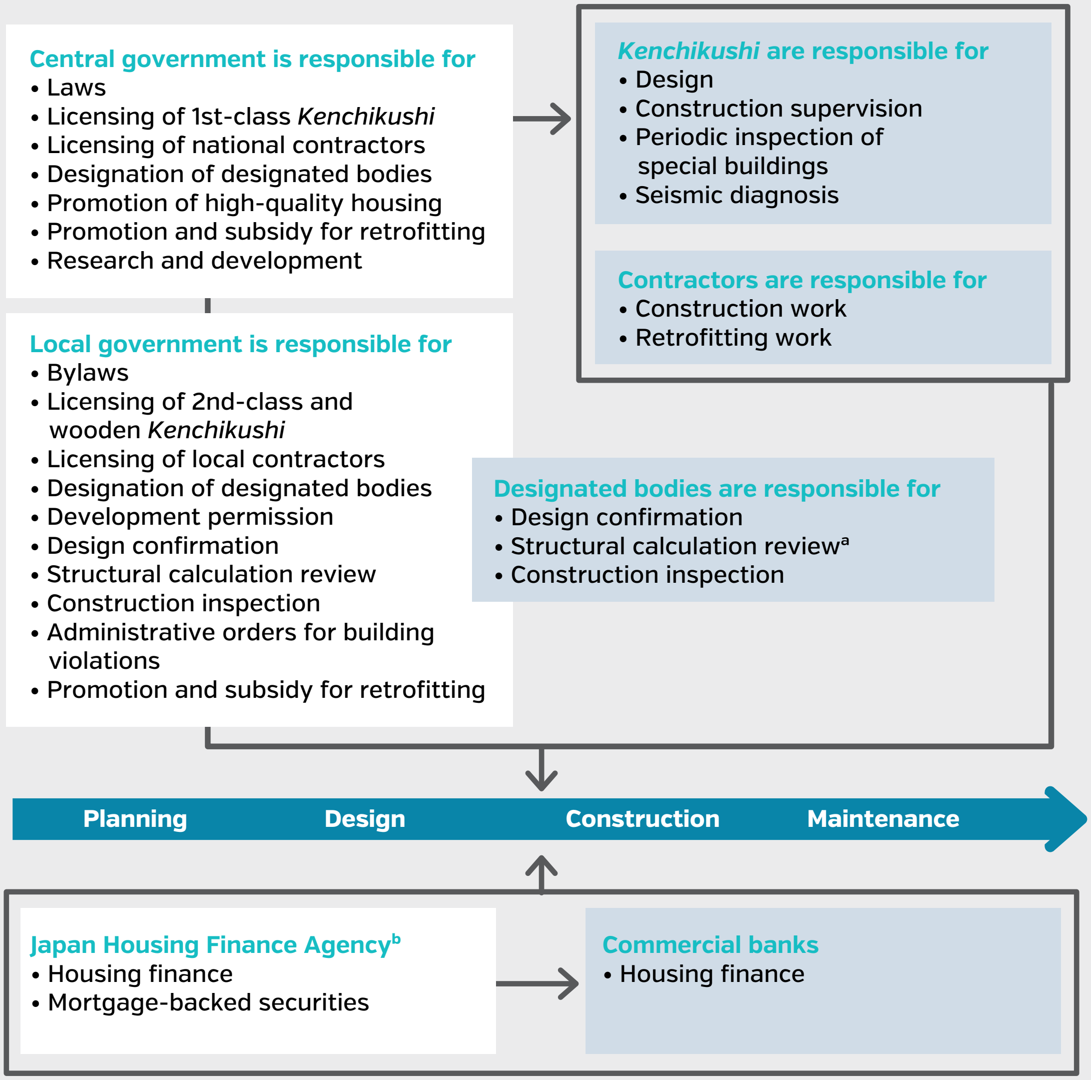
Kenchikushi—licensed architect-engineers—are responsible for building design and construction oversight. They are also involved in periodic inspection of special buildings (including hospitals, hotels, theaters, department stores, offices, apartments, etc.), and seismic diagnosis and retrofitting planning.

[6] *The local governments most active in building quality assurance are prefectures, large municipalities (those having over 250,000 residents), and those having building officials working under a Designated Administrative Agency.*

[7] *Laws passed by the central government apply to the whole country, but local governments also have their own policies for urban development based on local scale, tradition, and culture. To ensure that regulations implemented at the local level are applicable and effective, the central legal system allows local governments to establish bylaws that enhance or supplement regulations.*

[8] *MLIT or the prefecture designates the bodies.*

Figure 2.2 Roles of Major Stakeholders in Building Quality Assurance



a. The structural calculation review is conducted by a Designated Structural Calculation Body. Where such a body has not been designated, the local government conducts the review itself (though to date no local government has actually conducted this review).

b. The Japan Housing Finance Agency (formerly the Government Housing Loan Corporation) originally financed housing directly; it now does so mainly through support for commercial banks, though it continues some direct financing.

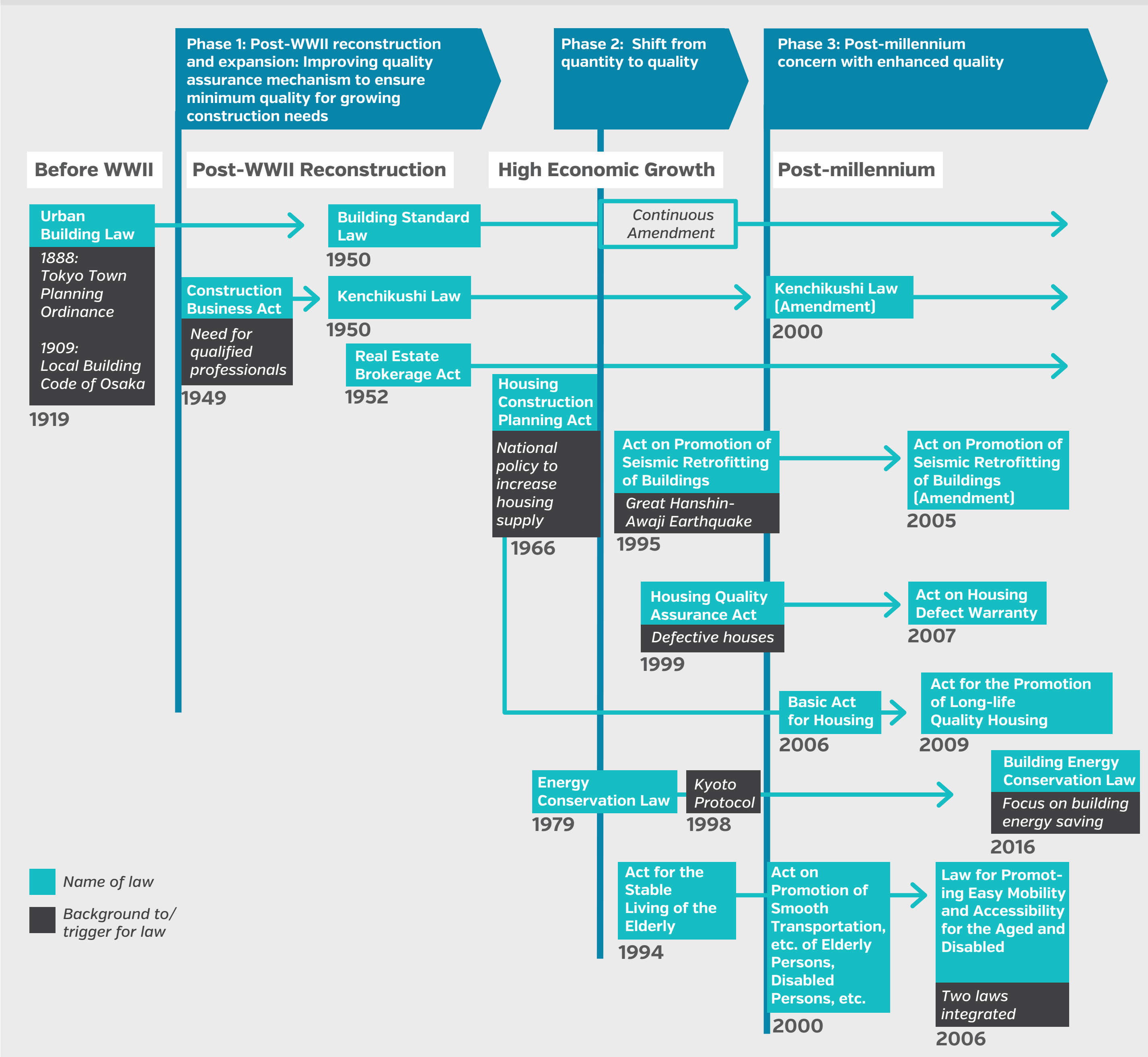
2.3 How Laws Developed to Meet Changing Needs

In response to changing socioeconomic needs and the pressure of natural and man-made disasters, Japan's legal framework for building quality assurance was developed and improved incrementally over the course of a century. The history of these changes is described below and illustrated in figure 2.3.

The first building regulations in Japan were municipal and date from 1888, when Tokyo issued regulations to address fire and hygiene issues. Osaka issued its own regulations in 1909.

The first building regulation created by the central government, the Urban Building Law (1919), did not apply across the country but focused on six large cities—Tokyo, Kyoto, Osaka, Yokohama, Kobe, and Nagoya. These cities were chosen partly because they had (or could develop) the necessary human and technical capacity to implement the law's height restrictions and design specifications, and partly because their rapid growth had resulted in sanitation issues that would be addressed by the law. In 1950, the regulations were extended to the whole country with the passage of the Building Standard Law. The new law also included a planning code (regulating floor area ratio [FAR], height, and building use) and a building code (dealing with structural safety, hygiene, fire safety, etc.). After 1950, the development of Japan's legal framework for building quality assurance falls roughly into three phases: (1) post-WWII reconstruction and construction boom, lasting into the 1980s; (2) a period through the 1990s focused on housing quality rather than quantity; and (3) the post-2000 period focused on enhanced quality needed to address changing demographics, environmental protection, and energy savings. The sections below offer more detail, but the important point is that from 1950 to the present, as technical and financial capacity grew and socioeconomic and other needs evolved, laws were introduced or changed to optimize regulations. In some cases, regulations were strengthened; for example, the experience of the Niigata Earthquake (1964) and Tokachi-oki Earthquake (1968) drove engineering research that led to higher seismic standards. In other cases, regulations were eased; for example, amendment of the BSL in 1987 and again in 2014 eased height restrictions for wooden buildings because technical advances had made construction of taller wooden buildings safe.

Figure 2.3 Incremental Development of Legal Framework for Building Safety



2.3.1 First Phase: Post-WWII Reconstruction and Construction Boom

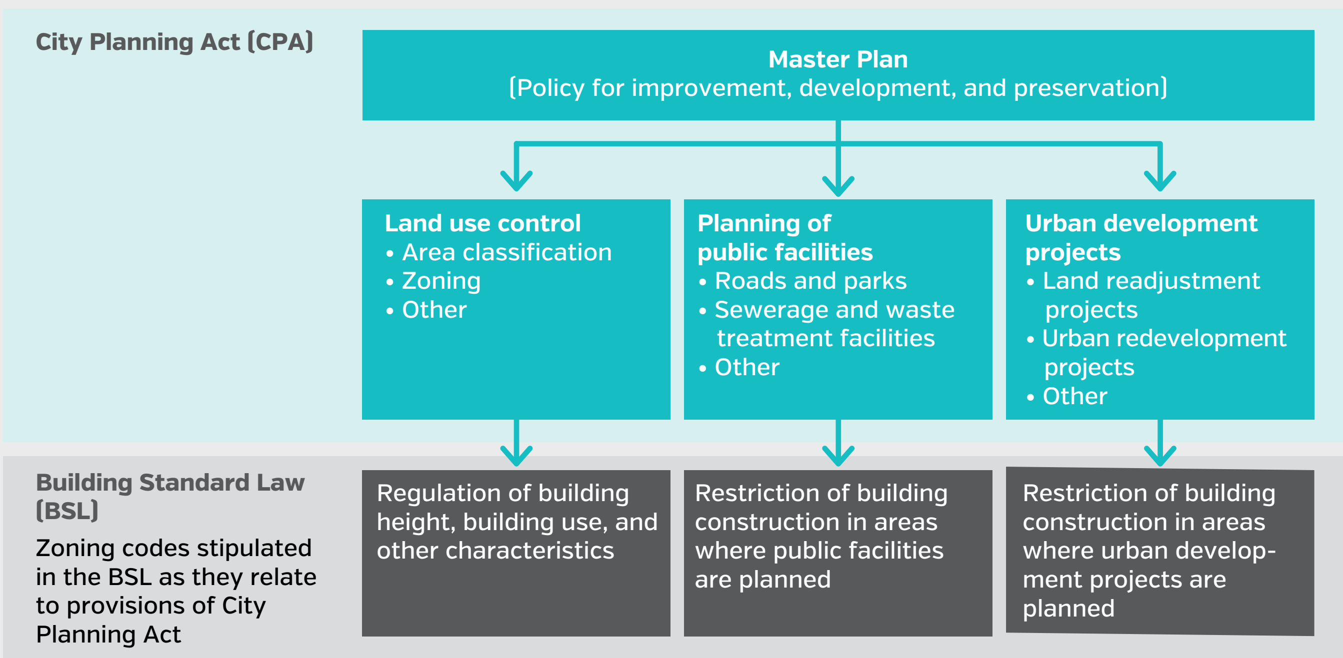
As Japan carried out reconstruction after World War II, the housing stock demand grew rapidly with the increase in population and sprawling urbanization across the country. Establishing a sound quality assurance mechanism for construction therefore became a pressing need for the government. In parallel, the government began to foster the capacity of building professionals and the construction industry, which would support the implementation of safer building practices.

Registration and licensing of building and design professionals. As building reconstruction and construction boomed after WWII, the Construction Business Act (1949) sought to ensure the quality of construction by creating a registration system for building contractors. The law has been amended several times to strengthen its regulations.

The Kenchikushi Law of 1950. This law established a licensing system for *Kenchikushi* (architect-engineers). It designated them as the only group permitted to design buildings or supervise construction works, and required that any buildings they designed had to comply with the technical requirements of related laws.

Development of financial instruments for construction or purchase of housing. Starting in the 1950s, the Government Housing Loan Corporation (GHLC; now Japan Housing Finance Agency, or JHF) began providing long-term, low-interest loans for the construction or purchase of houses. To improve the quality of construction, it also took the unique step of establishing proprietary technical criteria beyond the mandatory minimum BSL standard and publishing specifications and technical guidance that carpenters without an engineering background could follow.[9] See section 5.2.1 for details.

Figure 2.4 Relationship between the City Planning Act and the Building Standard Law

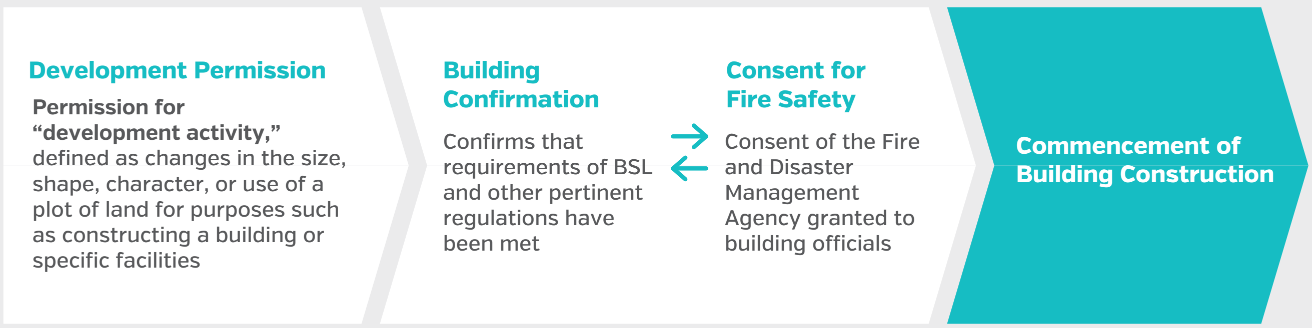


Source: MLIT.

[9] *The Japan Housing Corporation, established in 1955, was another financial institution that played a significant role in ensuring that housing was affordable for those with middle incomes by developing rental properties, properties for sale, and other projects. Its role ended in the 1980s, when its function was shifted to improving urban space and maintaining aged mass-housing buildings as part of the Urban Renaissance Agency.*

To ensure harmonization of urban development and building construction, Japan introduced two legal requirements: builders need to obtain development permission in order to change the size, shape, character, or use of a plot of land; and local building officials must grant a building confirmation for construction plans that meet the requirements stipulated in the BSL, in other pertinent regulations (notably those in the Fire Services Law)[10], and in regional bylaws. This system, illustrated in figure 2.5, is still in use; see section 4.3.1 for details.

Figure 2.5 Application Procedure Prior to Commencement of Building Construction



2.3.2 Second Phase: Shift to Higher Quality in the 1990s

As Japan achieved high economic growth in the 1970s and 1980s, its focus shifted to quality development. The devastating Great Hanshin-Awaji Earthquake in 1995 revealed the construction quality issues that the quality assurance mechanism then in place had not addressed. This event triggered the improvement of the system itself and promotion of large-scale seismic retrofitting work for the country.

Role of financial institutions and instruments in promoting housing quality. In the 1990s, those seeking to build or buy a home continued to take advantage of the long-term, low-interest loans provided by JHF to incentivize production of higher-quality houses.

Promotion of retrofitting work. Following the 1995 Great Hanshin-Awaji Earthquake, in which 250,000 houses and buildings were fully or partially destroyed,[11] retrofitting was identified as a priority. The post-disaster damage survey showed that buildings constructed to meet the old building code that defined the seismic standard suffered greater damage than those built to the newer standards of 1981.[12] To encourage seismic diagnosis and retrofitting of existing buildings, the Act on Promotion of Seismic Retrofitting of Buildings was established in 1995.[13]

Consumer protection. In 1999, in response to the large number of structurally defective houses revealed by the Great Hanshin-Awaji Earthquake, Japan passed the Housing Quality Assurance Act. This law extended to 10 years the period during which contractors or developers are liable for defects in new houses.[14] It also introduced the Housing Performance Indication System, which enables consumers to evaluate their house's performance against a set of standardized performance indicators (resistance to earthquake, energy saving, sound insulation, etc.). Results evaluated by a third-party organization can be included in contract documents and be factored into insurers' decisions about seismic insurance premiums (see annex 5D for details).

[10] *Other pertinent regulations are contained in the Ports and Harbors Act, Gas Business Act, Water Supply Act, Urban Green Act, and the Act on Promotion of Smooth Transportation, etc. of Elderly Persons, Disabled Persons, etc.*

[11] *The estimate is from Japan's Fire and Disaster Management Agency.*

[12] *This point is discussed more thoroughly in chapter 1. See especially figure 1.1.*

[13] *The law was amended in 2005 to require prefectural governments to make plans for retrofitting of public facilities and houses, including clear and tangible targets.*

[14] *This is an exception to the civil code, which stipulates a defect liability period of one year.*

2.3.3 Third Phase: Post-millennium Concerns

As global leaders advanced an agenda concerned with climate change and inclusive development, Japan started to adopt such trends into its national development plans. In this context, the construction sector played a key role by implementing relevant new acts enacted by the government.

Further consumer protection. The Act on Assurance of Performance of Specified Housing Defect Warranty of 2007 offered further protections to consumers by requiring construction companies to deposit a bond for defect liability or to purchase housing defect liability insurance. This requirement ensured that even financially troubled companies could be held accountable for defects for 10 years.

Environmental protection. The Act for the Promotion of Long-Life Quality Housing of 2009 established standards to increase the life of housing to lessen housing's impact on the environment. In response to the expectation of much longer-lived buildings, a suitable loan system was established, and policies were put in place to encourage preferential tax treatment (for income tax, registration license tax, real estate acquisition tax, and fixed asset tax) for buildings that met the standards under the law.

Aging population and enhancement of accessibility. In response to shifts in Japanese lifestyles and values caused by an aging population and falling birth rate, Japan passed the Basic Act for Housing in 2006 to promote a stable housing supply and improved living environment. In 2006, another law passed in response to shifting demographics was the Law for Promoting Easy Mobility and Accessibility for the Aged and Disabled (2006)[15]. This law contains comprehensive legal regulations for improved accessibility in the built environment and specifies both mandatory and voluntary accessibility standards for building construction. Buildings that satisfy the voluntary standard are eligible for looser FAR limits, tax breaks, and subsidies, and are allowed to display the logo indicating that they are a certified accessible facility.

Promotion of energy savings. The Building Energy Conservation Law was established in 2015 to promote energy savings in buildings. It follows the earlier Energy Conservation Law (1979), which was passed after the second oil crisis and which has been revised several times, including the amendment of 1998 in response to the Kyoto Protocol. The new law specifies mandatory energy consumption performance standards for new buildings and includes voluntary standards linked to less restrictive FAR specifications.

[15] *The law combined the Act for the Stable Living of the Elderly (1994) and the Act on Promotion of Smooth Transportation, etc. of Elderly Persons, Disabled Persons, etc. (2000).*

3
Incremental Enhancement of Building Standards

Key takeaways

- To achieve high levels of resilience in the built environment, institutionalizing an incremental reform process is crucial. Japan institutionalized a system to both identify the cause of building failure (through assessments of damaged buildings) and continuously inform policy decisions to strengthen building regulations.

- Close cooperation between policy makers and the academic community can foster an enabling environment for state-of-the-art technologies and push the frontier through research.

- Focused academic research on prevalent building practices in the informal sector can help integrate informal buildings—built based on limited engineering knowledge—into formal regulatory systems.

- Practical and realistic reforms can be developed through transparent and inclusive processes involving a wide range of stakeholders, including building regulators, designers, builders, material manufacturers, representatives from industry groups, and academic communities. Engagement of industry groups will help make the regulation accessible, practical, and scalable, in part by leveraging the private sector's ability to deliver services and influence consumers.

Until early in the post–World War II reconstruction period, Japan was in a situation similar to that of some developing countries today, employing construction that did not adhere to a high seismic standard, having very poor concrete quality, and facing a large housing demand. Only gradually did it achieve the high level of building safety it enjoys today. This chapter explains the gradual process through which Japan improved its building standards, with a focus on four key components: the role of natural disasters in driving research and priorities; the importance of technological advances and specifically the collaboration of government, academia, and industry; the incorporation of seismic design in building standards; and the consultative process used in updating standards.

3.1 Natural Disasters as Triggers for Integrating Resilience into Building Regulation

The Building Standard Law of 1950 (described in chapter 2) has been revised many times, but the milestone revision is that of 1981, which provided a new seismic design method—one that was proved effective by several subsequent earthquakes. The 1981 revision took place in response to the 1968 Tokachi-Oki Earthquake, which caused substantial damage to reinforced concrete (RC) buildings designed to the Building Standard Law (BSL) standard in effect at that time. That event made clear the necessity of upgrading the seismic design standard, and as a result, the Ministry of Construction (the precursor of MLIT) started a five-year research project to comprehensively improve anti-seismic technology and develop a new seismic design method. The draft version of the new method was completed in 1977; further improvements were made based on the damage caused by the 1978 Miyagi-oki Earthquake; and the BSL was revised in 1981 to incorporate the new standard.

This pattern—a disaster event reveals deficiencies in the current building standards, and the law is changed in response once the necessary technological knowledge is available—has characterized Japan's development of seismic design standards for the past 100 years (see figure 3.1). The 1981 BSL revision is an especially important example. It represented a fundamental change to the old law to reflect the most recent technology in engineering methods and materials, and serves as the basis for the seismic standards in effect today. But there are other important examples as well:

- The 1923 Great Kanto Earthquake led to passage of the Urban Building Law in 1924, which contained Japan's first seismic standards.
- The original 1950 BSL was passed partly in response to the Fukui Earthquake of 1948.
- The Great Hanshin-Awaji Earthquake in 1995, which confirmed the performance of the 1981 standards, led to passage of the Seismic Retrofitting Promotion law and widespread efforts to ensure that older buildings were retrofitted to meet the 1981 seismic standards.

Figure 3.1 Earthquakes as Triggers for Incremental Improvements in Seismic Design Standards

1891 Nobi Earthquake
MMI > X
M8.0

↓

1892
- ● Investigation Committee on Disaster Prevention

1919 Urban Building Law
[Enforcement]
- ■ No seismic requirement [mostly for urban planning]
- ● Building permission by police

1923 Great Kanto Earthquake
MMI > X
M7.8

↓

1924 Urban Building Law
[Amendment]
- ■ First structural calculation regulation against seismic force [seismic coefficient: C=0.1]

1948 Fukui Earthquake
MMI > X
M7.2

↓

1950 Building Standard Law
[Replacement of Urban Building Law]
- ■ Minimum standard and updated structural calculation [C=0.2]
- ● Confirmation by local govern-ment
- ★ Adjacent road 2.7m -> 4.0m

1968 Tokachioki Earthquake
MMI > X
M7.9

↓

1970-71 Building Standard Law
[Amendment]
- ■ Strengthening of RC standards
- ★ Introduction of FAR in all areas

1978 Miyagiken-oki Earthquake
MMI > VII
M7.4

↓

1981 Building Standard Law
[Amendment]
- ■ New seismic code:
  - Medium-scale earthquake does not cause damage
  - Large-scale earthquake does not cause collapse

1995 Hanshin-Awaji Earthquake
MMI > IX
M7.3

↓

1995 Seismic Retrofitting Promotion Law
[Enforcement]
- ▲ Measures and guidelines for seismically deficient existing buildings

1998 Building Standard Law
[Amendment
- ■ Performance code
- ● Designation of private sector bodies to perform building confirmation and inspection

2004 Nigata Chuetsu Earthquake
MMI > IX
M6.8

2000 Building Standard Law
[Amendment]
- ■ Alternative seismic design method [response and limit deformation]

2005 Falsification of structural calculation documents

↓

2006 Building Standard Law/Seismic Retrofitting Promotion Law
[Amendment]
- ■ Designation of structural calculation review body; strict review process [large buildings]
- ▲ Seismic retrofitting promotion plan by local government

2011 Great East Japan Earthquake
MMI > X
M9.0

↓

2013,2014 Building Standard Law/Seismic Retrofitting Promotion Law
[Amendment]
- ■ New regulation for large wooden buildings
- ● Easier process for structural review
- ▲ Mandatory seismic diagnosis of large public buildings

■ *Building/seismic design*
● *Building confirmation and inspection*
▲ *Retrofitting promotion*
★ *Environmental regulations*
Note: RC= reinforced concrete; FAR= floor area ratio.

3.2 Collaboration among Government, Academia, and Industry in Technological Research

As the previous section suggests, Japan's ongoing improvement of its building standards has depended in part on continuing technological research and advances. In Japan, this research has long been carried out by government, universities, and industry working collaboratively. This approach originates in the mission of Japanese universities, which were founded to train government personnel and private sector leaders. Especially during periods when the government and private sector had limited capacity, academia played an important role in furthering knowledge. Japan's government research institutions continue to have close ties with the universities today. The government now has a mechanism in place to organize multiple stakeholders into advisory committees when important policies are designed; leading academics are typically appointed to serve as chair of study groups in these cases. The General Technology Development Project is an example of collaboration among Japanese government, academia, and industry. Initiated in 1972, it is an ongoing, comprehensive research effort aimed at developing construction technologies in response to important and pressing needs in the construction sector. Under MLIT's leadership and with the participation of academia and the private sector, it has contributed to the development of multiple laws and technical guidelines, including the drastic amendment of the BSL in 1981. As of fiscal year 2011, 61 research projects had been completed under its auspices. Table 3.1 shows some key examples.

Table 3.1 Sample Contributions of the General Technology Development Project

Project	Duration	Contribution
Development of new seismic design code	1972–1976	Revision of BSL in 1981
Development of housing performance comprehensive evaluation system	1973–1977	Development of evaluation criteria for housing performance (later used by financial institutions offering housing loans)
Development of new building construction system	1995–1997	Presentation of building construction system based on performance evaluation and development of guidelines for performance evaluation (draft)
Development of technology for countermeasures against sick building syndrome[a]	~2001–2003	Verification of reduction measures; provision of information for revision of BSL related to the countermeasures against sick building syndrome

a. Sick building syndrome refers to illness suffered by building occupants; symptoms, which include headache, respiratory irritation, dizziness, and nausea, seem to worsen as people spend longer periods in the building.

The first project included in table 3.2, development of new seismic design code, was a major achievement because it formed the basis for the 1981 BSL revision that imposed a new, higher seismic standard. Before 1981, seismic design was based on a static design method that did not consider the dynamic characteristics of structures. This approach was the result of a limited understanding of earthquake ground motion and the response of structures subject to earthquake generated excitation, which is an important element for estimating the seismic loads. But building damage caused by a series of earthquakes—the Niigata Earthquake (1964), Tokachi-oki Earthquake (1968), and Los Angeles Earthquake (1971)—showed the need for a new seismic design method. The Ministry of Construction thus initiated the five-year Development of New Seismic Design Code project in 1972. A number of partners were involved in the project, including the Ministry of Construction and its affiliated research institutes (Public Works Research Institute and Building Research Institute), university professors, and experts from private companies. The Building Research Institute, a national research institute, had a particularly important role in coordinating and finalizing the project.

Comprehensive research into all aspects of seismic design ultimately produced the new seismic design method. Just after the completion of the project, the Miyagiken-oki Earthquake occurred; its damage verified the concept of the new design method and led to the revision of the BSL in 1981 to include the new method.[16]

In general, where policy making concerns itself with disaster preparedness and seismic risk reduction, technical experts have a key role to play. This is true not just in Japan but more generally, as box 3.1 shows.

Box 3.1 How Academic Research Supports Policy Making

Japan shares its own experience with countries facing similar challenges. From 1986 to 2012, the Japan International Cooperation Agency (JICA) supported a number of countries in building their seismic research capacity, including Mexico and Peru. In both countries, the technical projects have had a direct influence on policy making and on updating and enhancement of seismic performance standards for buildings. These experiences suggest the wider applicability and success of Japan's collaborative model, in which academia and government work together to ensure that policy making reflects state-of-the-art technology.

Mexico

JICA's technical cooperation project in Mexico ran from 1990 to 1997. Under the project, Mexico (1) developed an earthquake strong motion observation network, (2) created guidelines for seismic structure design and construction for masonry structures, and (3) trained construction engineers in Central and South America as well as in Mexico. The National Center for Disaster Prevention (CENAPRED), which the project supported, is now a core organization in the civil protection system of Mexico, involved in creating, managing, and promoting public policies related to disaster prevention and in keeping technical seismic regulations up to date.

Peru

Under JICA's seismic center project in Peru, which ran from 1986 to 1993, the Japan-Peru Center for Earthquake Engineering Research and Disaster Mitigation (CISMID) was created. CISMID conducts research into structural and geotechnical engineering and disaster mitigation planning. The center also provides consultant services to the government (e.g., National Institute of Civil Defense and the Ministry of Housing Construction and Sanitation) on seismic risk assessment and emergency damage inspection. As a member of several national level committees—including a science and technology advisory committee, a scientific committee on natural disasters, and the seismic design standard committee—it is also involved in the policy-making process for seismic disaster risk reduction.

Sources: López, 2005; Ishiyama 2005; JICA 1999.

[16] *The researchers looked specifically at (1) earthquake ground motion, (2) dynamic characteristics of soil, (3) dynamic characteristics and seismic resistant capacity of structural elements, (4) dynamic characteristics of structures and earthquake response analysis method, (5) seismic design method for structures, and (6) earthquake disaster mitigation countermeasures.*

3.3 Concept of Seismic Design in the Building Standard Law

The new seismic design method included in the 1981 BSL revision still serves as the core of Japan's seismic design code today. This section shows how the new design method significantly improved seismic safety of RC buildings and wooden buildings—two building types that are widely used in developing countries as well as in Japan. These examples are relevant for developing countries in part because of the building types they deal with, and more broadly because they demonstrate how context-specific research can inform development of a seismic standard that caters to a country's specific needs.

In essence, any seismic design must (1) determine the seismic load, and (2) develop a structural design to resist that load. The new 1981 method, unlike the old, took into account the dynamic response characteristics of buildings and employed an elastic design method. Its development was facilitated by the accumulation of data on strong earthquake ground motion, along with dramatic advances in computers and computing technology that made analyzing earthquake dynamic response easier. The new method has several distinctive features:

- It determines earthquake load by ground condition and buildings' vibration characteristics.
- It includes a seismic design for both medium- and large-earthquake ground shaking. For medium-earthquake ground shaking, it prevents building damage through the elastic design method; for large-earthquake ground shaking, it accounts for nonlinear response and ultimate load-bearing capacity. The basic concept is that in extreme cases, building collapse should be avoided to save lives.
- It analyzes dynamic response for buildings taller than 60 m using the method authorized by MLIT.

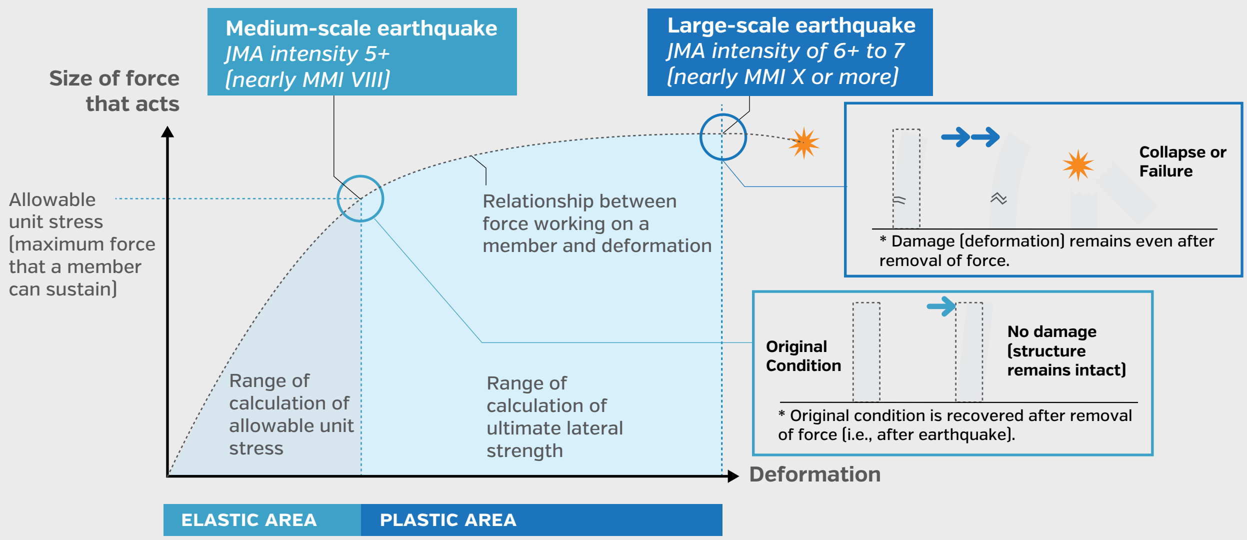
The new standard has proved effective in mitigating earthquake damage in RC buildings and wooden houses. (Details on the relative shares of different building types in Japan are in annex 3A).

3.3.1 Reinforced Concrete Structures

RC is one of the most common building types. In Japan, the RC design standard was first created in 1933 and then revised many times based on the experience of earthquakes. In the 1968 Tokachi-Oki earthquake, for example, there was extensive brittle failure of columns, a condition that may cause sudden building collapse; in response, Japan revised the standard for strengthening the shear capacity (for example, by shortening the hoop interval from 30 cm to 10 cm). In the 1978 Miyagiken-Oki earthquake, buildings that used piloti structures,[16] such as apartments with a parking garage on the first floor, were severely damaged. In response, Japan incorporated a two-part seismic design in the 1981 BSL: the standard addresses both the structure's strength and its deformation capacity. As explained above, for a medium-scale earthquake (once in several decades), the structure must be able to recover to its original condition, while for a large-scale earthquake (once in several hundred years), the structure must not collapse—though it may suffer severe damage—in order to save people's lives. The two-part design is illustrated in figure 3.2.

[16] Pilotis are posts, pillars, or similar structures that support a building and serve to raise it above ground level.

Figure 3.2 Major Conceptual Change in the 1981 Seismic Standard Accounting for Both Building Strength and Deformation Capacity



Source: MLIT website, http://www.mlit.go.jp/common/000188539.pdf (in Japanese).

Note: Japan measures earthquake intensity on a JMA intensity scale (roman numerals), as explained at http://www.jma.go.jp/jma/en/Activities/inttable.html. The figure here provides MMI (Modified Mercalli Intensity) values (arabic numerals) for ease of comparison, though there is no exact correspondence between the scales. See Kunugi (2000, figure 4) for a chart that helps to clarify the complex correspondence. Magnitude and intensity measure different characteristics of earthquakes; the U.S. Geological Survey website https://earthquake.usgs.gov/learn/topics/mag_vs_int.php) has a good explanation. Since intensity has direct impacts on building damages, his report uses intensity as the seismic scale. It converts the JMA intensity to MMI based on the correspondence chart presented by Kunugi (2000, figure 4), and on scientific studies on specific events when available (e.g., Sokejima et al. [2004]).

The effectiveness of the new seismic design standard for RC was demonstrated during the Great Hanshin-Awaji Earthquake in 1995. Of the 1,026 RC buildings in Nishinomiya and Nada wards severely damaged in this event, 46 percent had been built before 1971, 39 percent between 1971 and 1981, and 15 percent after 1981.[18] With this clear evidence for the 1981 standard's effectiveness, Japan undertook a nationwide program to retrofit structures built before 1981 (see section 5.1 for details).

3.3.2 Wooden Houses

Wooden structures have been popular in Japan since ancient times; they form a large share of existing housing (especially detached houses) and continue to be built (see annex 3A). Two different construction methods are used for detached wooden houses: (1) the modified traditional Japanese method, whose main shear load–bearing elements are columns, beams, and braces;[19] and (2) the wood frame method introduced to Japan from North America in the 1950s, whose main shear load–bearing elements are walls. Japan's wooden houses were originally considered "non-engineered" and relied on conventional knowledge; but standards for the houses were gradually improved based on modern engineering knowledge, so that today's wooden houses are considered engineered structures.

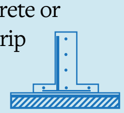
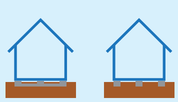
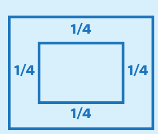
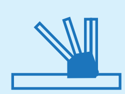
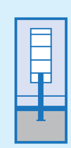
[18] *The data are from Nagao, Yamazaki, and Inoguchi (2010); Yamaguchi and Yamazaki (2000a, 2000b); and Yamazaki and Murao (2000).*

[19] *The main difference between the traditional method and the modified method is that the latter requires diagonal braces, concrete strips, and mat foundation, while the former does not.*

Older wooden houses, mostly built by carpenters untrained in engineering principles, fared badly in the Great Hanshin-Awaji Earthquake; some 180,000 buildings were destroyed or collapsed because of inadequate or poor-quality bearing walls, unbalanced distribution of walls, and poor connections between sill and foundation. The damage caused by the 2016 Kumamoto Earthquake shows the same tendency. During the nearly 70 years since the creation of the Building Standard Law, the seismic performance of wooden houses has gradually been enhanced by the lessons learned from earthquakes. The key milestones for upgrading the specifications of wooden houses under the BSL are summarized in table 3.2. Note the especially strong enhancement of 2000, which was based on the lessons learned from the Great Hanshin-Awaji Earthquake, and the specification developed by the GHLC for its voluntary advanced quality enhancement system (described more extensively in section 5.2).

Currently, the BSL does not require structural calculations for wooden houses less than three stories if a *Kenchikushi* is involved in their design and construction. The quality of wooden houses is assured through simple design specifications that allow the house to be built by carpenters without advanced knowledge of seismic engineering. By including these small-scale wooden houses—which used to be considered as non-engineered structures in the Japanese context—within the scope of building regulations, their quality can be assured through the relevant specifications. The introduction of licensed *Kenchikushi* for design and oversight of wooden structures, along with training of carpenters, has also helped improve the quality of wooden houses. Box 3.2 describes training of carpenters; box 3.3 describes how other countries have incorporated non-engineered structures in their building regulations.

Table 3.2 Incremental Improvement of Specifications for Wooden Houses under the Building Standard Law

Building Standard Law	Regulation for Wooden Houses				
	Foundation	Quantity of bearing wall (cm/m²)	Balance of bearing wall	Diagonal brace	Connection between structure and foundation
1950		8 / 12		Use of clamp, nail, or bolt for fixing	Use of clamp for fixing
1959		12 / 21			
1971					Use of plate hardware by JHF (beginning around 1979)
1981	Concrete or RC strip 	15 / 29		Use of plate hardware (from around 1981)	Use of hold-down hardware (from around 1988)
2000	Mat or strip depending on soil-bearing capacity 		Established wall balance 	Use of brace hardware 	Use of hold-down hardware for fixing 

Source: *Adapted from KEN-Platz–Nikkei BP website*
http://kenplatz.nikkeibp.co.jp/atcl knpcolumn/14/505663/061300t014/?SS=imgview&FD=1421851125.

Box 3.2 Training the Next Generation of Carpenters

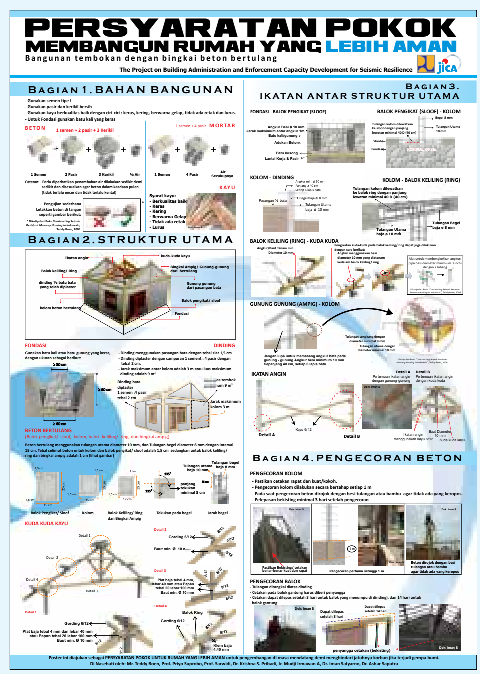
Skilled construction workers are important actors in assuring building quality in Japan. In particular, carpenters play an important role in assuring the quality of Japan's characteristic wooden houses. As carpenters skilled in this style of housing have aged, however, fewer individuals with the requisite skills have been available to do this type of work.

To help preserve Japan's housing inheritance and train younger workers in the requisite skills, the Ministry of Health, Labor and Welfare offers grants to employers that train carpenters to build wooden houses. The Ministry is also promoting a national qualification system designed to improve carpenters' skills. MLIT has established a three-year carpenter training program in the form of a school run by a private organization. The school enrolls 18- to 25-year-olds, and it offers subsidies to builders who teach there. Unfortunately, the number of builders who can conduct the necessary trainings is declining.

Box 3.3 Building Regulations for Non-Engineered Buildings

Non-engineered construction is common around the world—and is also especially vulnerable to earthquakes. Drawing on Japan's experience of incrementally improving the safety of non-engineered wooden structures through building regulations, JICA has offered technical support to other countries seeking to establish non-engineered building standards. Both in Indonesia and El Salvador, the results of scientific research were put into practice, and building regulation systems were adopted as national policy. The occurrence of disasters in both countries accelerated the process of establishing non-engineered standards. The brief case studies presented here offer lessons on how to ensure the safety of non-engineered construction. the number of builders who can conduct the necessary trainings is declining.

Figure B3.1 JICA Poster Showing Key Requirements for Safe Confined Masonry Structures



Box 3.3 Building Regulations for Non-Engineered Buildings CONTD.

Indonesia

After the Central Java Earthquake in 2006, JICA helped Indonesia develop a system to support reconstruction of one-story non-engineered houses. To improve the seismic performance of these traditional structures, three key requirements were identified, all of which needed to consider locally available and affordable methods. The requirements concerned (1) the quality of materials, (2) the structural section of main members, and (3) the connection of structural members. To promote adoption of these requirements, the government tied them to its conditional cash transfer scheme. By 2014, about half of all districts and cities in Indonesia had adopted this approach. As of December 2016, that figure had increased to 86 percent.

In February 2016, the government of Indonesia formally enacted regulations for building permits, including the key requirements for non-engineered buildings, and also established a data acquisition system to manage compliance with the permitting regulations. Reducing the vulnerability of these highly vulnerable buildings saves lives in the event of a disaster, and the establishment of a legal framework for building regulation is a major step toward improved building safety.

El Salvador

Earthquakes in January and February 2001 partially or totally destroyed about 20 percent of El Salvador's 1.36 million homes, more than half of which belonged to poor households. In response to this event, JICA implemented a seismic resistance project that tested four construction methods commonly used for low-income housing: (1) block panel, (2) reinforced adobe, (3) soil-cement confined masonry, and (4) concrete block. A second phase of the project developed a draft seismic standard for the four construction methods, carried out experimentation and research for standard analysis, and supported development of a dissemination system. In March 2014, the government enacted legislation specifying seismic standards, and local regulatory officials were trained to screen homes based on the new seismic criteria.

The main issue for disseminating the seismic standard is the economic capacity of low- to middle-income homeowners, who cannot afford to hire experts for design and construction and often construct their own houses. In these contexts, a building permit without a plan, and even construction without a building permit, is not uncommon. Building permits are not always carefully checked, partly due to legal ambiguities surrounding the building permitting process; individual building officials may have wide discretion, or they may lack the technical expertise to verify. Formulating and publicizing the standard is obviously only the first step, and dissemination in the field and ensuring uptake from the community are another challenge. Stakeholders in El Salvador continue to discuss how these issues should be addressed.

Conclusion

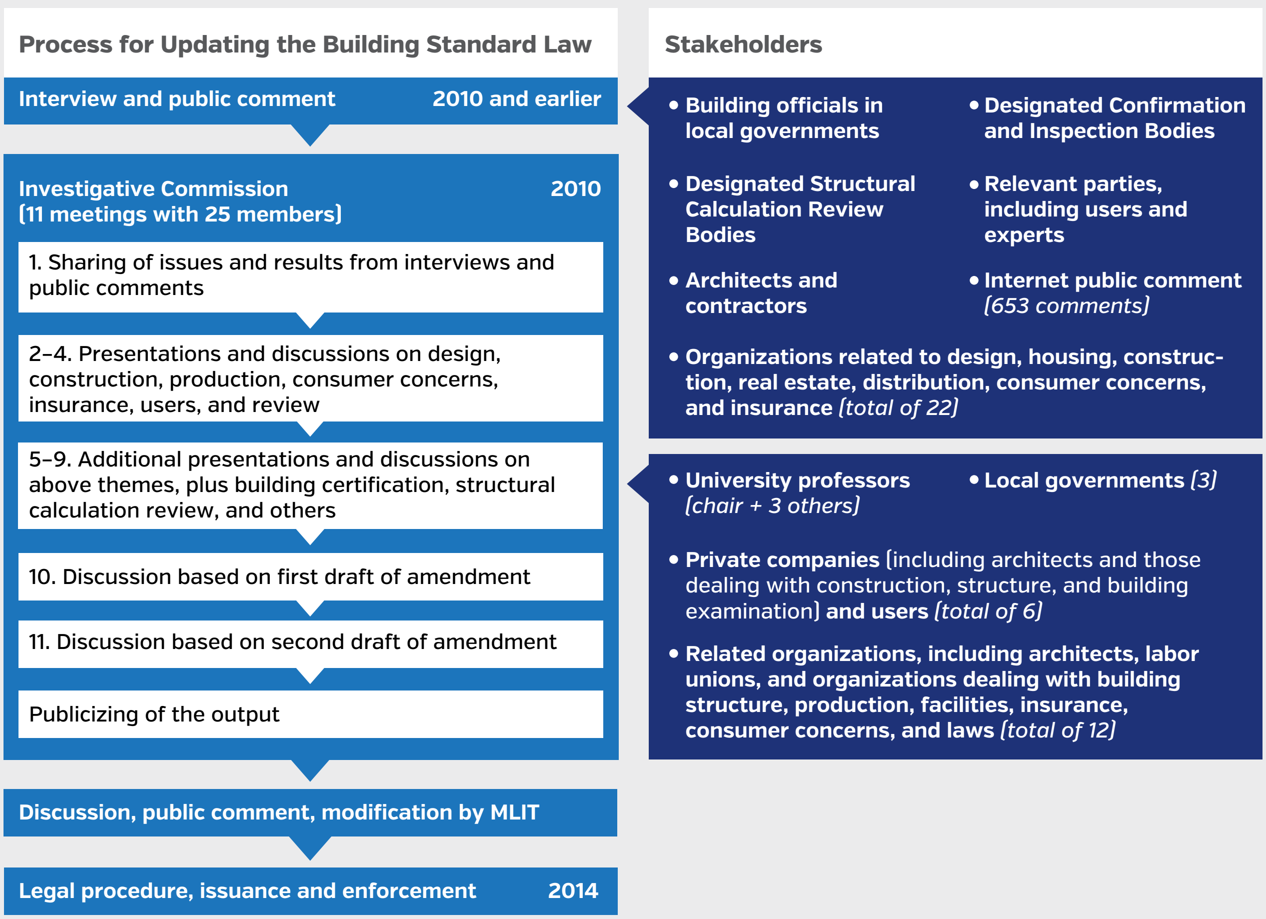
These examples illustrate how education, compliance support, and financial incentives, rather than coercive enforcement, can help increase the quality of non-engineered structures. They also draw attention to the importance of institutionalizing procedures for technical support and inspection so those processes can be sustained over the long term. These procedures "should be part of a broader disaster risk strategy rather than confined to short-term disaster recovery programs"; they will require long-term financial support and entail participation by "national and local governments, community-based organizations (CBOs), universities, and the private sector, including the building sector" (GFDRR 2016, 99).

Sources: Honda (2013) and Sawaji (2015) for El Salvador; Kamemura et al. (2016) for Indonesia.

3.4 Consultation Process for Updating Building Standards

The consultation process for revising laws and standards is not identical in every case, but certain elements, such as public involvement and a multi-sectoral approach, are now common. Japan introduced a public comment system in 1999 to encourage greater impartiality and transparency in developing regulations and rules, and the system was institutionalized in 2005. The process by which the BSL was amended in 2014 (illustrated in figure 3.3) is a good example of how standards are updated. First, local governments, designated bodies, private sector stakeholders, and others were interviewed, and public comments were collected through the Internet. Based on the results, an investigative commission was formed; it had 25 members and held 11 meetings. Members discussed the results of the interviews and public comments and over the course of eight meetings debated the issues at stake. Those meetings formed the basis for the draft results. Once these were discussed by the commission, they were made available to the public. MLIT then discussed the results internally and invited public comment before the amendment was made.

Figure 3.3 Consultation Process for Updating the Building Standard Law in 2014



4

Quality Assurance Mechanism for Building Safety: Planning, Design, and Construction

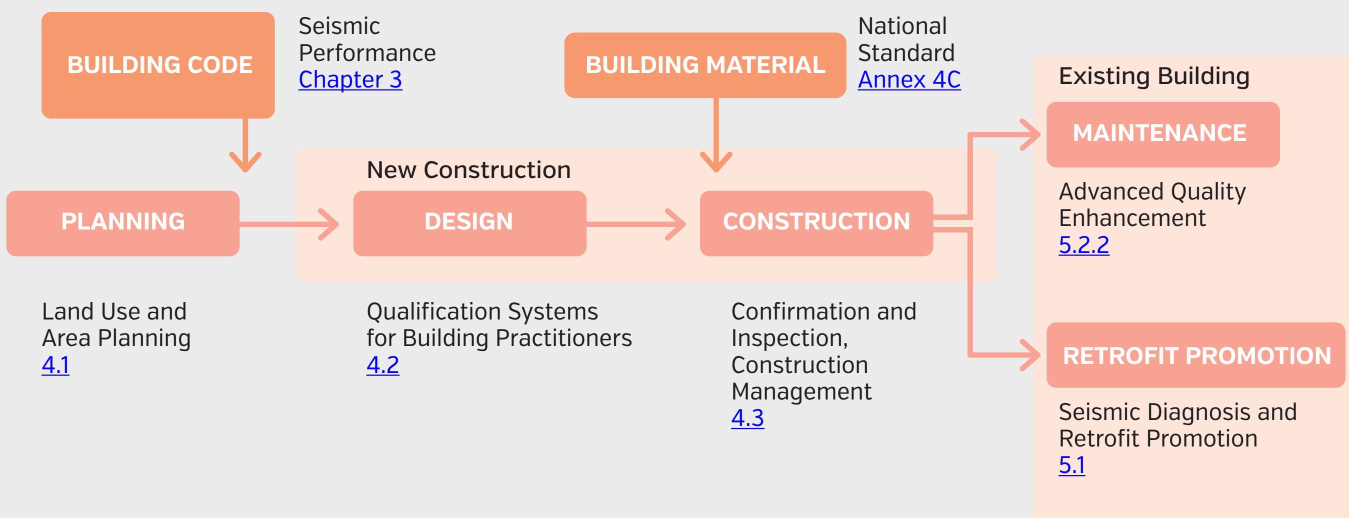
Key takeaways

- An integrated regulatory system that includes a planning code and a building code can effectively control land use and urbanization as well as support disaster risk management.
- Combining a qualification system for building practitioners and a nationwide capacity-building program can increase the number of qualified professionals. A successful qualification system should operate alongside capacity-building programs that attract and incentivize industry groups and individuals to obtain qualification.
- The private sector can be strategically leveraged to strengthen the capacity of building regulators, but only where mechanisms for oversight, fairness, and conflict resolution are robust.

The mechanism for assuring building quality in Japan has several components: relevant laws and standards, the licensing system for design and construction, and the building regulatory framework. These function as a system to ensure the high quality and safety of the built environment. This chapter looks in detail at the process for building quality assurance as it operates over the first three phases of a building's life cycle: planning, design, and construction itself (the fourth phase of the life cycle, maintenance and retrofit, is explained in the next chapter). The chapter concludes with a look at the private sector's role in assuring building quality in Japan.

The four phases are shown and briefly summarized in figure 4.1

Figure 4.1 Quality Assurance System in Japan



- **Planning.** Building regulatory procedures start at the planning stage and involve decisions about land use. To ensure that land use regulations and building regulations work in concert, Japan has harmonized the City Planning Act (CPA) and the Building Standard Law (BSL); in other words, planning codes stipulated in the BSL take account of and are related to the contents of the CPA.
- **Design.** At the design stage, licensed *Kenchikushi* design buildings in accordance with the quality and safety standards of the BSL, which (as shown in chapter 3) have been incrementally revised to ensure that the building code stipulates optimal seismic performance.
- **Construction.** Construction begins after the design has been formally confirmed as adhering to the requisite technical standards. Interim and final inspections are conducted during this stage.
- **Maintenance.** Buildings are checked periodically for safety and are retrofitted (as needed) to improve seismic resistance (see chapter 5).

4.1 Planning Stage: Land Use and Area Planning

4.1.1 Land Use in City Planning

In Japan, city planning regulations apply in both City Planning Areas and Quasi-City Planning Areas are coordinated through the City Planning Act (CPA) and Building Standard Law (BSL). City Planning Areas are divided into Urbanization Control Areas, which impose strict control on development, and Urbanization Promotion Areas, which promote development. The CPA specifies the land use zones that local governments may designate in an Urbanization Promotion Area (e.g., residential, commercial, industrial). The BSL Planning Code regulates buildings' volume, height, and use according to each land zone, while the BSL Building Code stipulates the requirements for safety, hygiene, fire prevention, etc. for individual buildings (table 4.1). Schools and hospitals, for example, can't be built in areas that are designated as industrial zones.

Table 4.1 Building Code and Planning Code

	Coverage	Purpose	Contents
Building Code	All areas	Assure the quality of individual buildings	Site, structure, fire prevention, facilities, evacuation, etc.
Planning Code	City Planning Area and Quasi-City Planning Area	Assure urban functionality and quality of living environment	Land use, floor area volume, building form, adjacent roads, etc.

4.1.2 Permitted and Restricted Development

City planning regulations under the BSL and CPA assure the safety of buildings in part by limiting where development may take place. Where building is deemed appropriate in City Planning Areas or Quasi-City Planning Areas, those wishing to undertake large-scale development must obtain permission in advance from the local government and must also take necessary safety measures (e.g., ground improvement, construction of retaining walls). In areas where disaster risk is significant, development is generally prohibited.

The BSL stipulates building standards such as height and type, while the CPA stipulates the criteria that development projects must meet in order to obtain permission. Technical criteria for permission relate to securing of roads, water supply and drainage facilities, measures for disaster prevention, etc. Specific criteria related to disaster prevention include the vulnerability of infrastructure and public service facilities, and the necessity for preventing landslides, flooding, subsidence, etc. Under the Act on the Regulation of Housing Land Development (1969), urban areas having a high risk of landslides and related hazards are designated as Areas Regulated for Housing Land Development. Because site development could potentially increase landslide risk, development within these areas requires permission at the design phase and site inspection once construction is completed. Owners of land within these areas are required to keep their residential lots safe.

Restrictions apply to a number of different types of land:

- **Urbanization Control Areas.** This land may be subject to flooding, tsunami, or storm surge. Under the CPA, development is prohibited out of safety concerns.
- **Disaster Risk Areas.** This land is subject to tsunamis, high tides, and other floods. Under the BSL, construction of houses is prohibited, and other restrictions on construction may apply.[20]
- **Landslide areas.** These areas are common in Japan, where there are many steep slopes. Under the Disaster Prevention Act, activities that may induce slope failures, such as discharging water or cutting down trees, are restricted.

[20] *An example of such restrictions can be found in the Nagoya City Disaster Countermeasures Outline, which went into effect following the Ise Bay typhoon of September 1959. The ordinance regulates structure types and floor levels by city location in order to mitigate impacts of future storms.*

4.2 Design Stage: Qualification Systems for Building Practitioners

Under Japan's Kenchikushi Law, building design and construction management can be carried out only by licensed *Kenchikushi*. These architect-engineers play an important role in ensuring the quality and safety of buildings.

The Kenchikushi Law was enacted in 1950, when there was a large demand for housing. To ensure that there would be enough licensed professionals to design and oversee construction of houses, the law established several levels of *Kenchikushi* with different qualifications and levels of expertise. The three types of *Kenchikushi* currently recognized in Japan are shown in table 4.2, from most to least extensively trained.

Table 4.2 Types of *Kenchikushi*

Type	Licensing Authority
First-class *Kenchikushi*	Minister of MLIT
Second-class *Kenchikushi*	Prefectural governors
Mokuzo (wooden) *Kenchikushi*	Prefectural governors

Source: MLIT.

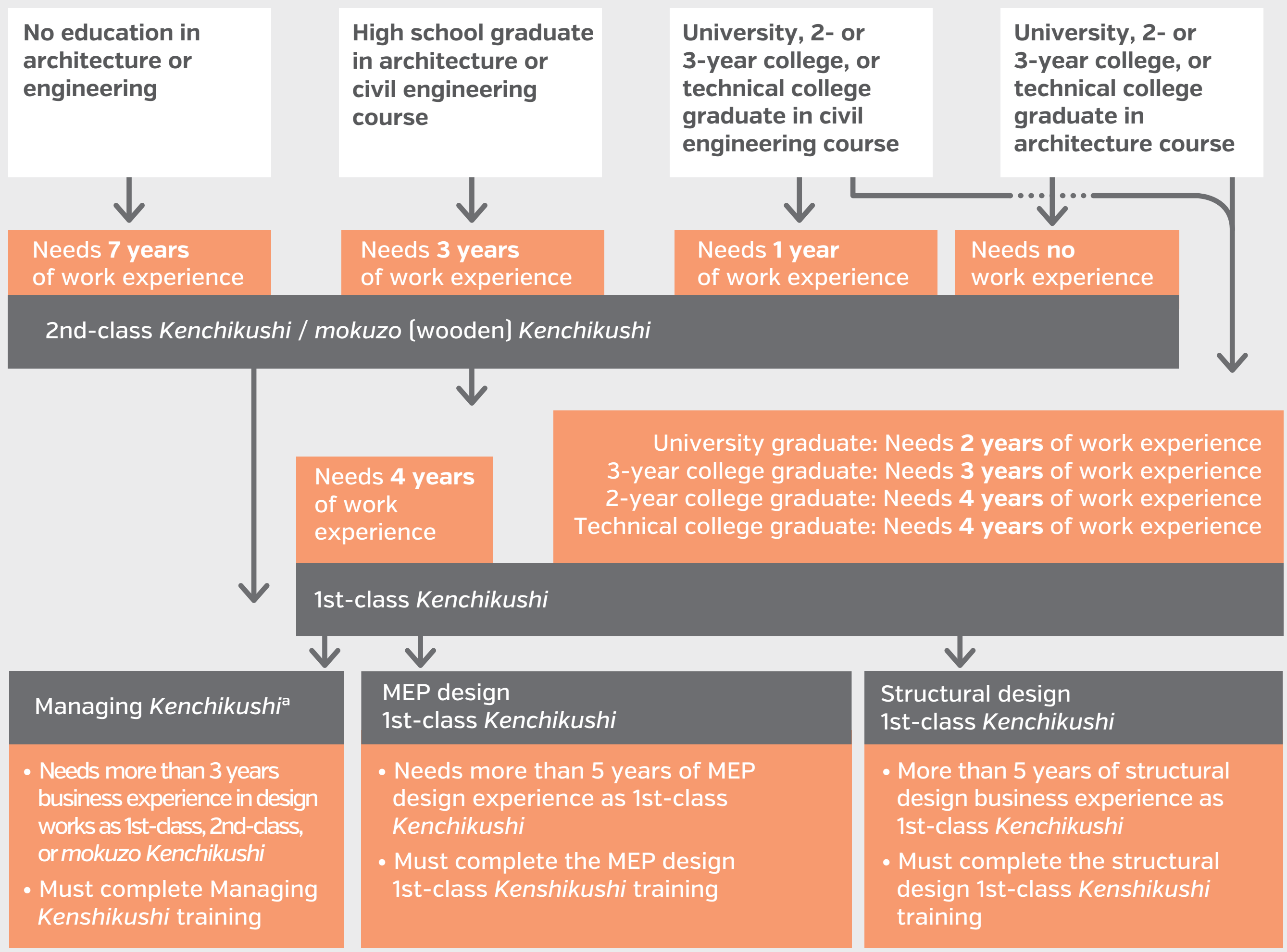
As construction types have diversified in Japan in response to socioeconomic changes, the required scope of activities for *Kenchikushi* has also expanded. Each type of *Kenchikushi* receives a different level of training and is responsible for different types of construction depending on building use, structural design, and scale. All three types of *Kenchikushi* may undertake design of small wooden buildings, but three-story buildings can be undertaken only by first- or second-class *Kenchikushi*; only first-class *Kenchikushi* can undertake buildings taller than 13 m. More details on the scope of activity by type of *Kenchikushi* are in annex table 4A.1.

To be certified as *Kenchikushi,* candidates must pass a test that has an academic component as well as a drafting and design component.[21] The qualifications that each type of *Kenchikushi* must demonstrate are stipulated in the Kenchikushi Law and differ depending on the *Kenchikushi* type. First-class *Kenchikushi*, for example, must show knowledge of planning, MEP (mechanical, electrical, and plumbing) systems, relevant laws and regulations, and construction work. The other two levels can substitute work experience for educational experience. Figure 4.2 gives more detail on the required qualifications of the different *Kenchikushi* types.

In addition to these three types of *Kenchikushi*, other types of certification exist to recognize specific expertise, such as in structural design, MEP design, and architectural office management. *Kenchikushi* are required to hold these certificates in order to implement the relevant work. To obtain the certificates, *Kenchikushi* must complete the courses of training stipulated in the Kenchikushi Law (see annex table 4A.2 for details).

21 Not surprisingly given the different levels of knowledge required of them, the different Kenchikushi pass their qualifying exams at different rates: the pass rate is 12.4 percent for first-class Kenchikushi, 21.5 percent for second-class Kenchikushi, and 27.3 percent for Mokuzo (wooden) Kenchikushi in 2015.

Figure 4.2 Qualifications for Each Type of *Kenchikushi* and for Specific Kenchikushi Licenses (according to Kenchikushi Law)



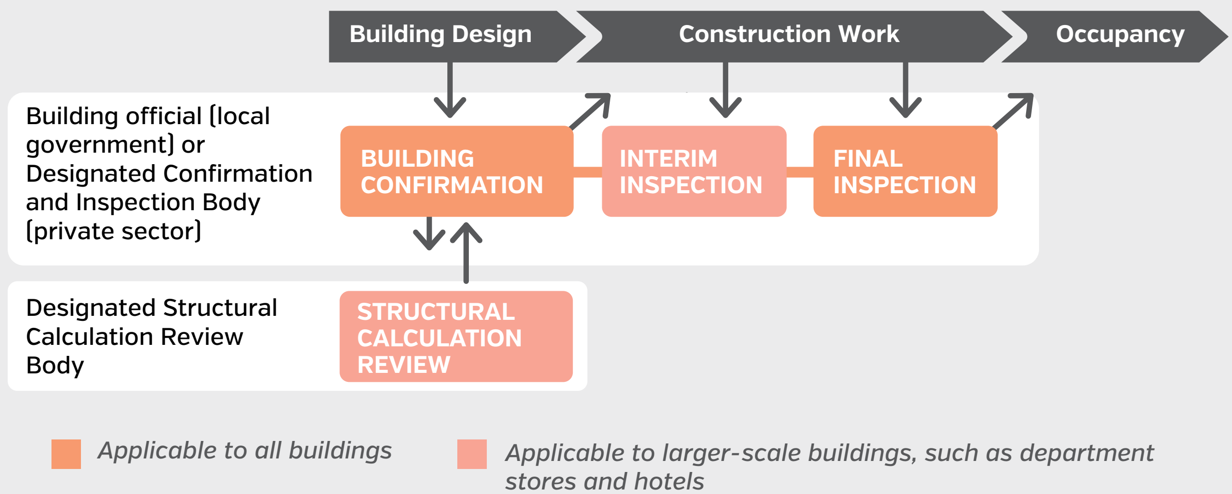
a. Managing Kenchikushi are responsible for managing a Kenchikushi office in accordance with the provisions of the Kenchikushi Law.

To stay current with building laws and regulations as well as evolving construction technologies and methods, all types of *Kenchikushi* must attend trainings every three years (see annex table 4A.3 for details). These regular trainings, held by an agency registered by MLIT, are compulsory under the Kenchikushi Law. Careful records are kept of attendance, and these data make it possible to confirm individuals' training history and their exposure to the latest information on laws, design, and construction management. In general, *Kenchikushi* are held to a high ethical standard, and Japanese law stipulates fines or jail sentences for breaches of their duty. See annex table 4B.1 for details.

4.3 Construction Stage: A Multi-step Process

Quality assurance at the construction stage is a multi-step process that involves preconstruction confirmation, structural calculation review, and interim and final inspections (figure 4.3). The process differs somewhat depending on the building's scale, use, and construction type. Quality assurance of building materials is also extremely important for ensuring building quality and performance; see annex 4C for information on Japan's national standards for building materials.

Figure 4.3 Quality Assurance Steps for New Buildings



4.3.1 Confirmation

Generally, in cases where a building is to be constructed, extended, rebuilt, or relocated, the owner must apply for and receive building confirmation—that is, confirmation that the building conforms to legal technical regulations (not limited to those in the BSL). These regulations relate to both the planning code (for example, requirements for building use and height within the land use zone) and the building code (for example, requirements for structural stability and fire safety).

In requiring confirmation rather than permission before construction begins, Japan's quality assurance process is somewhat unusual. Unlike some permission processes, the confirmation process allows virtually no discretion; if the building plan meets technical requirements, it is confirmed. Box 4.1 provides more detail.

The building regulatory authorities who carry out confirmations and inspections may belong to either the public or the private sector. The Designated Administrative Agencies are part of local government, and the Designated Confirmation and Inspection Bodies are private entities; table 4.3 shows the main differences between them. Owners seeking confirmation can choose to apply to either a private entity or a local public sector authority, though most choose private entities because they tend to provide more rapid service. There are also some differences in the roles of Designated Administrative Agencies depending on the population of the administrative area in question and the size of building being dealt with; see annex 4D.

The reasons for and consequences of private sector participation in Japan's process for building quality assurance are discussed in more detail in section 4.4.

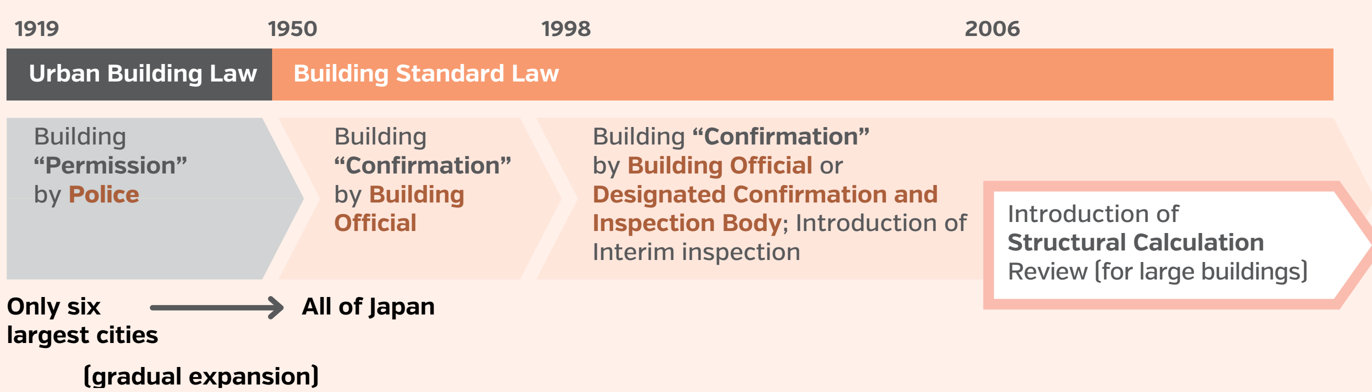
Table 4.3 Building Regulatory Authorities: Public versus Private Sector

Designated Administrative Agencies (public sector)		Designated Confirmation and Inspection Bodies (private sector)
Part of prefectural or municipal government	**Attributes**	Private entity (either for profit or nonprofit)
449 Designated Administrative Agencies 1,624 prefectural and municipal building officials	**Number of staff, organizations (as of 2016)**	133 organizations 3,087 private building inspectors
Must pass a qualifying examination; must be certified as first-class *Kenchikushi*; and must have two or more years of practical experience related to building administration or confirmation and inspection work	**Staff qualifications**	Must pass a qualifying examination conducted by MLIT and must be registered with MLIT
Building confirmation and inspection (officials conduct about 20 percent of building confirmations)	**Main responsibilities**	Building confirmation and inspection (officials conduct about 80 percent of building confirmations)
Correction of violations		No role in correction of violations

Box 4.1 From Building Permission to Building Confirmation

A salient feature of Japan's quality assurance process for construction is its reliance on confirmation rather than permission. That change is illustrated in the following figure and described below.

Figure B4.1.1 Changes in Authorities Responsible for Building Permission or Confirmation

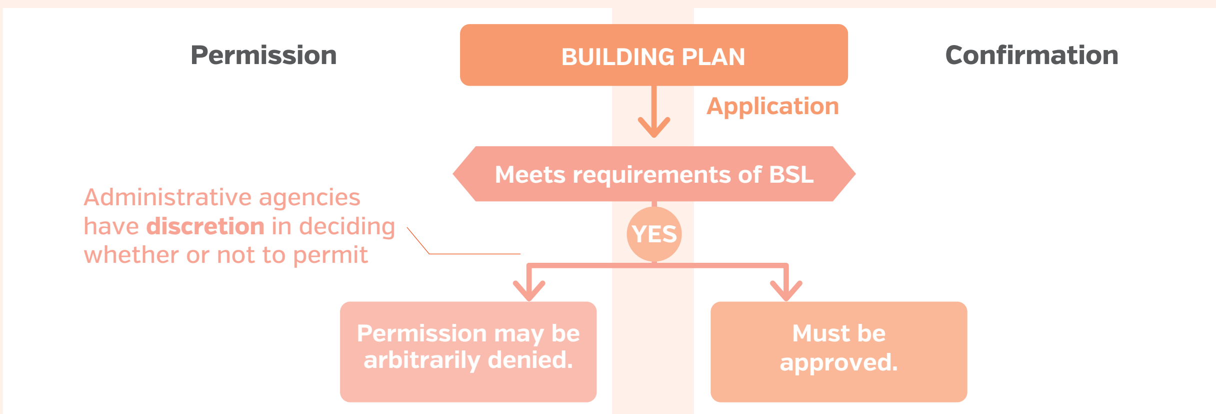


Box 4.1 From Building Permission to Building Confirmation CONTD.

Under the Urban Building Law of 1919, Japan's system involved issuing permission, as is usual in most countries. Permissions were issued by the police department for large-scale buildings (for smaller buildings, such as detached houses, a notification system was used). But as Miyake (2014) explains, the system was inefficient and potentially arbitrary; for example, approval could be refused merely at the discretion of the prefectural governor, and reviews could take several months. Moreover, after World War II, when construction of new housing boomed, the permission system was perceived as inadequate to keep up with demand.

Thus when the Building Standard Law was enacted in 1950, it replaced building "permission" with building "confirmation"—that is, confirmation that a building met technical requirements. The preliminary review of the building plans by the administrative authority was prescribed as a purely technical decision. This change transferred responsibility from the police to building officials in the prefectures and municipalities. The different procedures for permission and confirmation are shown in the figure below.

Figure B4.1.2 Differences between "Permission" and "Confirmation" in Japanese Context



The BSL also accommodates a degree of flexibility to cope with special circumstances if appropriate. As such circumstances entail additional time and considerations, applicants must obtain necessary approval from a relevant authority before commencement of confirmation procedures.

4.3.2 Structural Calculation Review

To confirm structural safety, certain buildings in Japan are subject to a structural calculation review. The relevant buildings are those taller than 60 m and those using advanced structural calculation methods (these must also be approved by the MLIT minister); wooden or steel buildings that are 13 m or taller, or that have eave heights of 9 m or more; reinforced concrete buildings that are 20 m or taller; and steel structure buildings that have four or more stories (excluding the basement levels). A building confirmation cannot be issued for any of these buildings until one of the Designated Structural Calculation Review Bodies conducts a review.

4.3.3 Interim Inspection

The content of the interim inspection varies depending on the type and function of the building. As explained below (section 4.4), Japan began strict enforcement of interim inspections (along with other changes to the inspection and confirmation process) after the Great Hanshin-Awaji Earthquake in 1995 revealed widespread building deficiencies. The changes were made as part of the 1998 amended BSL. The value of an interim inspection was demonstrated when houses financed by the Government Housing Loan Corporation (GHLC), which required interim inspections under its loan agreement, performed better than others in the Great Hanshin-Awaji Earthquake.

4.3.4 Final Inspection

Within four days of a building's completion, the owner must notify a building official or a Designated Confirmation and Inspection Body so that a final inspection can take place. This inspection determines whether the building conforms to relevant regulations. A new building cannot be used until the owner has obtained a final inspection certificate.[22] Some financial institutions require the final inspection certificate among the documents submitted for loan execution.

4.4 Private Sector Involvement in Building Quality Assurance

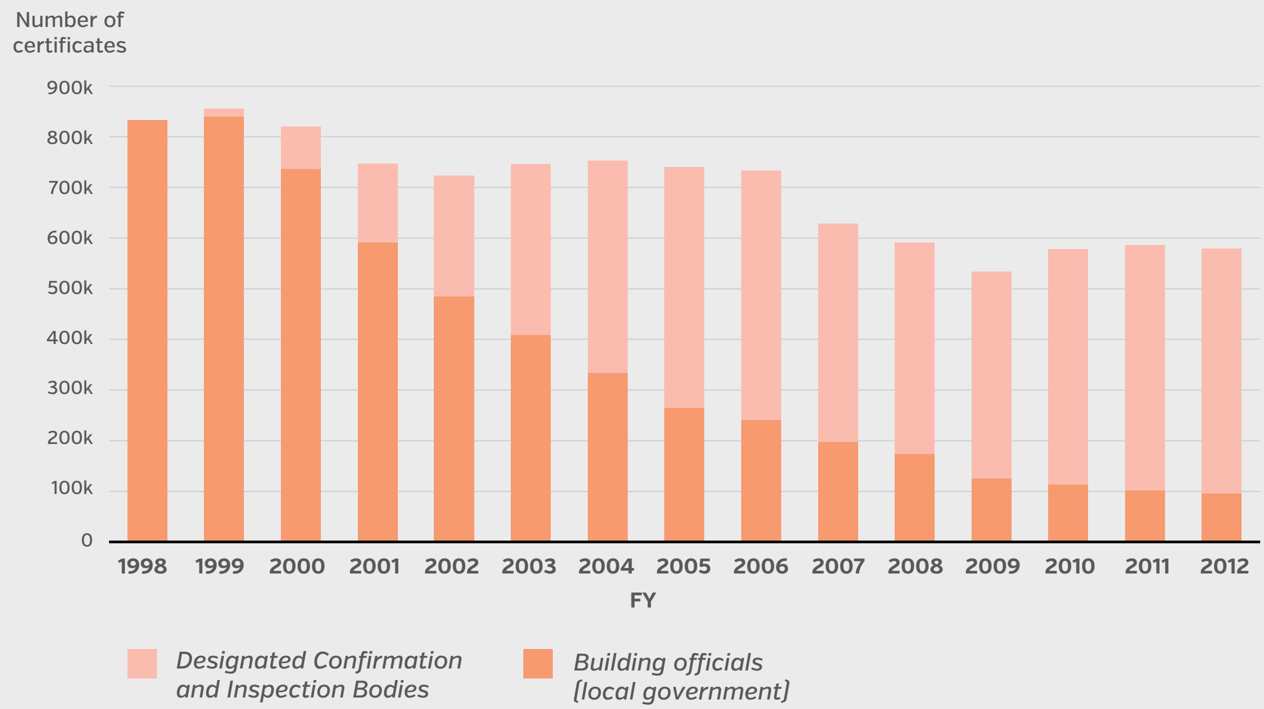
Japan introduced private sector involvement in building regulation in 1998, when it became clear that the public sector lacked the capacity to handle the required number of inspections and confirmations with adequate scope and depth. In 2016, thanks to private sector participation, the rate for final inspections was more than 90 percent—compared to a rate of less than 40 percent before 1998. It was the Great Hanshin-Awaji Earthquake in 1995 that revealed the consequences of the low inspection rate: the damage pattern showed construction deficiencies (such as lack of bearing walls for wooden houses) that final inspection would have detected and required remediation for. In response, Japan made changes in its system for confirmation and inspection, including the use of private sector building inspectors to meet demand.

The inability of public sector inspectors to keep up with demand was due mainly to Japan's socioeconomic growth. Before the 1998 amendment of the BSL, each local government official was responsible for more than 600 confirmations a year. Given these circumstances, the decision was made to allow fair and neutral private sector engineers to undertake building confirmation and inspection. Since building confirmation was a technical check that did not admit of discretion (see box 4.1), this approach did not seem to raise any legal issues.

The effect of private sector involvement can be seen in the increasing share of inspection certificates issued by the private Designated Confirmation and Inspection Bodies (shown in figure 4.4) and in the current high final inspection ratio (shown in figure 4.5).

[22] *There are a few exceptions to this rule. Small buildings (wooden detached houses of two stories or less) may be used before the owner obtains the final inspection certificate. Buildings may also be used before they are inspected if the building authority allows temporary use or if seven days have elapsed from the day on which the application for a final inspection was received.*

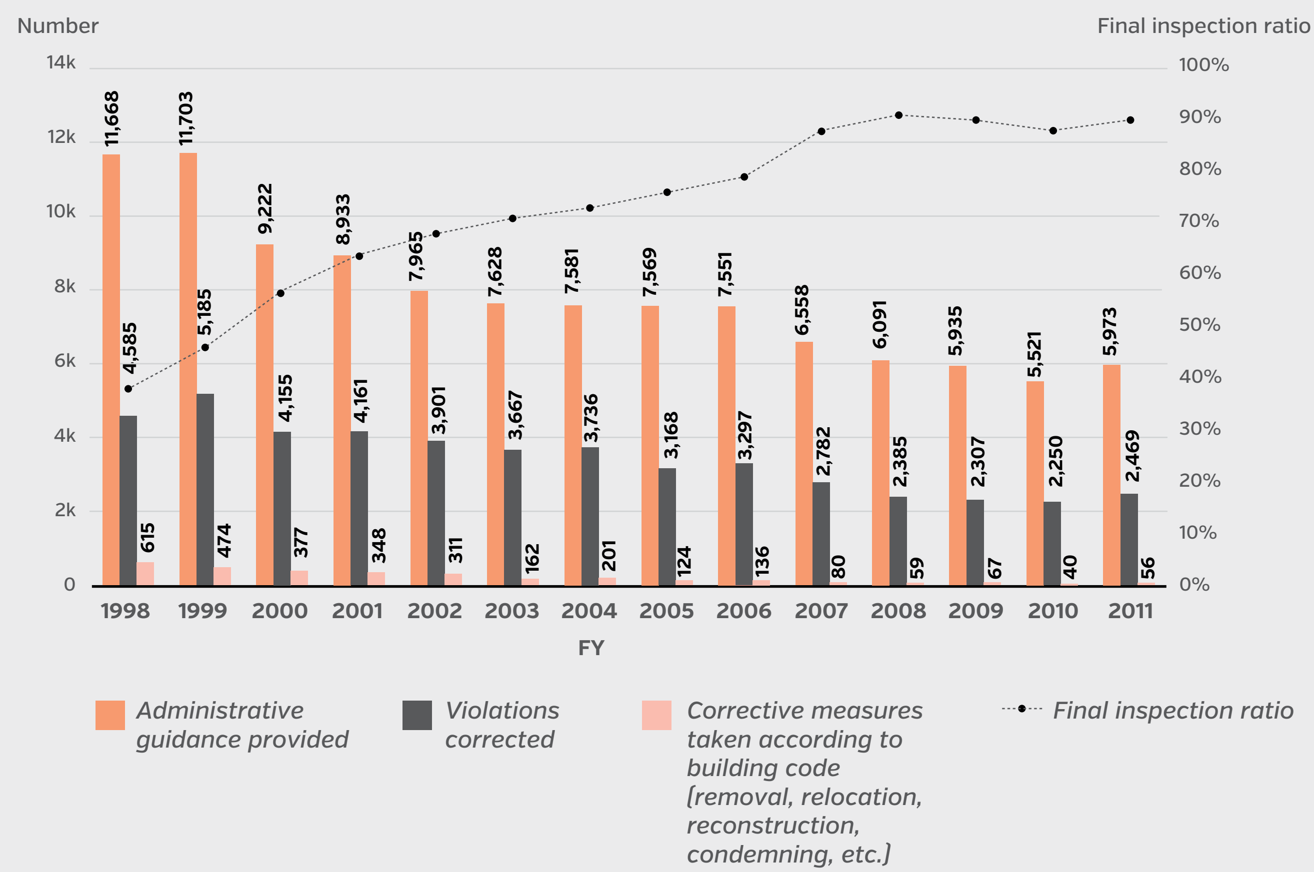
Figure 4.4 Trend in Issuing of Inspection Certificates: Public versus Private Inspectors, 1998–2012



Source: MLIT.

One benefit of private sector involvement in building quality assurance is that it allows government staff to fulfill other responsibilities, including correction of violations. Figure 4.5 shows the trend in the amount of administrative guidance issued and number of violations corrected since private sector involvement began.

Figure 4.5 Administrative Guidance, Correction of Violations, and Final Inspection Rate, 1998–2011



Source: MLIT.

Contrary to expectations, private sector involvement initially increased (rather than decreased) the workload of the local administrative authorities, as inexperienced private sector staff continually turned to them for guidance. To address this problem, local administrative offices further systematized the confirmation and inspection processes—for example, they developed lists of issues along with the methods and criteria to use in making determinations. This approach allowed the Designated Confirmation and Inspection Bodies to proceed with less guidance, and the workload of administrative officers decreased.

Another consequence of private sector involvement in Japan was a loss of public sector capacity as local government officials performed fewer building confirmations and inspections. To address this issue, local governments have focused on human resource development and technical transfer, and have implemented trainings and study sessions for building officers to help them maintain and improve their technical capacities. In addition, the College of Land, Infrastructure, Transport and Tourism (CLITT) managed by MLIT carries out trainings to enhance practical skills and to provide the latest information from academics, practitioners, and MLIT officers. (For further detail on capacity enhancement for public building officials and the training program offered by CLITT, see annex 4E.) Finally, when a relevant law is revised, training sessions are organized to ensure that staff are up to date. When the approach to structural calculation was revised in 2006, for example, the Japan Building Disaster Prevention Association implemented training sessions.

The policy choice to integrate private sector engagements in building quality assurance should be accompanied by appropriate safeguard mechanisms that favor the public interest over private profits. The following are specific lessons from Japanese experience; global lessons, including some from Japan, can be found in the World Bank Group (2018, p. 45–50) [23].

- The roles of each actor must be clear, and all actors must have the same understanding of their roles.
- Ensuring the quality of private sector staff is crucial. In Japan, the quality of the Designated Confirmation and Inspection Bodies is ensured through a system (operated by MLIT) that includes examination,[24] registration, and occasional on-site observation. Misconduct is punished by severe penalties, including business suspension.
- Continuing education is essential. Each local government conducts seminars and trainings on building certification and inspection for the Designated Confirmation and Inspection Bodies to ensure their knowledge and skills stay current.

For further discussion of how private sector participation affects building quality assurance, see annex 4F.

[23] *Doing Business 2018, World Bank Group (http://www.doingbusiness.org/~/media/WBG/DoingBusiness/Documents/Annual-Reports/English/DB2018-Full-Report.pdf)*

[24] *To help ensure that the requisite number of private sector candidates passes the examination, test preparation courses are offered by MLIT, local governments, and private companies.*

5

Quality Assurance Mechanism for Building Safety: Maintenance, Seismic Retrofit, and Efforts to Improve Building Quality

Key takeaways

- A package of financial and technical incentives, along with effective communication with building owners, can create an enabling environment for retrofitting at scale and for meeting numerical retrofit targets at both national and local levels.
- Retrofitting requires long-term commitment, particularly where the building stock is extensive. Targeting high-priority buildings can make retrofitting more efficient, while sustainable monitoring mechanisms can help accelerate scaling up of retrofitting activities. Collecting data on buildings' completion status can illustrate remaining gaps and show where efforts and financing should be directed.
- When coupled with technical specifications, housing finance can be leveraged as an instrument to improve structural safety.

The previous chapter looked at how the first three stages of the building life cycle function in Japan to assure building quality. This chapter looks at the fourth stage, building maintenance, which is broadly understood here to include seismic retrofit and larger efforts to improve building quality. At its most basic, building maintenance entails periodic safety checks of buildings by the Designated Administrative Agencies. These required checks are carried out at periodic intervals (ranging from six months to three years) by *Kenchikushi* (architect-engineers) or other qualified inspectors, and the results are reported to the Designated Administrative Agency. Different buildings may require different types of inspection, but for buildings of a certain size such as hospitals, hotels, department stores, theaters, apartment houses, and office buildings, the safety inspection typically looks at fire-prevention and other building equipment and at elevators and escalators. The inspection report notes the condition of the site and building equipment, including the state of any damage, corrosion, or deterioration. These various mechanisms have also contributed to a safer built environment through higher rates of implementation of safe building practices and regulatory compliance, including critical building maintenance and retrofit requirements.

5.1 Policy Instruments to Promote Seismic Retrofit

In Japan, the retrofit of seismically vulnerable buildings is a fundamental element of building quality assurance. The main policy instrument for seismic retrofit is the Act on Promotion of Seismic Retrofitting of Buildings (APSRB), which was enacted in 1995 following the Great Hanshin-Awaji Earthquake and revised in 2006 and 2013. Among other things, the APSRB makes local governments responsible for setting numerical targets for retrofit, outlines a consulting system to share and diffuse knowledge on retrofit, and develops guidelines for seismic retrofit. Figure 5.1 presents an overview of the law.

Figure 5.1 Overview of the Act on Promotion of Seismic Retrofitting of Buildings (APSRB)

Basic policy prepared by national government

- Numerical targets for seismic safety of houses and buildings of a certain size used by many people, such as hospitals, hotels, etc. (75% in 2003; > 90% in 2015)
- Policy to develop consulting system for dissemination of knowledge
- Policy to promote seismic resistant measures
- Method for seismic diagnosis and seismic retrofitting (guidelines)

Seismic retrofitting promotion plans prepared by local government

- Targets for seismic retrofitting of houses and buildings of a certain size used by many people, such as hospitals, hotels, etc.
- Definition of measures to achieve targets
- Target for seismic resistance of public buildings
- Designation of emergency routes (prefectures and municipalities) and evacuation facilities (prefectures)

(1) Control measures for promotion of seismic-resistant buildings

Types of noncomplying buildings targeted for guidance and advice

- Buildings of a certain size used by many people, such as hospitals, hotels, etc.
- Storage processing facilities handling a certain quantity and/or of explosives or oil
- Houses and small-scale buildings

Types of noncomplying buildings targeted to receive local government's instructions and to have seismic status publicized

- Buildings of a certain size used by many people, including people having difficulty in evacuating
- Buildings along the evacuation routes designated by prefectural or municipal government
- Buildings of a certain size used for storage and/or processing of a certain quantity of explosives or oil

Types of large-scale buildings required to conduct seismic diagnosis and publicize results:

Large-scale buildings whose safety must be confirmed (high priority)

- Buildings used by large numbers of people (such as hospitals and hotels) and large-scale buildings used by people having difficulty in evacuating
- Large-scale buildings used for storage and/or processing of explosives or oil

Large-scale buildings whose safety must be confirmed

- Buildings along the emergency routes designated by prefectural or municipal governments
- Designated evacuation facilities and government buildings used as emergency operation hubs

(2) Measures for efficient promotion of seismic-resistant buildings

Authorization of building modification plans to increase seismic resistance

- Includes exceptions for buildings exempted under other (non-seismic-related) regulations
- Includes exceptions for fire-proof buildings and those with certain building coverage ratios and floor area ratios

Approval of needed seismic retrofit of buildings for unit ownership

- Eases requirements for resolution of cases where large-scale seismic retrofit is being attempted (exemption of the section ownership law)

Seismic performance indication system (voluntary)

- Recognizes buildings that have achieved acceptable seismic performance

Seismic Retrofitting Support Center

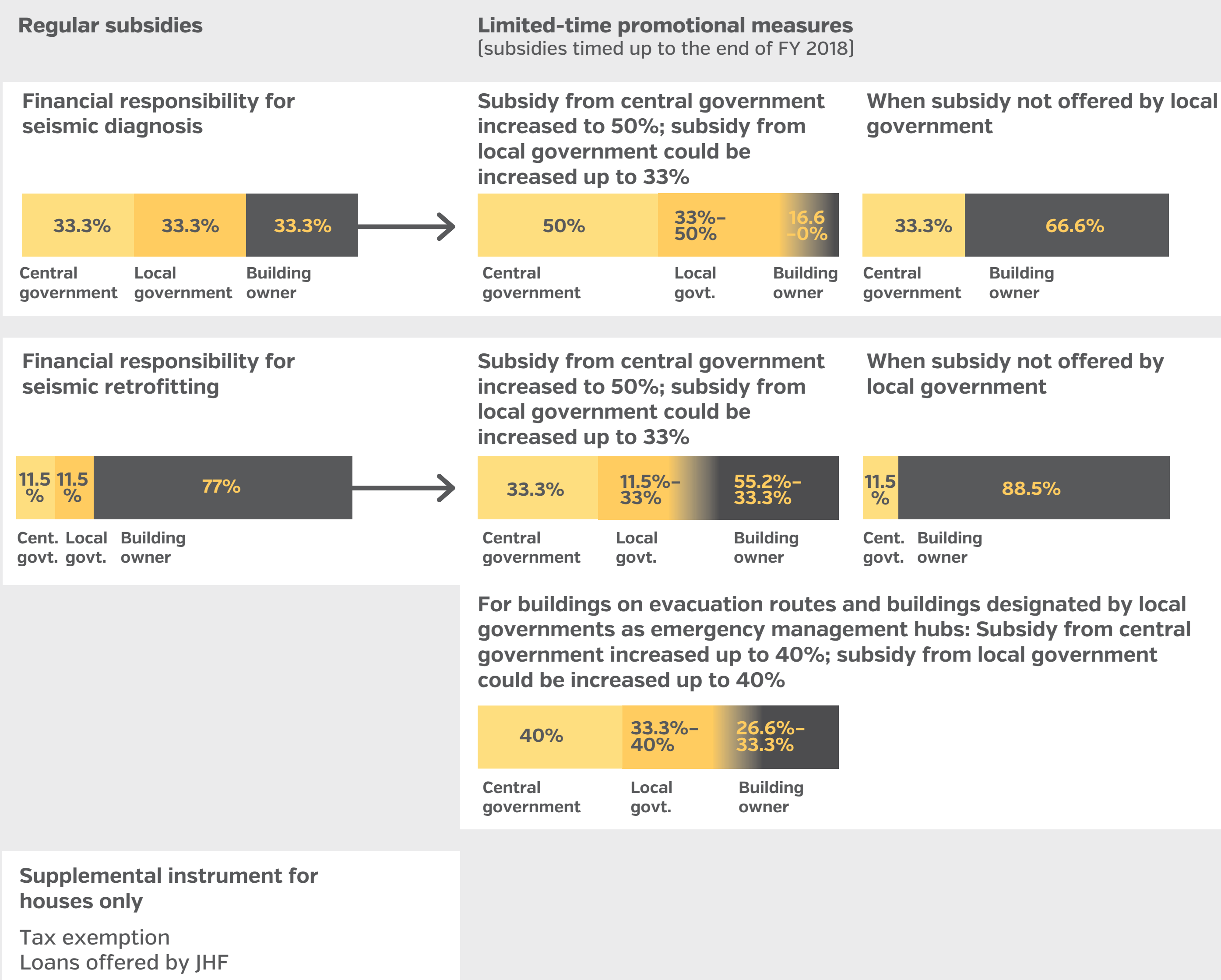
- One-stop shop providing information on and support for seismic diagnosis and retrofit

Other supporting programs

- Subsidies and tax benefits for seismic diagnosis and retrofitting works for existing building stocks.

To encourage building owners to carry out needed retrofit measures, Japan has implemented a system of financial incentives that divides the cost of works between the central government, the local government, and the building owners. This has been delivered through tax breaks, loans, and subsidies. The current system is shown in figure 5.2.

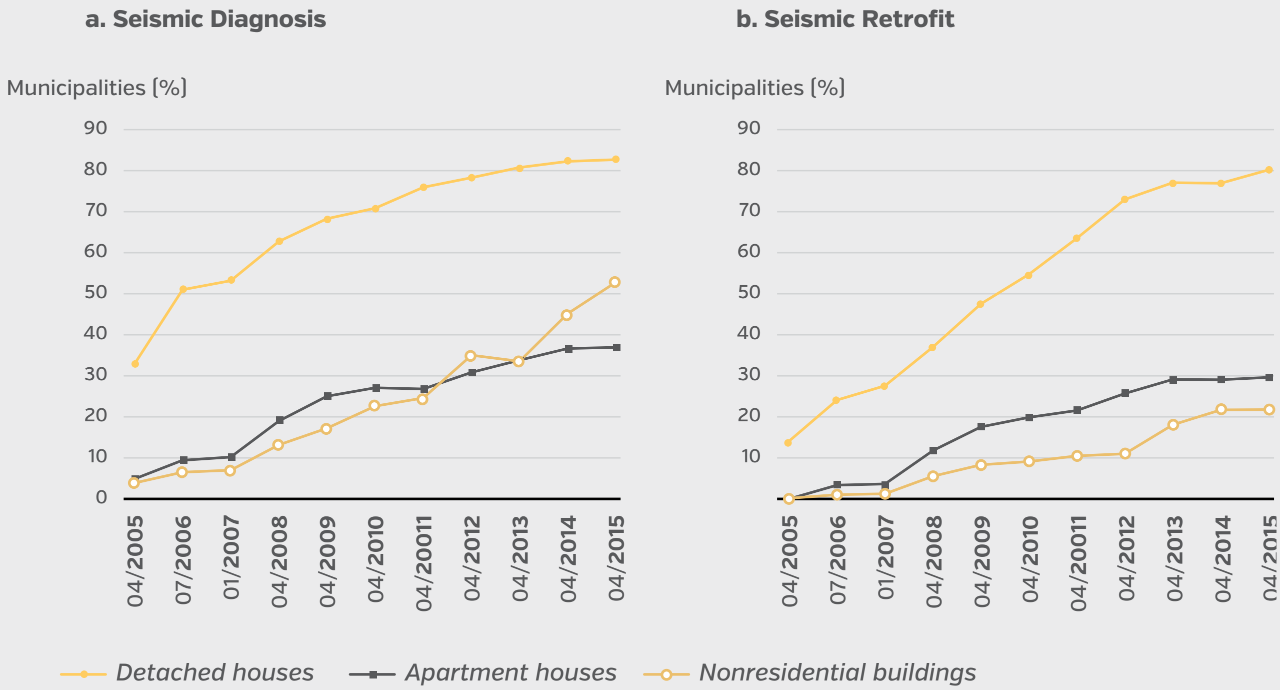
Figure 5.2 Subsidy Coverage for Seismic Diagnosis and Retrofitting as a Share of Required Costs



Source: MLIT, *http://www.mlit.go.jp/common/001123670.pdf* (in Japanese).

About 80 percent of municipalities also offer financial incentives to encourage seismic retrofit. This share has increased gradually over time, as shown in figure 5.3.

Figure 5.3 Share of Municipalities Offering Subsidies for Seismic Diagnosis and Retrofitting, 2005–2015



Source: MLIT.

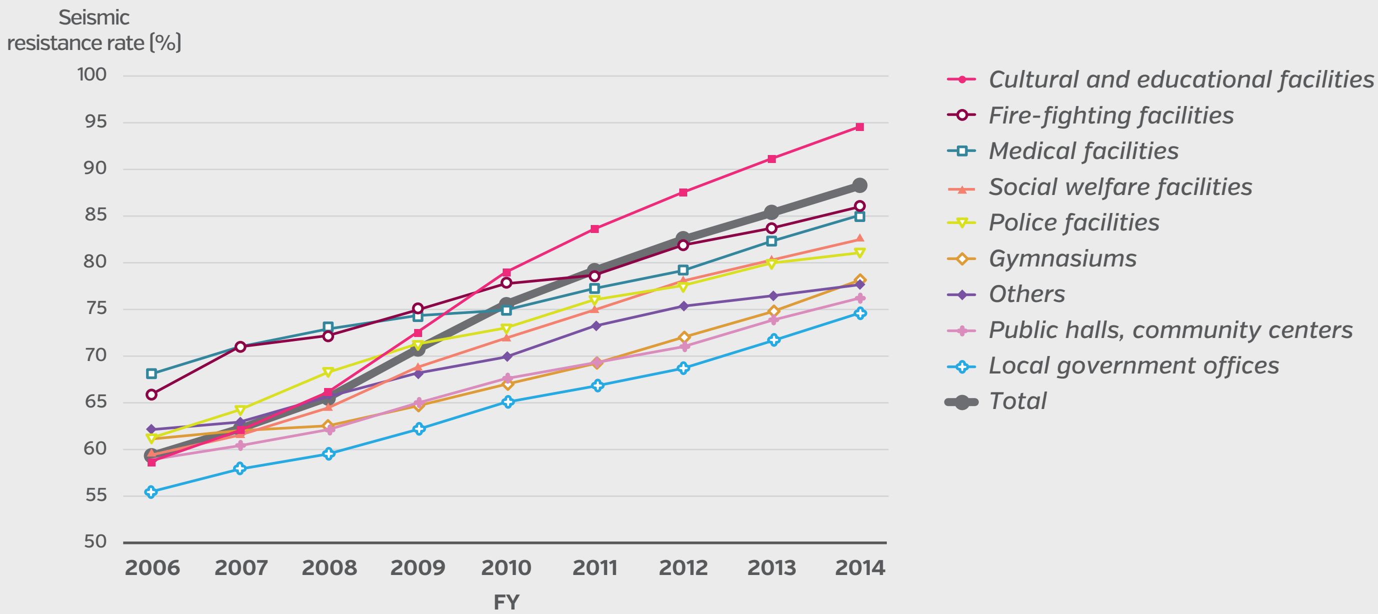
5.1.1 Seismic Retrofitting for Public Buildings

When a disaster occurs in Japan, public buildings are usually utilized as evacuation facilities and shelters. For this reason, seismic retrofitting for public buildings has been a priority and has served as an entry point for increasing the country's seismic resistance rate and resilience. Since 2006, the year after enactment of the APSRB, all types of public buildings have increased their seismic resistance rate (figure 5.4). Seismic retrofitting for schools has been a priority, and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) has offered special assistance for these facilities. As a result, the seismic resistance rate for schools had reached nearly 100 percent in 2016 (World Bank and GFDRR 2016) [25].

For information on local policies to promote seismic retrofit, see annex 5A. For a discussion of the technical criteria used to decide when a building qualifies for retrofitting and when it should be demolished, see box 5.1.

[25] *http://pubdocs.worldbank.org/en/148921478057894071/110216-drmhubtokyo-Making-Schools-Resilient-at-Scale.pdf*

Figure 5.4 Seismic Resistance Rates for Public Buildings, 2006–2014



Source: Fire and Disaster Management Agency.

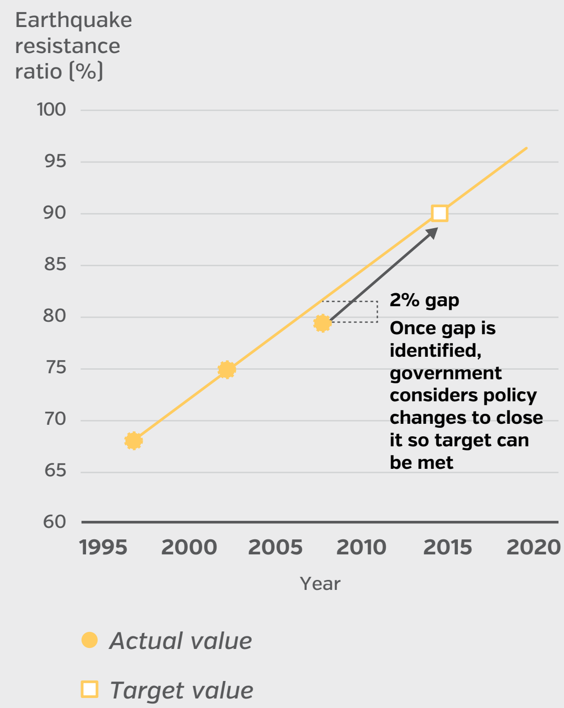
5.1.2 The Role of Statistical Data in Seismic Retrofitting

Statistical data play a crucial role in setting policy for seismic retrofit and more generally in efforts to promote an earthquake-resilient society in Japan. After the Great Hanshin-Awaji Earthquake, when a large number of buildings designed under the old seismic design code performed poorly, the Housing and Land survey sought to determine how many buildings were not adhering to the new standard. Based on the finding of 13 million buildings, the government devised specific policies to strengthen seismic resistance—such as setting the target value of the seismic resistance rates and securing subsidies for the retrofitting of houses. The Housing and Land Survey, which is conducted every five years, has served to monitor the progress of the seismic resistance rate. The statistical evidence collected through the monitoring activities is then used to inform policy decisions and amendments where necessary.

Figure 5.5 shows the trend in both the actual seismic resistance rates and the targets. The 2008 Housing and Land Survey showed a 2 percent gap between the target and the actual rate. These data prompted the government to devise policies such as subsidies that would help close the gap—an example of the key role statistical data can play in policy making.

Japan conducts a number of different surveys that help the government understand and monitor building quality; these are listed in annex 5B.

Figure 5.5 Tracking of Seismic Resistance Rates against Government Target to Identify Gaps



Source: Statistics Bureau, Ministry of Internal Affairs and Communications.

Box 5.1 Retrofit or Demolition?

For the purpose of retrofitting, the structure seismic resistant capacity index (*Is*) is generally used for seismic diagnosis.[a] Table B5.1.1 lists the relationship between *Is* and building seismic capacity subject to the Japan Meteorological Agency (JMA) intensity 6 to 7.

Table B5.1.1 Relationship between Is and Building Seismic Capacity

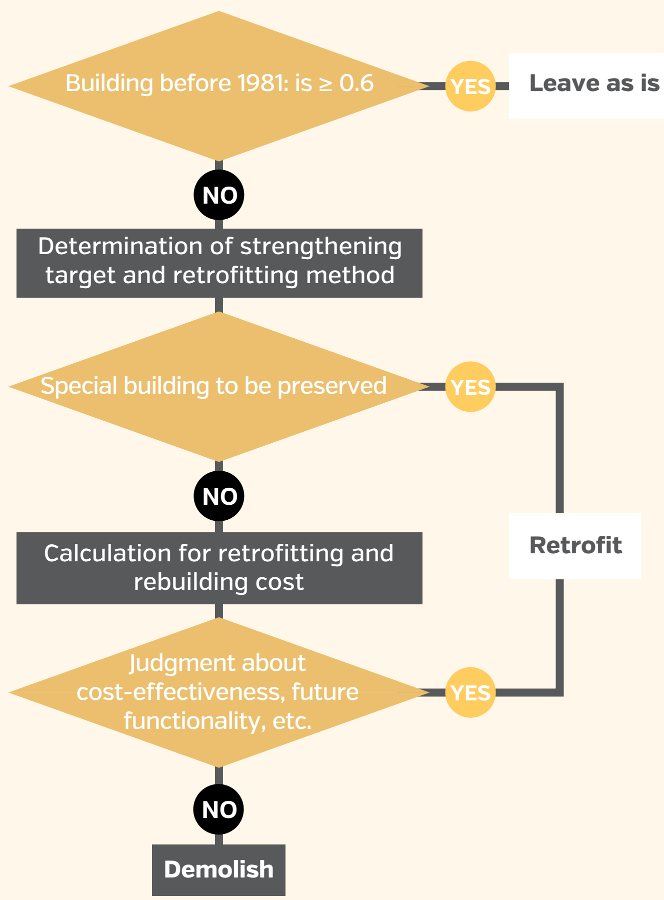
Is < 0.3	High possibility of severe damage or collapse
0.3 ≤ *Is* < 0.6	Possible severe damage or collapse
0.6 ≤ *Is*	Low possibility of severe damage or collapse

a. Structure seismic resistant capacity index Is, which is used to indicate the seismic capability of a building, is calculated as the product of three indexes that consider the strength and deformation capacity, irregularity, and age of the building. Thus Is = Eo × SD × T, where Eo represents the structural index of the building calculated from the product of strength index C and ductility index F, SD is the index accounting for unbalanced distribution of stiffness both in the horizontal plane and along the height, and T is the index that considers the deterioration of strength and ductility due to building age.

For buildings with insufficient seismic capacity, the question is whether to retrofit or demolish them. Several factors go into answering this question: how low the current seismic capacity is, the target level of retrofitting, the availability of retrofitting methods, the cost of the two approaches, the level of satisfaction with the building's current function and facilities, and plans for future use of the building. But there exists no simple measure to determine which choice is optimal. A general procedure for reaching a conclusion is shown in figure B5.1.2.

Under the original (1995) Act on Promotion of Seismic Retrofitting of Buildings, seismic diagnosis and retrofitting were not mandatory. The revised version of the act (2013) requires seismic diagnosis of private large-scale buildings, such as hospitals, hotels, schools, and commercial facilities, and also requires that diagnosis results be made available to the public.

Figure B5.1.2 Procedure for Determining whether to Retrofit or Demolish a Building



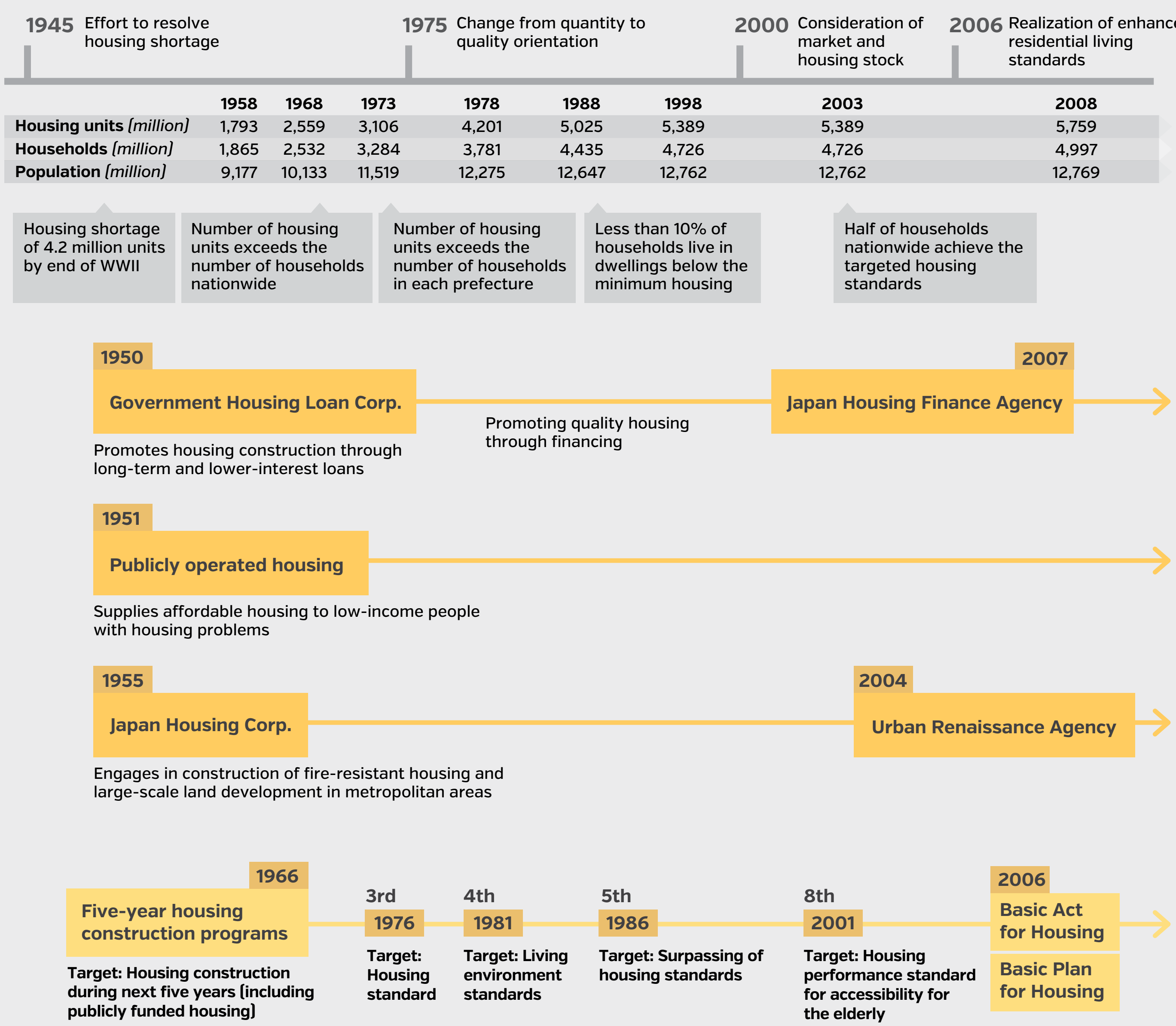
Source: MLIT, "Basic Policy for Promoting Seismic Diagnosis and Seismic Retrofitting of Buildings," Notice of Minister no. 184 (in Japanese).

5.2 Advanced Quality Enhancement through Financial Incentives and Voluntary Programs

In Japan today, the quantity of housing is sufficient (see annex 5C), but the quality of housing does not meet the needs of the country's aging population or address the country's increasing environmental problems. In response to this situation, Japan is seeking a major shift in the housing policy framework, one that focuses on raising residential living standards in general while also providing safety nets for low- and middle-income households, the elderly, people with disabilities, and other groups with special housing needs. Note that even though seismic performance is no longer the main concern, it still constitutes part of housing quality and is improving as an integral part of broader housing quality improvements.

Figure 5.6 summarizes the evolution of housing policy in Japan.

Figure 5.6 A History of Housing Policy in Japan, 1945–2008



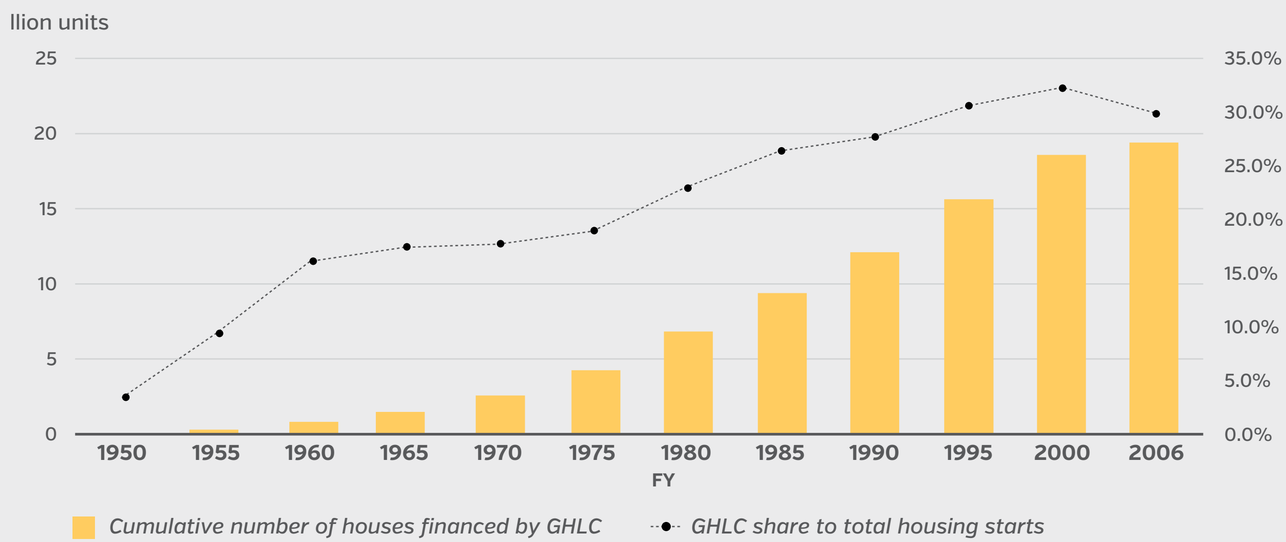
	1958	1968	1973	1978	1988	1998	2003	2008
Housing units *(million)*	1,793	2,559	3,106	4,201	5,025	5,389	5,389	5,759
Households *(million)*	1,865	2,532	3,284	3,781	4,435	4,726	4,726	4,997
Population *(million)*	9,177	10,133	11,519	12,275	12,647	12,762	12,762	12,769

Source: Building Center of Japan 2016.

5.2.1 Incremental Improvement of Japanese Housing Quality

In the past, Japan has successfully relied on financial incentives to encourage better housing quality. The GHLC helped improve the quality of houses by establishing proprietary technical criteria beyond the mandatory minimum standard of the BSL, as well as by publishing specifications and technical guidance that building practitioners could easily follow. In this way, the GHLC created an enabling environment in which buildings could achieve higher structural performance with minimum effort. Approximately 30 percent of the houses built after WWII were financed by the GHLC (figure 5.7). Moreover, it is likely that the high technical criteria, construction specification, and thorough construction inspection required of GHLC-financed houses triggered additional financing from private banks by giving them confidence in the quality of the construction. This additional financing may have helped ensure completion of construction by filling any remaining construction funding gaps.

Figure 5.7 Number of Houses Financed by GHLC, 1950–2006



Source: JHF.

In 2007, after GHLC had done so much to meet the demand for high-quality housing, the Japan Housing Finance Agency (JHF) was established to carry out part of GHLC's mandate. Since then, JHF has shifted its major business focus, and rather than act as a direct loan provider, it promotes securitization of fixed-rate housing loans originated by private financial institutions.

5.2.2 Voluntary Program for Improving Housing Quality

More recently, Japan has leveraged financial incentives to encourage voluntary adoption of high housing standards. It is using this approach to meet the goals of its current housing policy, which emphasizes improvements in the overall quality of residential life, including the residential environment and accessibility for the elderly and those with disabilities.

The Basic Act for Housing of 2006 and related National Basic Plan for Housing served to establish several voluntary programs that offer financial incentives for improving housing quality and that complement mandatory building requirements. These include the Lower Long-Term Fixed-Rate Housing Loan, the Housing Performance Indication System, and the Certification of Long-Life Quality Housing. They are summarized in table 5.1 and table 5.2; one of the systems, the Lower Long-Term Fixed-Rate Housing Loan (Flat 35/35S offered by JHF), is described in detail in the next section to suggest the kind of instruments available for improving housing quality and making enhanced residential living standards available to all. The other two programs are described in annex 5D.

Table 5.1 **Overview of Voluntary Compliance Programs**

Category	Program	Administering Authority	Contents	Incentives
Indicator of high housing performance	**Housing Performance Indication System** Legal basis: Housing Quality Assurance Act	Housing Performance Evaluation Bodies registered by MLIT	Compares building performance by categorizing key housing factors	• Can utilize financial support (through Flat 35/35S, etc.) according to the performance level • Offers smooth and quick process for settling disputes over construction quality • Offers discount for seismic insurance premium
High-quality housing with financial incentives	**Lower Long-Term Fixed-Rate Housing Loan** (**Flat 35, Flat 35S**)	Japan Housing Finance Agency Inspection institutions (Evaluation)	Lower long-term, fixed-rate housing loan	• Offers lower long-term, fixed-rate housing loan with high technical criteria • Offers interest rate reduction for higher-quality housing
	Certification of Long-Life Quality Housing Note: Legal basis: Act for Promotion of Long-Life Quality Housing	Local government Housing Performance Evaluation Bodies registered by MLIT (Evaluation)	Certification of Long-Life Quality Housing to help reduce the environmental impact of high-quality houses, etc.	• Offers tax deduction for housing loan, property tax reduction • Can utilize preferential interest rate

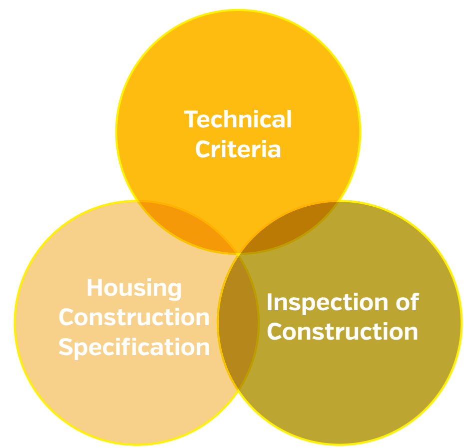
Table 5.2 **Comparison of Technical Criteria in Voluntary Compliance Programs**

Technical criteria/indicators (based on the Housing Performance Indication System) / Voluntary program	1. Structural stability	2. Fire safety	3. Durability of structural members	4. Ease of maintaining utilities	5. Energy efficiency	6. Ventilation and prevention of sick building syndrome	7. Luminous and visual environment	8. Acoustic environment	9. Accessibility for the aged and the disabled	10. Security	Other
Housing Performance Indication System	●	●	●	●	●	●	●	●	●	●	
Flat 35/35S	●		●	●	●	●			●		Size of houses, connection of road, etc.
Long-Life Quality Housing	●		●		●	●			●		Residential environment, maintenance plan, etc.

5.2.3 Lower Long-Term Fixed-Rate Mortgage with High Technical Criteria (Flat 35/35S by JHF)

Flat 35 is a long-term (35-year) fixed-rate mortgage provided through a collaboration between private financial institutions and the JHF, which is a semi-public institution. It encourages purchase of high-quality (e.g., earthquake resilient, energy-efficient) housing by offering buyers lower interests rates for a certain period of the loan repayment. It also provides several other benefits: (1) its fixed interest rate makes repayment safe and predictable; (2) it does not charge a guarantee fee or fee for prepayment; and (3) it entails JHF's technical criteria to support housing.

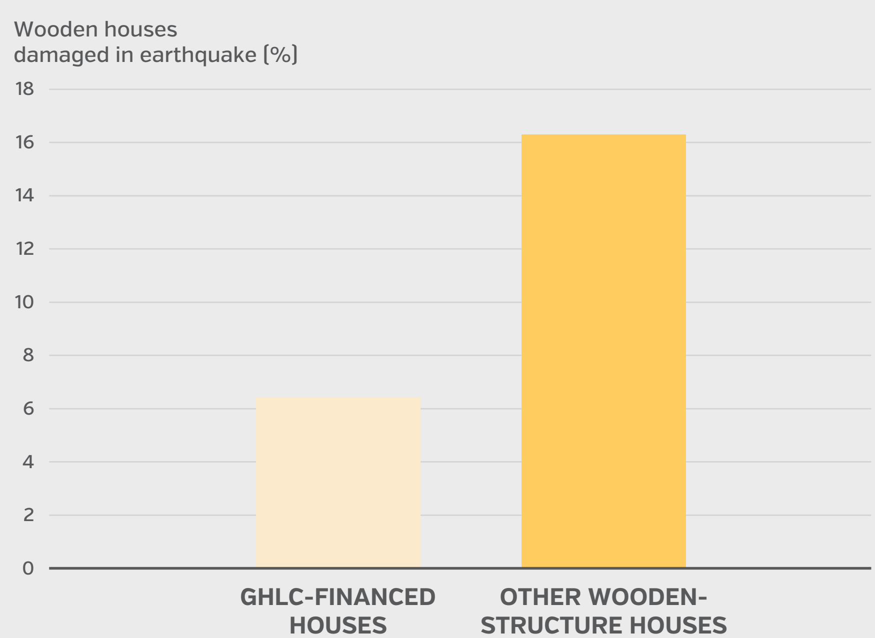
Figure 5.8 Framework for Lower Long-Term Fixed-Rate Mortgage with High Technical Criteria Offered by JHF



Source: JHF.

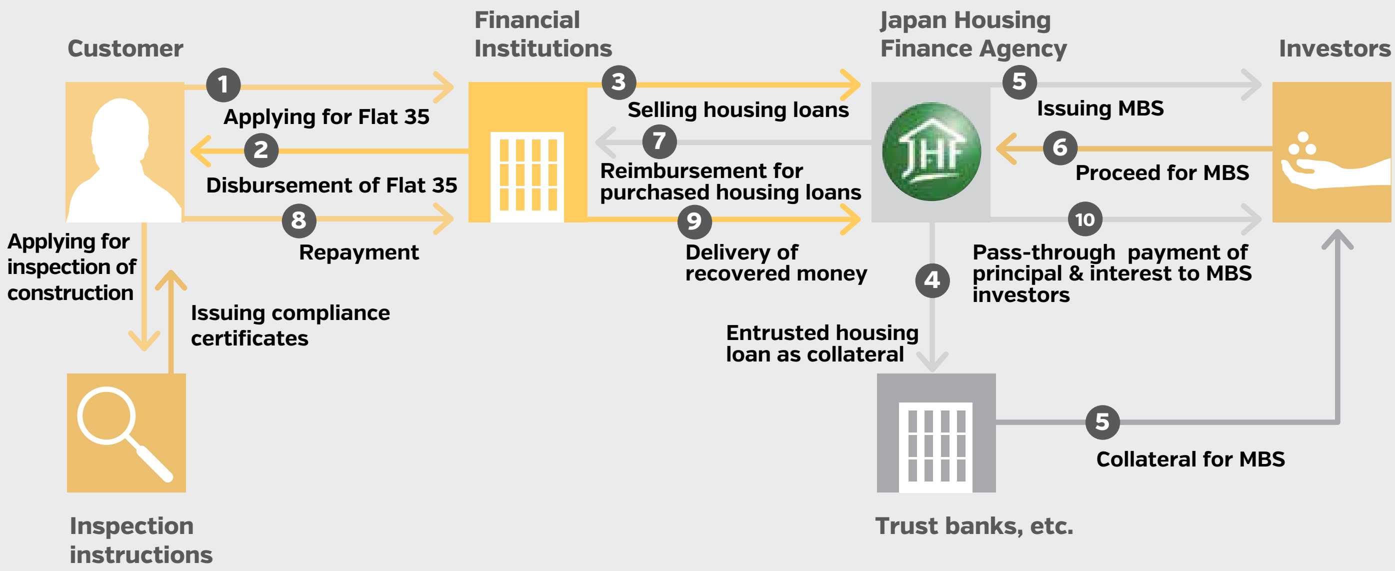
Under this program, the JHF applies proprietary technical criteria, clarifies such criteria with specification documents, and conducts on-site inspections after checking design drawings (figure 5.8). If the construction works are done in accordance with the criteria, funds are disbursed. This framework, unique among government housing finance institutions in the world, was vindicated in 1995, following the Great Hanshin-Awaji Earthquake: a post-disaster survey conducted by the JHF showed that houses financed by GHLC (predecessor organization of JHF) performed significantly better than privately financed houses. More than twice as many of the latter were heavily damaged or destroyed as the former (figure 5.9), and the survey analysis found that the difference in performance was due to the requirements for design and construction supervision imposed by the GHLC. JHF's current business model is shown in figure 5.10, and details on the technical criteria for the Flat 35/35S program are shown in figure 5.11.

Figure 5.9 Share of Wooden Houses Destroyed or Heavily Damaged in the Great Hanshin-Awaji Earthquake: GHLC-Financed Houses versus Others



Source: JHF 2012.

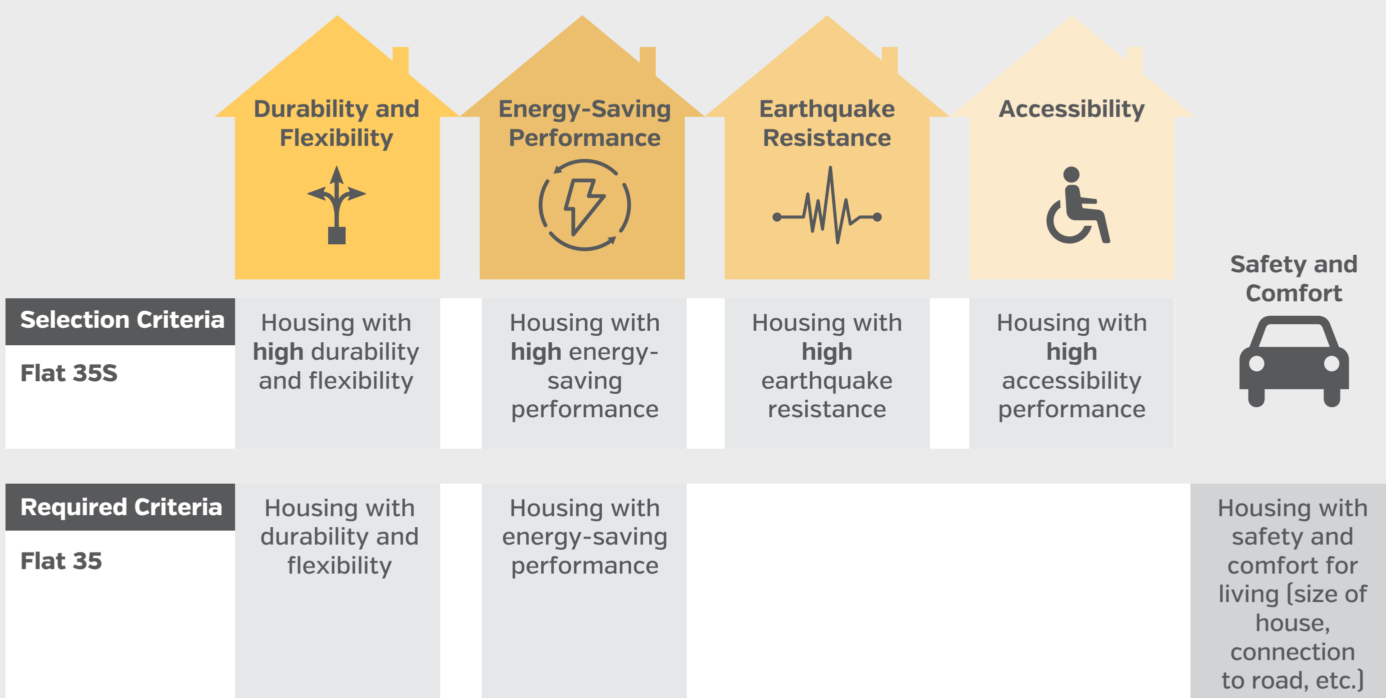
Figure 5.10 Current Business Model of JHF



Source: *JHF 2016.*

Note: MBS = mortgage-backed securities. For details of the JHF business model, please refer to the agency's website at *http://www.jhf.go.jp/english/index.html*

Figure 5.11 Technical Criteria for Flat 35/35S



Source: JHF brochure.

6
Lessons Learned

1. Regulation should be understood as a tool to guide and support the safety of the built environment; though it combines controlling and enabling elements, it should not be seen principally as a means of exerting control.

One key lesson of Japan's experience is that stand-alone regulation doesn't work. Nor does a top-down approach that loses sight of the purpose of regulation. A safe built environment cannot be achieved through regulation alone but depends on an enabling environment that facilitates compliance and that includes accessible public services, mechanisms to incentivize meeting or even exceeding existing standards, and proactive educational support for capacity development in both the private and public sectors. See in particular the following discussions:

- Accommodating changing social needs within regulations in a timely manner (section 2.3)
- Capacity-building and training programs for building officials (section 4.4, annex 4E)
- Capacity enhancement of building practitioners (section 4.2)
- Improving efficiency of building confirmation and inspection by engaging the private sector (section 4.4, annex 4F)
- Incentivized housing finance and technical guidance package for improving housing performance (sections 5.2.2, 5.2.3; annex 5D)
- Establishing a technical support unit and subsidies for promotion of seismic retrofitting (section 5.1.1, annex 5A)

2. Countries need a clear understanding of their available human, technical, and financial capacity in order to develop an effective approach to building safety.

This understanding ensures that initial standards are realistic and appropriate and also facilitates targeting of institutions for capacity building and raising of standards over time. By taking capacity into account at every stage of reform, Japan ensured that a given standard could be implemented and complied with. Its quality assurance efforts began at the municipal level; the first national building code was piloted in only six cities (with relatively high capacity in both the public and private sectors) and then expanded to targeted areas as capacity was simultaneously increased. Legal provisions likewise started from minimum requirements for specific goals, such as hygiene and fire safety, and then grew into a framework that addresses all relevant issues in the entire institutional ecosystem. Japan also targeted specific types of public buildings for standard enhancement(e.g., schools) as an entry point for applying the standard more broadly. See in particular the following discussions:

- Incremental development of laws (section 2.3)
- Incremental enhancement of building standards and targeted areas (section 3.1)
- School retrofitting program at scale (annex box 5a.1)
- Seismic retrofitting of public buildings (section 5.1.1)

3. Proactive support for compliance with building regulations–through education and training, financial incentives, and other mechanisms that engage stakeholders–helps create an effective and enabling regulatory environment.

After World War II, Japan shifted from a permitting system for building approval, which was based on top-down command and control, to a confirmation system, which requires only that certain predefined criteria have been met. This step was part of a larger movement toward a more enabling regulatory environment designed to proactively support compliance rather than rely on coercion. Japan also introduced training and licensing of building professionals and set up loan programs offering tax breaks and other incentives for houses that exceeded the mandatory minimum standard. This type of environment makes complying with codes easier, hence increases compliance—and overall safety. See in particular the following discussions:

- Transition from building permission to building confirmation (box 4.1)
- Response to socioeconomic needs through timely building regulation (section 2.3)
- Easing of regulation based on practical needs on the ground: (section 2.3)

4. Safe construction information, technical services, and professional expertise should be available to anyone who seeks them.

A well-functioning regulatory system ensures that technical knowledge and services are available to and utilized by all segment of the population, regardless of education or economic status. In Japan, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has established systems to train, qualify, and continually educate authorities involved in building quality assurance (including special trainings to ensure authorities stay current with technological advances or changes in the code), and it offers training to private sector designers and builders as well. The government has also developed various communication materials that promote safer construction and publicize resources available to consumers. In addition, Japan met a growing need for capacity in building confirmation and inspection by allowing private sector agencies to perform these tasks. This expanded capacity has resulted in a much higher rate of interim and final inspection of buildings, as well as much shorter wait times for building confirmation. See in particular the following discussions:

- Advanced Quality Enhancement through Financial Incentives and Voluntary Programs (section 5.2)
- Capacity enhancement of building practitioners (section 4.2)
- Capacity-building and training programs for building officials (section 4.4, annex 4E)
- Improving efficiency of building confirmation and inspection by engaging the private sector (section 4.4, annex 4F)
- Promoting seismic retrofitting in scale (section 5.1)
- Offering financial incentives and technical assistance to individual households through subsidized housing loans (section 5.2)

5. Formal regulatory systems should recognize prevalent construction practices, including non-engineered construction, and the risks associated with them.

In Japan, the wooden housing structures characteristic of the country—originally non-engineered—have grown gradually safer and more earthquake-resilient. These improvements stem from the decision to establish standards for non-engineered construction, to include these standards in the formal building code, to incrementally increase the standards (until today wooden structures are considered engineered), and to provide training to the carpenters and architect-engineers who specialize in wooden construction. These experiences show that formal recognition of prevalent construction types can drive significantly improved resilience through targeted guidance. See in particular the following discussions:

- Recognition of locally and widely used construction practice in the formal building code (section 3.3.2)
- Training in traditional building practices for carpenters (box 3.2)
- Technical assistance programs in Indonesia and El Salvador to improve seismic safety of non-engineered construction (box 3.3)

6. An effective regulatory regime is based on science and requires the participation of academia.

Japan's ongoing improvement of its building standards has depended in part on continuing technological research, which is carried out by scientists, researchers, and engineers in academia working collaboratively with government and industry to solve technical problems related to building safety. This approach ensures that any changes to regulations are based on an accurate scientific assessment of post-disaster building behavior and damage. The involvement of academia in building regulation has been especially important in Japan during periods of limited government and private sector capacity. Today, Japan's policy making is informed by government research institutions and by continued close ties to the universities. See in particular the following discussions:

- Partnership with academic community (section 3.2)
- Public consultation process for updating building standards (section 3.4)

7. Governments can strengthen their regulatory regimes by coordinating action with the building industry.

This coordinated approach has allowed Japan to scale up enforcement of building regulations and achieve improved levels of compliance with building safety requirements (through effective supply of materials of standardized quality, for example), has encouraged healthy private sector competition, and has ensured that regulations reflect current social and economic demands from the consumers (such as demands for certain construction materials or services). This approach has also helped promote transparency and fairness. When considering a change in regulation, for example, the Japanese government invites public comment from local governments and private sector stakeholders, and addresses these concerns in a series of discussions before finally amending the rule. See in particular the following discussions:

- Public consultation process for updating building standards (section 3.4)
- Mass production of housing and leveraging market mechanisms for competitive capacity increase (annex 5c)

8. The private sector can play an important role in effective enforcement of building regulation, but only where mechanisms for oversight, fairness, and conflict resolution are robust.

The private sector can offer governments additional capacity, but its resources must be tapped responsibly. The experience in Japan shows that there must be clarity and agreement about the roles and responsibilities of private sector personnel, and that their quality must be assured through accreditation and ongoing training. Moreover, their actions must be subject to careful oversight, with punishment meted out for any fraud or dishonesty. See in particular the following discussions:

- Private sector involvement in building quality assurance (sections 2.2, 4.4; annex 4F)
- Code violation (box 4B.1)

9. Financial mechanisms can play a key role in promoting safety and overall quality in the built environment.

Since 1950, Japan has relied on the Government Housing Loan Corporation (now the Japanese Finance Housing Agency) to support its housing goals. The various programs JHF offers consumers include financial incentives to comply with building standards in excess of the mandatory standard. These programs have made a significant contribution to building safety in Japan; analysis of damage following the Great Hanshin-Awaji Earthquake in 1995 showed that GHLC/JHF-financed houses performed significantly better than privately financed houses, and that this difference was due to requirements for design and construction supervision. See in particular the following discussions:

- Financial incentives for meeting higher than mandatory standard, and development of technical guidelines (section 2.3)
- Better earthquake performance of houses built to GHLC/JHF specifications (sections 4.3, 5.2)
- GHLC/JHF's creation of an enabling environment for high structural performance (section 5.2)

10. A resilient built environment can be achieved through an incremental approach—one that ensures regular impact monitoring, promotes learning and improvement, and serves as the basis for consistent policy updates.

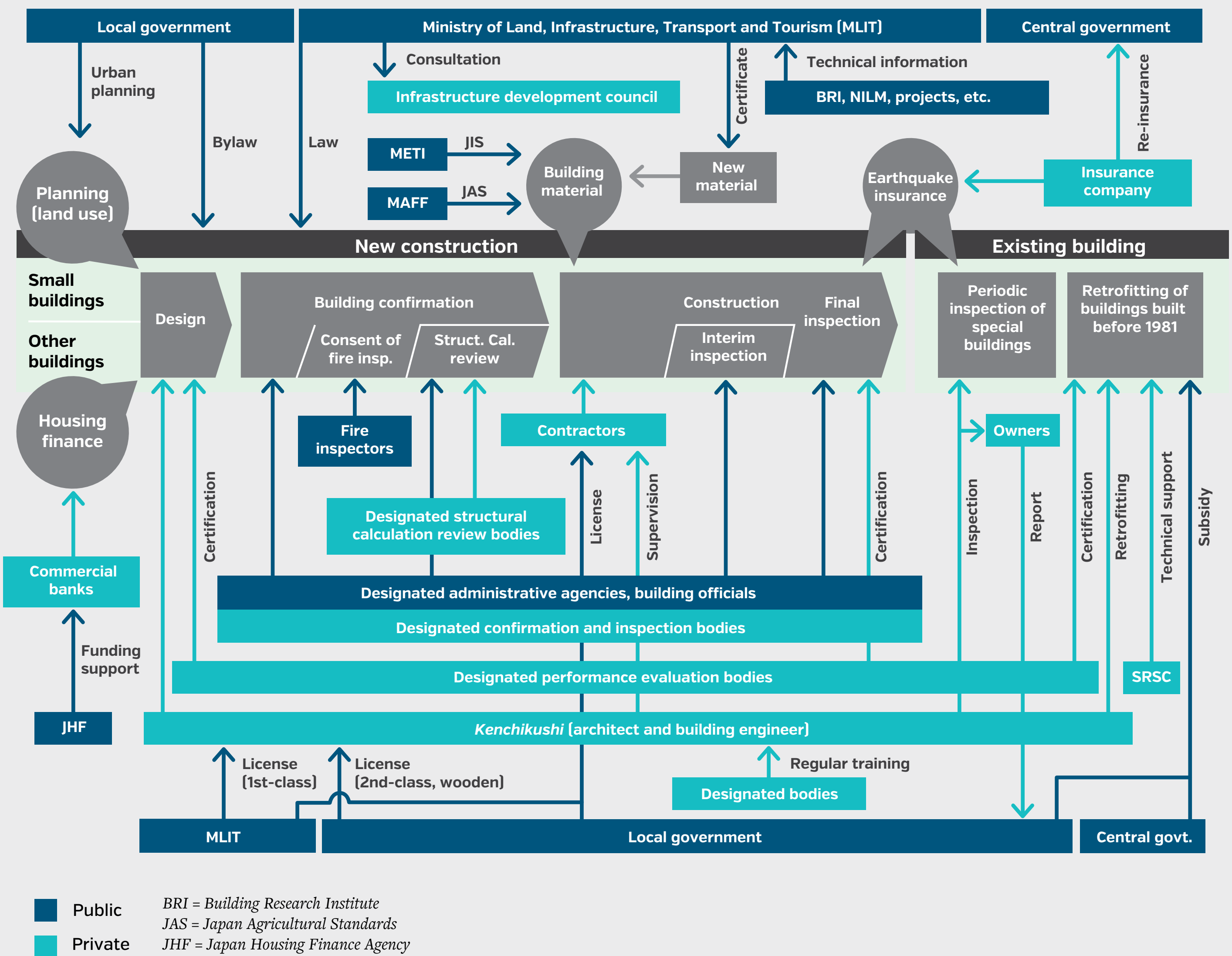
Notwithstanding the significant gains made over the last century, Japan continues its efforts to increase building resilience through regulation. The incremental approach requires establishing and continuing to develop a base of technical knowledge, as well as an institutional system to assess disaster damages and translate into practice the lessons learned from each disaster. It also requires an enabling environment that facilitates periodic amendment of regulations to ensure that they meet current socioeconomic requirements. Japan's experience shows that where effective building regulation is concerned, reform is not a destination but a journey—and that accumulated knowledge and data are powerful and necessary tools to bring along. See in particular the following discussions:

- Measuring the impact of implementing building regulations (section 1.1)
- Incremental enhancement of building regulations (section 3.1)
- Technology development and research as basis for policy making (section 3.2)
- Reflecting disaster damage analysis in code development (section 3.2)
- Dedicated research institutes and enabling partnerships with the academic community (section 3.2)
- Role of statistical data in seismic retrofit (section 5.1.2)
- Surveys undertaken in Japan in order to monitor and assess building quality (annex 5B)

7
Annexes

Annex 2A Japan's Building Quality Assurance System: Stakeholder Mapping

Figure 2A.1 Japan's Building Quality Assurance System: Stakeholder Mapping



BRI = Building Research Institute
JAS = Japan Agricultural Standards
JHF = Japan Housing Finance Agency
JIS = Japanese Industrial Standards
MAFF = Ministry of Agriculture, Forestry and Fisheries
METI = Ministry of Economy, Trade and Industry
NILIM = National Institute for Land and Infrastructure Management
SRSC = Seismic Retrofitting Support Center

Note: "Small buildings" are wooden houses less than two stories with an area less than 500 m². "Other structures" are single-story buildings with an area less than 200 m². "Special buildings" are designated by local governments and include hospitals, hotels, theaters, department stores, offices, apartments, etc.

Annex 2B Japan's Building Quality Assurance System: Stakeholder's Major Roles

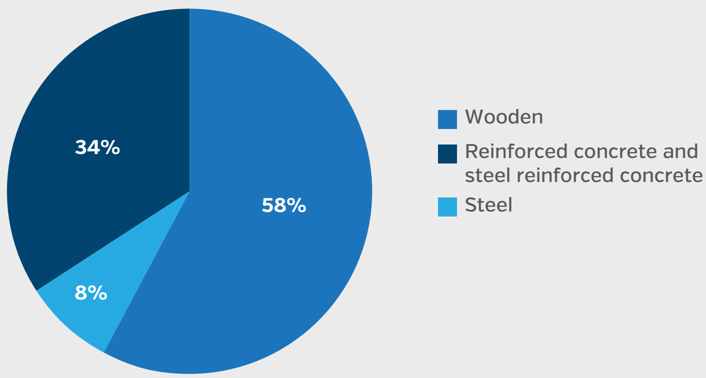
Table 2B.1 Japan's Building Quality Assurance System: Stakeholder's Major Roles

Organization	Status	Major Role for Building Quality Assurance
Ministry of Land, Infrastructure, Transport and Tourism	Ministry	Develops legal system for building quality assurance, issue licenses for 1st-class *Kenchikushi* (architect-engineers) and large-scale building contractors
Ministry of Economy, Trade and Industry	Ministry	Responsible for creation of Japanese Industrial Standards, applicable to building materials like cement, rebar, etc.
Ministry of Agriculture, Forestry and Fisheries	Ministry	Responsible for creation of Japanese Agricultural Standards, applicable to building materials like wood, etc.
National Institute for Land and Infrastructure Management	Under MLIT	Research institute affiliated with MLIT; responsible for conducting research in the field of housing and public capital to support MLIT to plan and propose its technology policies
Building Research Institute	Under MLIT	Research institute affiliated with MLIT; responsible for implementing the research and development for technology related to housing, building, and urban planning
Japan Housing Finance Agency	Under MLIT and Ministry of Finance	Independent administrative agency; provides funding support for smooth and efficient financing necessary for housing construction through general financial institutions
Designated Administrative Agency	Local government	Responsible for building confirmation in design stage and interim and final inspection in construction stage
Designated Confirmation and Inspection Body	Designated by MLIT or prefecture	Private entity; responsible for building confirmation in design stage and interim and final inspection in construction stage
Designated Performance Evaluation Body	Designated by MLIT	Private entity; responsible for evaluation of building design and structural calculation using 10 criteria (such as safety and efficiency) and for issuing certification
Designated Structural Calculation Review Body	Designated by MLIT or Prefecture	Private entity; responsible for supporting building confirmation by reviewing and checking the adequacy of structural calculations for specified buildings
Seismic Retrofitting Support Center	Designated by MLIT	Private entity; responsible for conducting research and providing information related to seismic diagnosis and seismic retrofitting of buildings

Annex 3A Major Construction Types for Residential Buildings in Japan

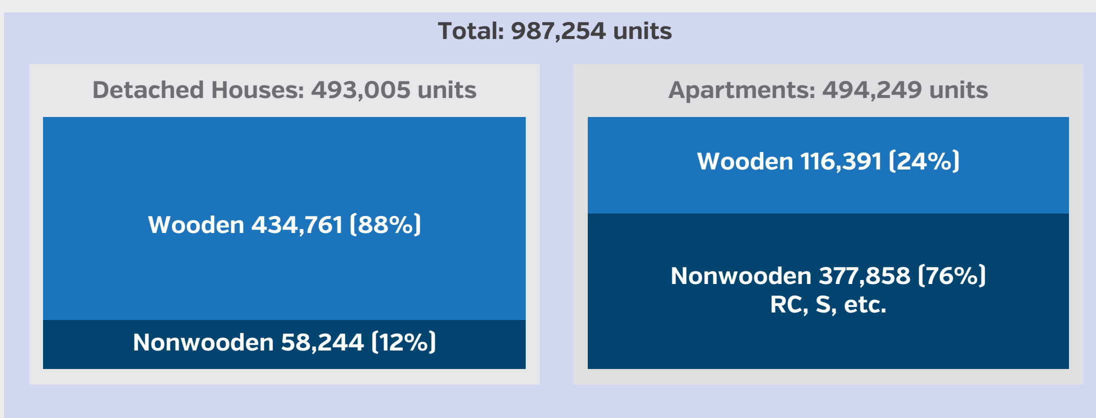
In Japan, residential buildings are typically built of wood, RC, or steel reinforced concrete. According to the 2013 Housing and Land Survey (Statistics Bureau 2013), the residential building stock consists of 52.1 million units, including 30.1 million wooden houses (57.8 percent), 17.7 million RC and steel reinforced concrete buildings (33.9 percent), and 4.2 million steel buildings (8 percent) (figure 3A.1). Among newly constructed buildings built during fiscal year 2013 (April 2013–March 2014), about 88 percent of detached houses and 24 percent of apartment buildings were wooden structures (figure 3A.2).

Figure 3A.1 Existing Residential Buildings by Structural Type



Source: Statistics Bureau 2013.

Figure 3A.2 Share of Wooden Buildings among New Construction (FY 2013)



Source: MLIT.

Annex 4A Scope of Activity and Training Programs for *Kenchikushi* (architect-engineers)

Different building types (as determined by building use, scale, and structural design) require the involvement of different types of *Kenchikushi* with different levels and types of expertise. Table 4A.1 gives details.

Table 4A.1 Scope of Activity for Different Types of *Kenchikushi*, by Type of Building

<table>
<tr><th colspan="2" rowspan="3">Height and structure
Total floor area (m²)</th><th colspan="5">Height of building ≤ 13m and height of eave ≤ 9m</th><th rowspan="3">Height of building > 13m or height of eave > 9m</th></tr>
<tr><th colspan="3">Wooden</th><th colspan="2">Nonwooden</th></tr>
<tr><th>1 story</th><th>2 stories</th><th>3 stories</th><th>Up to 2 stories</th><th>3 stories or more</th></tr>
<tr><td colspan="2">area ≤ 30</td><td colspan="2" rowspan="2">Permissible for anyone (need not be licensed Kenchikushi)</td><td rowspan="5">Permissible only for 1st-class and 2nd-class Kenchikushi</td><td>Permissible for anyone</td><td>Permissible only for 1st-class and 2nd-class Kenchikushi</td><td rowspan="8">Permissible only for 1st-class Kenchikushi</td></tr>
<tr><td colspan="2">30 < area ≤ 300</td><td colspan="2" rowspan="2">Permissible only for 1st-class and 2nd-class Kenchikushi</td></tr>
<tr><td colspan="2">100 < area ≤ 300</td><td colspan="2">Permissible for 1st-class, 2nd-class, or Mokuzo</td></tr>
<tr><td colspan="2">300 < area ≤ 500</td><td colspan="2" rowspan="2">Permissible only for 1st-class and 2nd-class Kenchikushi</td><td colspan="2" rowspan="5">Permissible only for 1st-class Kenchikushi</td></tr>
<tr><td colspan="2">General-purpose buildings</td></tr>
<tr><td rowspan="2">500 < area ≤ 1,000</td><td>Special-purpose buildings</td><td colspan="3">Permissible only for 1st-class Kenchikushi</td></tr>
<tr><td>General-purpose buildings</td><td>Permissible for 1st-and 2nd-class</td><td colspan="2">Permissible only for 1st-class Kenchikushi</td></tr>
<tr><td colspan="2">Special-purpose buildings</td><td colspan="3">Permissible only for 1st-class Kenchikushi</td></tr>
</table>

Source: MLIT.
Note: Special-purpose buildings are schools, hospitals, theaters, cinemas, grandstands, public halls, assembly halls with auditoriums, and department stores.

In order to conduct certain technical works, *Kenchikushi* must complete specific training courses. Table 4A.2 summarizes who may take the courses, what they cover, and how participants are tested.

Table 4A.2 Additional Qualification Training for *Kenchikushi*

Type of certificate	Qualifications	Course content	Examination
Structural design 1st-class *Kenchikushi*	1st-class *Kenchikushi* with 5 years or more of business experience in structural design	Lecture—2 days • Structural design overview • Relevant laws and regulations; certification of compliance with law • Basics of structural design • Seismic diagnosis, seismic reinforcement • Specific structural designs	1-day multiple-choice test (choosing one of 4 branches) and written questionnaire • Subject related to relevant structural regulations (certification of compliance with law) • Subject related to building structure (Structural design)
MEP design 1st-class *Kenchikushi*	1st-class *Kenchikushi* with 5 years or more of business experience in MEP	Lecture—3 days • Design technique for electrical equipment • Design technique for air conditioning facilities and ventilation equipment • Design technique for plumbing and sanitary facilities • Design technique for transportation facilities • Building equipment related to laws and regulations • Building equipment design overview • Certification of compliance with law	1-day written questionnaire plus drafting and design • Subject related to MEP regulations (certification of compliance with law) • Subject related to building MEP (MEP design)
Managing *Kenchikushi*	*Kenchikush*i with 3 years or more of experience in design works	Lecture—5 hours • Subjects related to Kenchikushi Law and other relevant laws and regulations • Subjects related to building quality assurance	1-hour true/false test, 30 questions • Subjects related to Kenchikushi Law and other relevant laws and regulations • Subject related to building quality assurance

Source: Japan Architectural Education and Information Center website, http://www.jaeic.or.jp/index.html.

To ensure that they stay current with knowledge of architecture and engineering, including changes in laws and regulations and development of new technologies, *Kenchikushi* must attend related training sessions every three years. As shown in table 4A.3, five periodic training programs are offered by the training agencies, though not all courses are open to all types of *Kenchikushi*.[26]

Table 4A.3 *Kenchikushi*: Continuous Professional Training Requirements

Eligible to enroll	Content of training (lecture – 5 hours)	Examination (true/false test – 1 hour)
All 1st-class *Kenchikushi* belonging to design firms[a]	• Subjects related to construction laws and regulations • Subjects related to design and construction management	40 questions • Subjects related to construction laws and regulations • Subjects related to design and construction management
All 2nd-class *Kenchikushi* belonging to design firms	• Subjects related to construction laws and regulations • Subjects related to design and construction management	35 questions • Subjects related to construction laws and regulations • Subjects related to design and construction management (except for buildings as defined in Article 3 of the Kenchikushi Law)
All *Mokuzo* (wooden) *Kenchikushi* belonging to design firms	• Subjects related to construction laws and regulations • Subjects related to design and construction management	30 questions • Subjects related to laws and regulations for wooden building construction • Subjects related to design and construction management for wooden buildings
All Structural Design 1st-class *Kenchikushi*	• Subjects related to structural regulations • Subjects related to structural design	40 questions • Subjects related to structural regulations • Subjects related to structural design
All MEP Design 1st-class *Kenchikushi*	• Subjects related to MEP regulations • Subjects related to MEP design	40 questions • Subjects related to MEP regulations • Subjects related to MEP design

Source: Japan Architectural Education and Information Center website, http://www.jaeic.or.jp/index.html.

a. A design firm is a registered Kenchikushi office that engages in design, construction administration, and other related services, in accordance with the Kenchikushi Law.

[26] *According to the MLIT website (http://www.mlit.go.jp/en/index.html), as of 2016 there were nine registered training agencies, including some nonprofit organizations and private institutions, that provided such training.*

Annex 4B Penalties for Misconduct by *Kenchikushi* (architect-engineers)

Kenchikushi are held to a high standard of professional conduct and are subject to fine or imprisonment for violations of the Kenchikushi Law, as detailed in table 4B.1

Table 4B.1 Penalties for Violations by *Kenchikushi* and Building Owners

Law	Target	Violation	Penalty
Building Standard Law	Owner or installer of the building equipment	Construction without confirmation (building confirmation, interim inspection, final inspection)	Imprisonment (one year or less) or fine (JPY 1 million or less); corporations more heavily penalized
		Violation against a correction order for the building, suspension of construction work	Imprisonment (three years or less) or fine (JPY 3 million or less); corporations more heavily penalized[a]
	Kenchikushi	Violation against major substantive section of law such as technical requirement for structural capacity or fire prevention (Excluding small-scale buildings)	Imprisonment (three years or less) or fine (JPY 3 million or less); corporations more heavily penalized[a]
Kenchikushi Law	*Kenchikushi*	Operation of business without a license	Imprisonment (one year or less) or fine (JYP 1 million or less); corporations more heavily penalized Revocation of license, suspension of business, etc.
		Violation of an order to suspend business	
		Name lending, false certification of structural safety	

a. The penalty applies only in relation to work on specified buildings such as schools, hospitals, and apartments.

The best-known case of misconduct among *Kenchikushi* involved falsification of structural calculation documents and is described in box 4B.1.

Box 4B.1 How Japan Improved Qualification Requirements for and Supervision of Designated Confirmation and Inspection Bodies: The Aneha Scandal

In October 2005, MLIT received a report from a Designated Confirmation and Inspection Body about the possibility that structural calculation documents attached at the time of building confirmation had been falsified. MLIT investigated and announced to the public on November 17, 2005, that the alleged falsification had been confirmed.

It emerged that Mr. Aneha, a first-class *Kenchikushi*, had falsified structural calculation documents for buildings that did not meet design standards. This violation of the law and breach of professional ethics allowed construction of buildings with clear design flaws to proceed. Mr. Aneha was stripped of his first-class *Kenchikushi* status in December 2005 and was arrested in April 2006.

The falsified structural calculation documents were applied without being checked by the primary contractor's design office, and were certified in the process of building confirmation. Neither building officials nor the Designated Confirmation and Inspection Bodies saw through the fraud: the falsification was overlooked in 29 of the Designated Administrative Agencies and six of the Designated Confirmation and Inspection Bodies.

All told, there were over 100 cases in which structural calculation documents were falsified by Mr. Aneha and related companies. Those responsible had their licenses revoked or were subject to prohibition/suspension of business.

The "Aneha scandal" called into question the seismic resistance of a large number of apartments, and hence the safety of many residents. It also left the public feeling unsure of whether they could rely on the seismic resistance of buildings, and created distrust in the confirmation and inspections bodies.

In addition, it revealed some key institutional problems and showed that neither the *Kenchikushi* qualification system nor the confirmation and inspection system was functioning properly.

To address these problems and prevent any recurrence of similar fraud cases in the future, the government reviewed the building quality assurance process and made some changes:

- The Building Standard Law was reformed in 2006 to introduce a structural calculation review by the Designated Structural Calculation Review Body for buildings over a certain size.
- The interim inspection was made mandatory for apartments of three stories or more, though each Designated Administrative Agency can decide on the target buildings, as before.
- The requirements for becoming a Designated Confirmation and Inspection Body were made stricter, and the waiting period was extended from two years to five years for re-designation after revocation of designation.
- The Kenchikushi Law was reformed in 2006 to strengthen penalties for violations and to add requirements for reporting and regular training.
- The Act on Assurance of Performance of Specified Housing Defect Warranty was enacted in 2007 to protect consumers.

Sources: MLIT 2006a, 2006b

Annex 4C Quality Assurance Mechanism for Building Materials and Construction Management

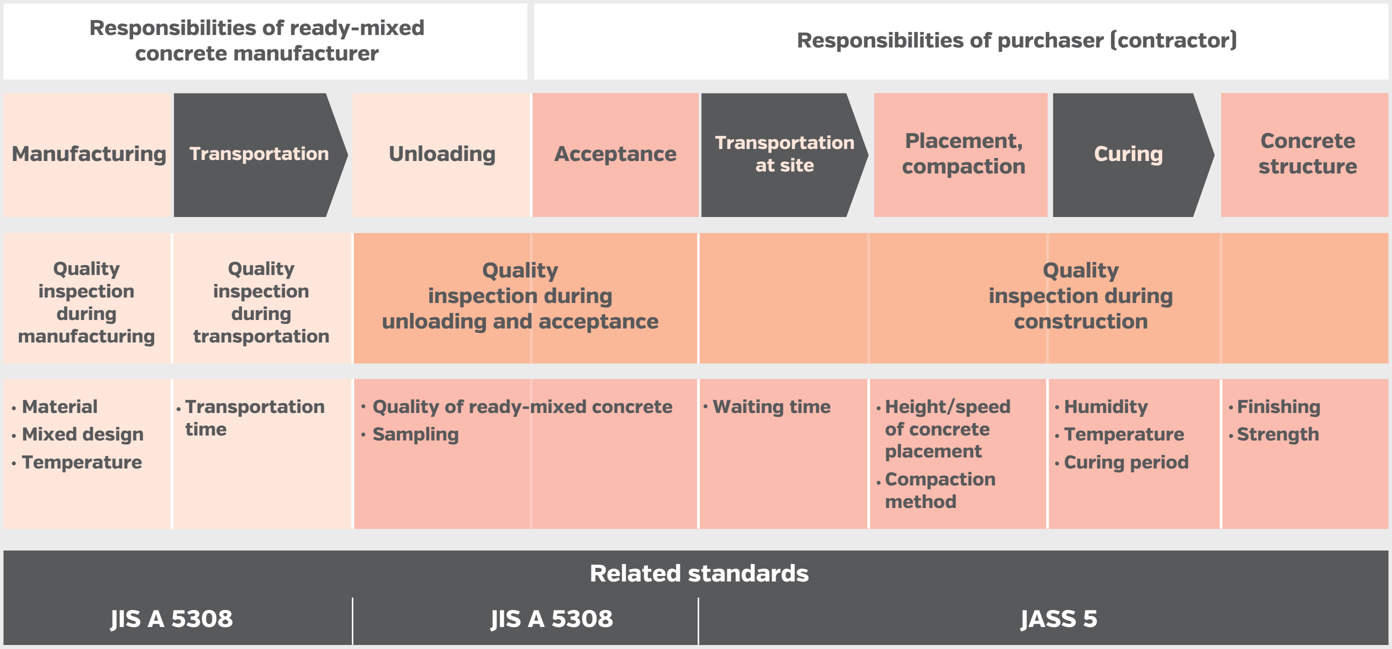
Quality assurance for building materials and construction management is extremely important for ensuring buildings' quality and performance:

- Various public and private organizations issue specifications for construction to assure quality. The Specification for Public Building Construction issued by MLIT governs all public construction. For private construction works, the MLIT specification is used as a base, with the JASS (Japanese Architectural Standard Specifications) issued by the Architectural Institute of Japan often applied for part of the works.
- A standard specification not only helps ensure building quality and performance, it also facilitates a more efficient and rational construction process. Under this process, the contractor selects and procures the building materials according to the specifications, and the construction manager checks all the building materials or—depending on the specification—conducts a spot check. The materials manufacturer issues the material certificate to the purchaser at the time of product delivery. This certificate is one way for the construction manager to check the conformity of the building materials to the standard and to demonstrate at the interim and final inspections that the standard has been met.
- Two sets of standards are relevant for Japan's quality assurance mechanism for building materials: national and international. National standards include Japanese Industrial Standards (JIS) and Japanese Agricultural Standards (JAS). Materials that do not meet the specifications of JIS or JAS must be certified by MLIT to be used as building materials. Both JIS and JAS have been revised every five years in response to safety improvements, technology development, and other changes. The main international standards are those of the International Organization for Standardization (ISO). ISO does not include all the standards required for every country's national standards, but its importance has grown as international trade has increased. This creates an incentive to incorporate international standards into the national standards, and the current JIS and JAS are consistent with ISO.
- Standardization of building materials makes rapid, low-cost mass production possible. In Japan, standardization has been promoted jointly by the public and private sectors. The government established the Industrial Standardization Law so that the deliberations and paperwork related to the industrial standard could be handled efficiently and quickly. The private sector helped make the use of mass-produced products more common and helped disseminate and promote the techniques for using them.
- Only manufacturers certified by the registered authorities can mark JIS or JAS on their products.[27] To be certified, the manufacturer must pass an examination demonstrating that manufacturing and inspection have been carried out in accordance with JIS or JAS standards. The quality of the products is also examined by accredited test laboratories through random sampling tests.
- Material quality is checked across the various manufacturing and construction phases. During the manufacturing process, the manufacturer conducts the necessary inspection according to JIS or JAS for quality assurance. At the construction stage, material quality is checked at the construction site both by the contractor and by the construction manager, in accordance with the specification.

As an example of the quality assurance process for building materials used in construction, figure 4C.1 shows the process for ready-mixed concrete, including the responsibilities of different actors and the standards that apply.

[27] *The registered authorities are organizations registered with the relevant minister. As of 2016, there were 12 national organizations and 3 foreign organizations registered as JIS authorities, and 4 national organizations and 10 foreign organizations registered as JAS authorities related to civil engineering and architecture.*

Figure 4C.1 Quality Assurance Process for Ready-Mixed Concrete



Source: Japanese Architectural Standard Specifications.

Annex 4D Government Responsible for Administration of Building Quality Assurance, by Area Population and Building Size

Table 4D.1

Area	Government responsible for administration of building quality assurance	
	Large buildings	Small buildings
Administrative area of municipal government with a population of more than 250,000 (major cities; 231 local governments designated)	Municipal governments	Municipal governments
Administrative area of designated municipal government with a population of less than 250,000 (mainly small cities; 171 local governments designated)	Prefectural governments	Municipal governments
Areas not otherwise specified (most town and villages; around 1,300 local governments)	Prefectural governments	Prefectural governments

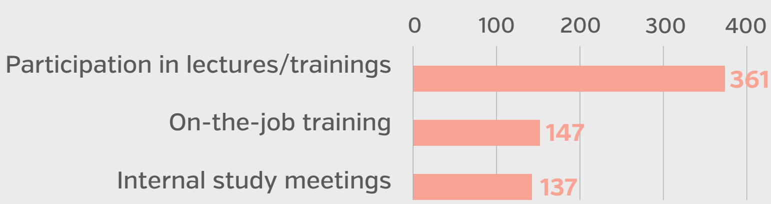
Note: "Small buildings" include one- or two-story detached houses. "Large buildings" include all other buildings. The number of local governments is as of April 2016 (data from Japan Conference of Architectural Examination).

Annex 4E Capacity Development and Training Programs for Building Administration

The College of Land, Infrastructure, Transport and Tourism (CLITT) is a comprehensive training institute affiliated with MLIT that carries out training programs for MLIT officials, local governments, and independent administrative agencies, as part of a continuous professional development process. These programs help participants increase their knowledge and improve their administrative capabilities. Each year CLITT systematically carries out about 200 training courses covering diverse fields and receives about 8,000 trainees. To train and enhance the capacity of Japan's public building officials, CLITT holds regular trainings sessions; some data on participation are in figure 4E.1.

Figure 4E.1 Capacity Enhancement for Building Officials through CLITT Training

a. Number of Designated Administrative Agencies Participating in Training Activity, 2012 (out of 448 agencies)



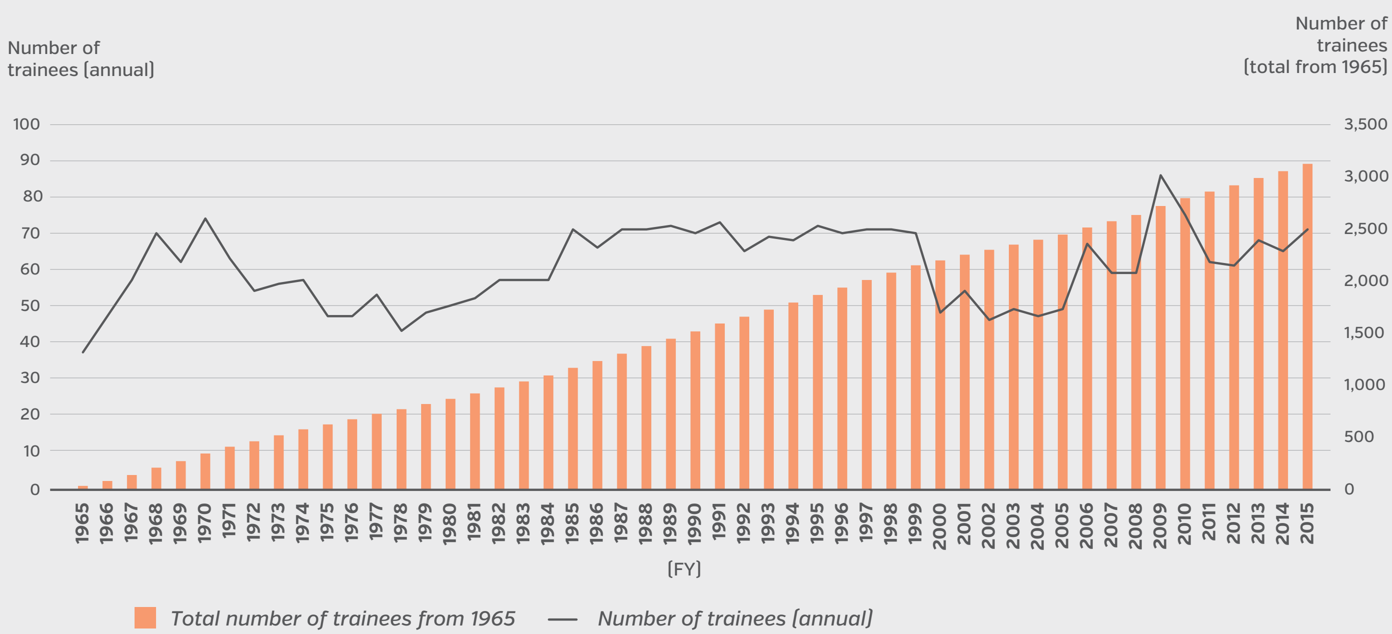
b. Training for Building Officials, FY 2007–FY 2012

Total number of lectures/ trainings	Total number of building officials participating	Total number of days
1,117	27,077	1,644

Source: MLIT.
Note: The number of lectures/training sessions includes private sector lectures and trainings, which public building officials may attend.

Summary of training for building administration. CLITT conducts a long training course for building administration. About 70 people enroll each year; the total number of trainees from 1965 to 2015 exceeds 3,000. The training mainly focuses on the basic contents of, and common subjects related to, the Building Standard Law and other relevant laws and revisions. It also addresses current issues and trends. For example, in 1965 and 1966, training devoted more time to countermeasures against building violations than in other years (24 hours in 1966 versus 3 hours in 2015). Because of revisions to the BSL, the time devoted to structural calculation and explanations of interim inspection, etc., have increased since 2000. Training in 2006—the year after the Aneha scandal (see annex box 4B.1)—emphasized the structural calculation program and the exercises on dynamic response and limit capacity calculation. In 2016, based on lessons learned from the Great East Japan Earthquake, the training added technical standards related to preventing ceilings from falling. Figure 4E.2 shows the trend in the number of trainees in CLITT over time, and table 4E.1 shows a sample training curriculum.

Figure 4E.2 **Trend in the Number of Trainees in CLITT, 1965–2015**



Source: MLIT.

Table 4E.1 Training Curriculum for Building Officials (example from 2015)

	Subjects		Hours	Content
Common Subjects	Special Subject	Opening Lecture	1.0	
	Basic Subjects	Building Standard Law (General remarks)	1.5	Revision history of the Building Standard Law
		Building Standard Law (Jurisprudence)	3.0	Legal status of building confirmation and building officials, relationship between the Building Standard Law and the Civil Code, the State Redress Act, etc.
		Building Standard Law (Fire safety requirement)	2.0	Building Standard Law (Fire safety requirement)
		Building Standard Law (Equipment requirement)	2.0	Building Standard Law (Equipment requirement)
	Technical Subjects	Legal liability of *Kenchikushi*	2.0	Legal relationships and legal responsibilities surrounding *Kenchikushi*
		Correction and prevention of violation buildings	3.0	Corrective guidance of violation buildings
	Relevant Subjects	Fire Service Law and building guidance	1.5	Outline of the Fire Service Law, relationship between fire management and building guidance administration
		Building Energy Conservation Law (new law) and energy saving standard	2.0	Latest trend about the Building Energy Conservation Law (new law) and energy saving standard
	Others	Entrance ceremony/Completion ceremony etc.	2.5	
	Common Subjects Subtotal		**20.5**	
Building Guidance Course	Basic Subjects	Building Standard Law (Structural requirement)	3.0	Building Standard Law (Structural requirement)
		Building Standard Law (Planning codes)	1.5	Building Standard Law (Planning codes)
	Technical Subjects	Building Standard Law and Disaster Risk Management Guidance	2.0	Latest trend of guidance and efforts for disaster risk management guidance, outline of the Act of Promotion of Seismic Retrofitting of Buildings and seismic diagnosis etc.
		Judicial precedents in building administrative disputes	3.0	Trends and case studies of litigation related to Building Standard Law
		Concrete method of interim inspection	2.0	Concrete method and example of interim inspection
		Accessibility	1.5	Outline of laws and regulations related to the accessibility
		Judgment of the sky factor	1.5	Outline of judgment of the sky factor
		Efforts of building administration in Kyoto city	1.5	Efforts of building administration in Kyoto city
		Allowable unit stress calculation and horizontal load-carrying capacity calculation	2.5	Allowable unit stress calculation and horizontal load-carrying capacity calculation
		Response and limit capacity calculation	1.6	Response and limit capacity calculation
		Technical standards related to measures against dropping of ceiling	0.4	Technical standards related to the measures against dropping of ceiling
		Fire safety verification method	2.0	Fire safety verification
		Evacuation safety verification method	2.5	Evacuation safety verification method
	Relevant Subjects	Measures to improve narrow road	2.0	Measures to improve narrow road
		Comprehensive Assessment System for Built Environment Efficiency (CASBEE)	2.0	Comprehensive Assessment System for Built Environment Efficiency (CASBEE)
	Discussion	Discussion	16.0	Current issues concerning building guidance administration
	Building Guidance Course Subtotal		**45.0**	
Total			**65.5**	

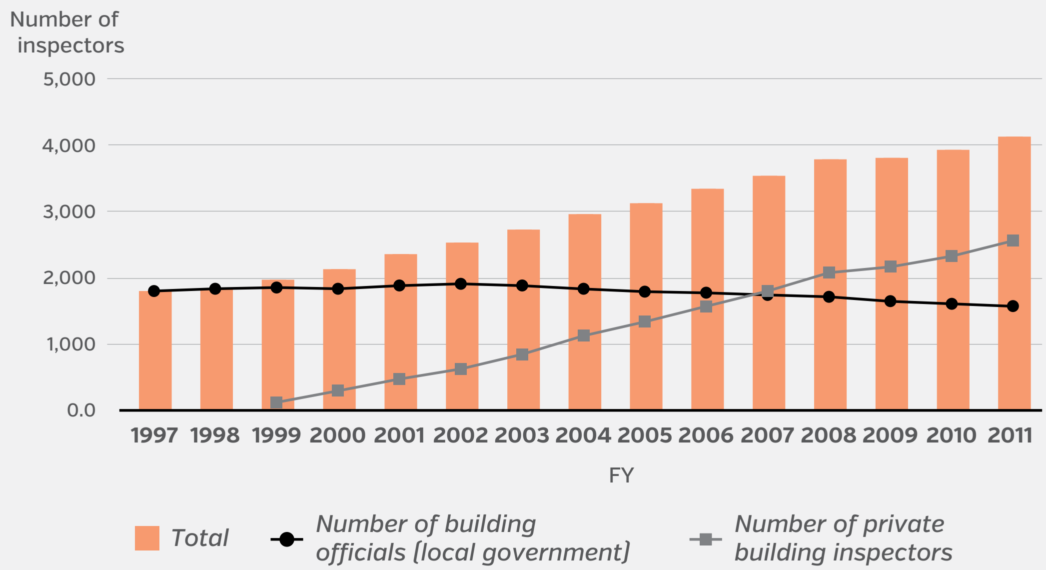
Source: CLITT.

Annex 4F Impacts of Private Sector Participation in the Building Quality Assurance System

Private sector participation in Japan's building quality assurance system has in general had a positive impact on the system. This annex offers data on some of the specific changes brought about by involvement of the private sector.

Increased number of private inspectors. Since the building inspection process opened to include the private sector in 1998, the number of private building inspectors has grown. Figure 4F.1, which shows the trend in the number of inspectors for building confirmation, indicates that the number of private building inspectors surpassed the number of public sector building officials after 2007. With private inspectors now taking major roles in building confirmation and inspection, the burden on local public building officials has decreased significantly.

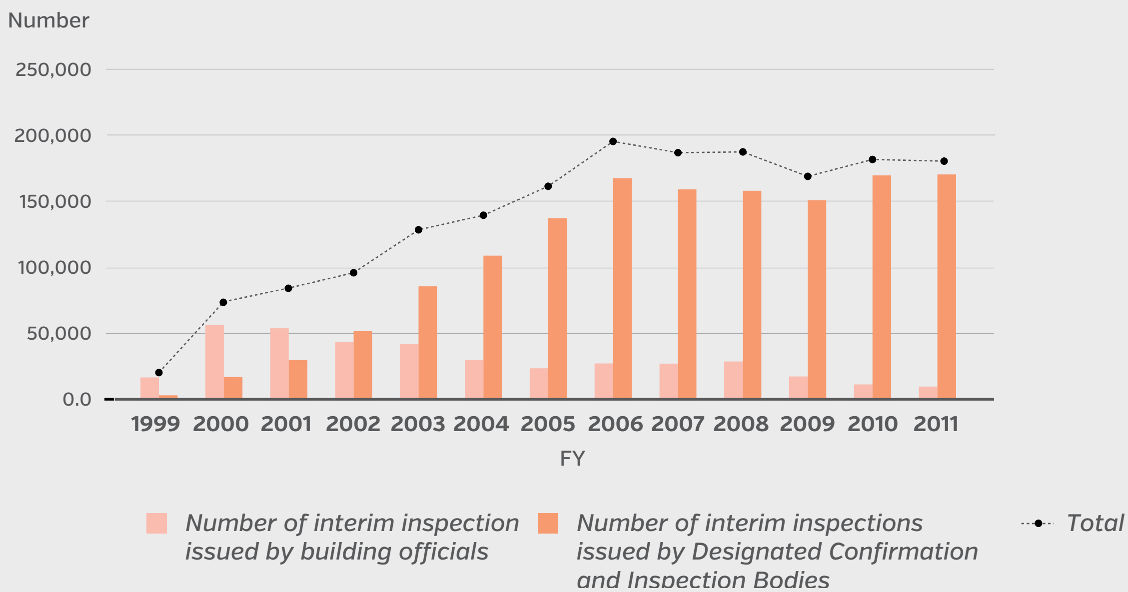
Figure 4F.1 Trend in the Number of Inspectors: Public and Private, 1997–2011



Source: MLIT.

Drastic improvement in completion of interim inspections. Private inspectors have for some years performed the large majority number of interim inspections, as shown in figure 4F.2. This trend has led to a gradual decrease in the amount of administrative guidance issued and violations corrected.

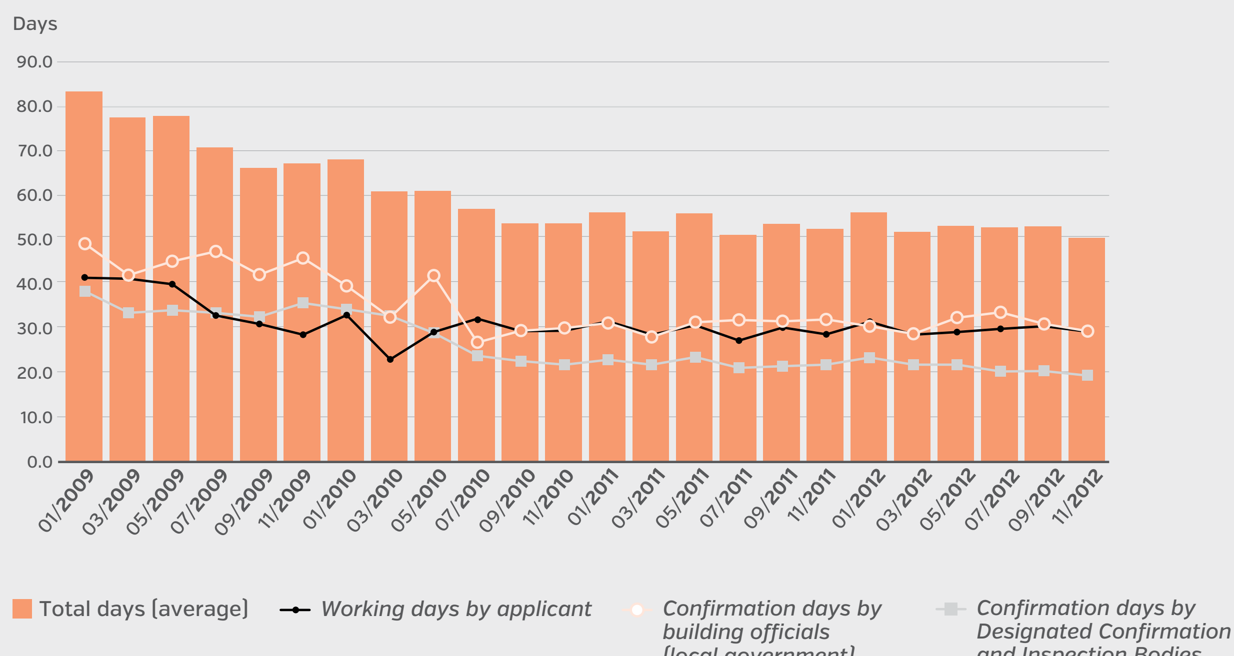
Figure 4F.2 Trend in the Number of Interim Inspections: Public versus Private, 1999–2011



Source: MLIT.

Reduced time for building confirmation. Figure 4F.3 shows both the public and private sector trend in the length of wait for building confirmation—that is, the number of days between the filing of an application for confirmation and the performance of the confirmation. On average, confirmation by the private Designated Confirmation and Inspection Bodies takes place approximately 10 days earlier than confirmation by local public building officials.

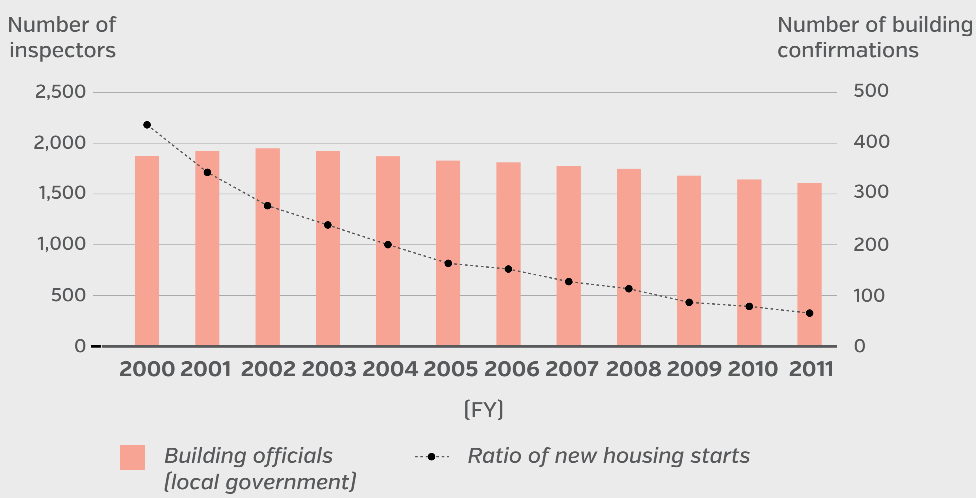
Figure 4F.3 Reduction in Time for Building Confirmation as Triggered by Private Sector Engagements



Source: MLIT.

Efficiency gained through private sector engagement for Building Confirmation. The number of building confirmations per building official has been decreasing since private sector involvement began, as shown in figure 4F.4. This trend means that building officials have more time to attend to original administrative task works such as violation correction. The cost of private inspection is typically higher than for public, but more applicants chose private inspection because it allows for quicker confirmation (as shown in figure 4F.3).

Figure 4F.4 Reduction in Building Confirmations per Building Official as Triggered by Private Sector Engagements, 2000–2011



Source: MLIT.

Annex 5A Local Policies and Programs to Promote Seismic Retrofit

Some policies for promoting seismic retrofit are made at the local government level. Table 5A.1 gives examples of local efforts to encourage owners to retrofit their buildings.

Table 5A.1 Efforts by Local Governments to Encourage Seismic Retrofit

Public awareness programs	Technical assistance
• Dedicated websites for promoting earthquake resistance • Brochures explaining seismic diagnosis, etc. • Events to promote earthquake resistance • Seminars and learning sessions to disseminate knowledge about earthquakes	• Contest and award for innovative seismic design and retrofitting construction works • Dispatch of experts for seismic diagnosis • Introduction of seismic reinforcement technology • Introduction of seismic retrofitting example • Publication of seismic diagnosis guidelines • Technical training for seismic diagnosis engineers

The central government has prioritized certain buildings for seismic resistance and set target seismic resistance rates for them. By 2015, 90 percent of public and other important buildings were supposed to be seismically resistant. Local governments have set their own targets as well. Table 5A.2 shows the target rates and actual rates for Yokohama city.

Table 5A.2 Seismic Resistance Rates in Yokohama City: Target versus Actual

Type of building	Seismic resistance rate		
	End of FY 2015		End of FY 2020
	Target rate	Actual rate	Target rate
Houses	90%	89%	95%
Private buildings (hospitals, hotels, department stores, etc.)	90%	89%	95%
Public buildings (governmental offices, schools, hospitals, fire stations, police stations, etc.)	100%	99%	

Source: Seismic Retrofitting Promotion Plan, Yokohama City.

Public buildings can play an important role in disaster management; schools, for example, may be used as emergency shelters (see box 5A.1). Local governments should therefore prioritize the seismic resistance of public buildings and use this work as an entry point to promote the seismic resistance of private houses.

Box 5A.1 Japan's School Retrofit Program

Seismic retrofit programs have focused on public buildings and large-scale buildings as well as houses, in part because public buildings such as schools and governmental offices often serve as disaster management base facilities and evacuation sites. School facilities in particular have played an important role as temporary shelters. For this reason, seismic diagnosis and retrofit of school facilities should be promoted as a disaster risk reduction measure.

The Program for Earthquake-Resistant School Buildings—the national government's initiative for making schools earthquake-resistant—began in 1978 and continues today. It was initiated to address the schools' poor seismic capacity and the government's slow pace in conducting school retrofit. Under the program, school infrastructure has been inventoried, and data on earthquake risk (such as damage to buildings) continue to be collected. These data allow the national government to prioritize necessary actions, and have been incorporated in laws to promote risk mitigation.

The national government carries out the program through MEXT, which directs and supports local governments. MEXT is responsible for providing local governments with technical support and assistance for preparation of financial measures that facilitate school building retrofitting. MEXT is also responsible for monitoring the project's progress and for determining how to use the seismic diagnosis results to prioritize vulnerable buildings, as outlined in the "Guidelines for Promotion of Earthquake-Resistance School Building" (MEXT 2003).

On the other hand, local governments are responsible for deciding whether to reconstruct or retrofit schools. Local governments also decide which method to use for seismic retrofitting (steel-frame bracing, RC shear wall, etc.) based on the type of structure, condition of the building, duration of the construction, costs, etc. Program implementation is carried out at the local level.

Japan's experience also offers several lessons to developing countries seeking to improve the seismic safety of their schools:

1. Experiences from previous disaster events can be used to accelerate retrofitting.
2. Accumulating data can help encourage program implementation and development.
3. Each actor in the disaster risk management process, including retrofit efforts, should have clearly defined roles and functions.
4. Developing comprehensive and flexible programs with clear priorities and targets is important.
5. Continuing advances in engineering research are the basis for developing a retrofitting program.
6. Proactive support by the national government, strong initiative on the part of program implementers, and clearly defined roles for schools within the disaster management context are critical to retrofit of school facilities.

Note: For a full case study, please see World Bank and GFDRR, "Making Schools Resilient at Scale: The Case of Japan," http://pubdocs.worldbank.org/en/148921478057894071/110216-drmhubtokyo-Making-Schools-Resilient-at-Scale.pdf.

Annex 5B Statistical Information on Housing in Japan

Japan has implemented various surveys in order to comprehend and monitor building quality. These data are the basis for policy review and are utilized in devising policy instruments. Table 5B.1 shows several examples of statistical data related to buildings in Japan.

Table 5B.1 Examples of Statistical Data on Buildings in Japan

Survey name	Survey purpose	Main information collected	Survey method	Interval
Housing and Land Survey	To acquire basic data for formulating various housing-related policy measures. Investigates actual conditions of dwellings and other occupied buildings to clarify the present conditions and trends.	• Number and area of dwelling rooms (in units of tatami mats) • Construction materials • Number of stories of building • Type of building • Year of construction • Floor space area; building area • Whether enlargement, remodeling, refurbishing etc. is taking place	Questionnaire to selected households	Every five years
Building Dynamic Statistics Survey	To reveal the dynamics of buildings, and to obtain basic data regarding construction and housing.	• Location • Schedule of construction • Structure type • Total floor area • Number of stories	Collection by prefecture based on the building construction notification stipulated by the BSL, etc.[a]	Monthly/yearly/ every fiscal year
Comprehensive Survey of Living Conditions	To obtain basic data required for promoting housing policies by investigating housing and living environments and matters related to changes in residence status over the last five years.	• Evaluation of housing and living environment • Matters related to changes in residence status over the last five years • Matters related to future lifestyles, etc.	Same as Housing and Land Survey; target is households chosen at random from Housing and Land Survey	Every five years
Housing Market Trend Survey	To obtain basic data for the study and planning of future housing policies by revealing actual conditions of individual houses, purchase of new and existing houses, moves to rental housing, and renovations.	• Comparison of current houses with previous houses • Financing method for housing construction • Housing Performance Indication System, etc.	For custom-built houses: Mail survey For houses built for sale, existing houses, private rental houses, and renovated houses: In-person survey by enumerator	Yearly

a. The BSL stipulates that building owners who intend to construct or demolish a building must notify the local government.

Annex 5C How Japan Met Goals for Housing Quantity

Immediately after WWII, Japan faced a housing shortage of 4.2 million units. In response to this deficit, the government took three steps that would serve as the foundation of a publicly funded system for housing supply: it enacted the Building Standard Law; it established the GHLC (now JHF) to provide long-term, low-interest finance for the construction or purchase of houses; and it enacted the Publicly Operated Housing Act to provide subsidies that allowed local governments to supply low-rent (publicly operated) housing.

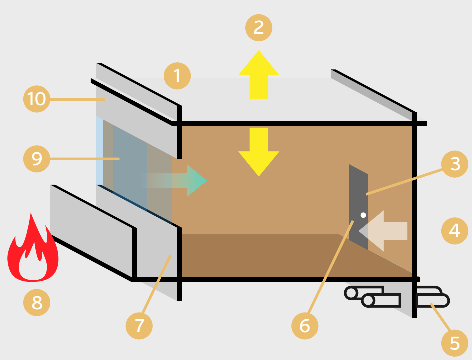
In 1955, when an influx of people to cities further strained the urban housing supply, the Japan Housing Corporation (now Urban Renaissance Agency) was established to supply housing, and land for housing, to working people. In 1966, the Housing Construction Planning Act was enacted to stimulate housing construction: under this law, the cabinet began to adopt comprehensive five-year housing construction programs, which included construction by the private sector as well as by the central and local governments. The government also promoted mass-produced (prefabricated) housing in the publicly operated sector, and this approach was later adopted by the private sector. Factory production of housing components, including paneling and unitization, began in the late 1950s. Factories also produced industrial materials such as lightweight steel frames and plastics whose quality was controlled by construction material standards. These factory-produced “industrialized houses” helped ensure housing quality as well as quantity.

In 1968, as a result of technological innovation, enhancement of quality, and lower manufacturing costs related to mass production, the number of new houses in Japan exceeded 1 million units. In 1973, the total number of houses exceeded the total number of households in all prefectures. Japan had reached its goal of one house per household.

Annex 5D Voluntary Systems for Improving Housing Quality

This annex describes two voluntary systems that offer financial incentives for improving housing quality: (1) the Housing Performance Indication System, and (2) the Certification of Long-Life Quality Housing. The Housing Performance Indication System, based on the Housing Quality Assurance Act enacted in 1999, is a voluntary system that evaluates houses according to 10 broad fields and 33 specific items. The evaluation is carried out by Registered Housing Performance Evaluation Bodies, which are registered by MLIT. Figure 5D.1 shows the 10 fields of the system.

Figure 5D.1 Ten Fields of the Housing Performance Indication System



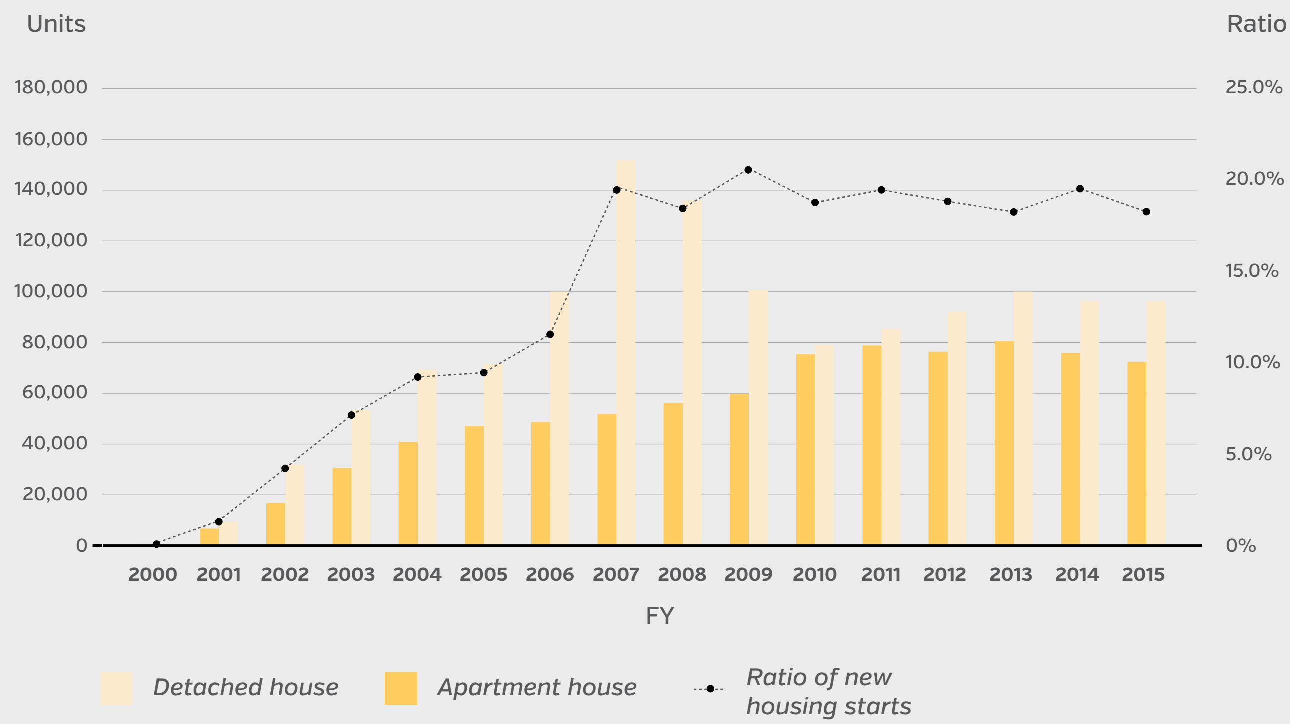
1. Structural stability
2. Acoustic environment
3. Security against instrusion
4. Indoor air environment
5. Consideration for maintenance and remodeling
6. Measures for the aged and the handicapped
7. Protective measures against degradation
8. Fire safety
9. Luminous and visual environment
10. Thermal environment

Source: Building Center of Japan 2013.

The Housing Performance Indication System is closely related to the Flat 35/35S (described in section 5.2.3). It offers financial incentives—such as a lower long-term fixed-rate housing loan and discounted earthquake insurance premiums—for achieving higher quality. In addition, if a dispute arises concerning a house evaluated by this system, the Designated Dispute Settlement Commission will handle the matter and resolve the dispute swiftly and efficiently.

Figure 5D.2 shows the share of houses issued a housing performance evaluation report since 2000. Currently, about 20 percent of new houses use the Housing Performance Indication System.

Figure 5D.2 Trend in Houses Issued a Housing Performance Evaluation Report, 2000–2015

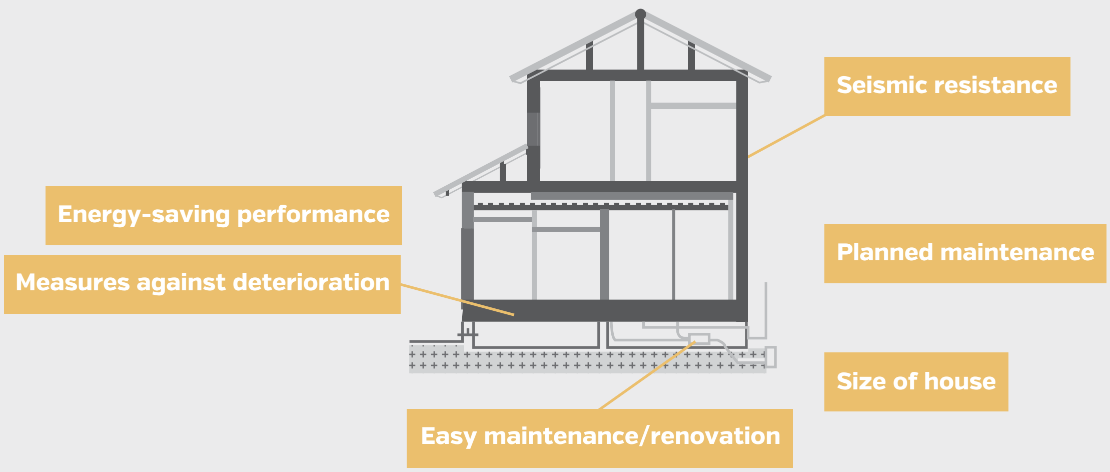


Source: Housing Performance Evaluation Association; Statistics Bureau; Ministry of Internal Affairs and Communications.

Certification of Long-Life Quality Housing is based on the Act for the Promotion of Long-Life Quality Housing enacted in 2009, and reflects the goals of that act as well as those of the Basic Plan for Housing (National Plan), enacted in September 2006 and revised in March 2016. The goal is for Japan to become a society that lessens its environmental impact by meeting housing needs with existing stock (rather than through new construction). This has resulted in measures that aim to extend the useful life of housing. Currently, the average actual age of demolished houses in Japan is about 30 years.

Under the Act for the Promotion of Long-Life Quality Housing, "Long-Life Quality Housing" is defined as superior housing with features to support long-term use in good condition. Housing that meets the necessary requirements (shown in figure 5D.3) is certified by the Designated Administrative Agency.

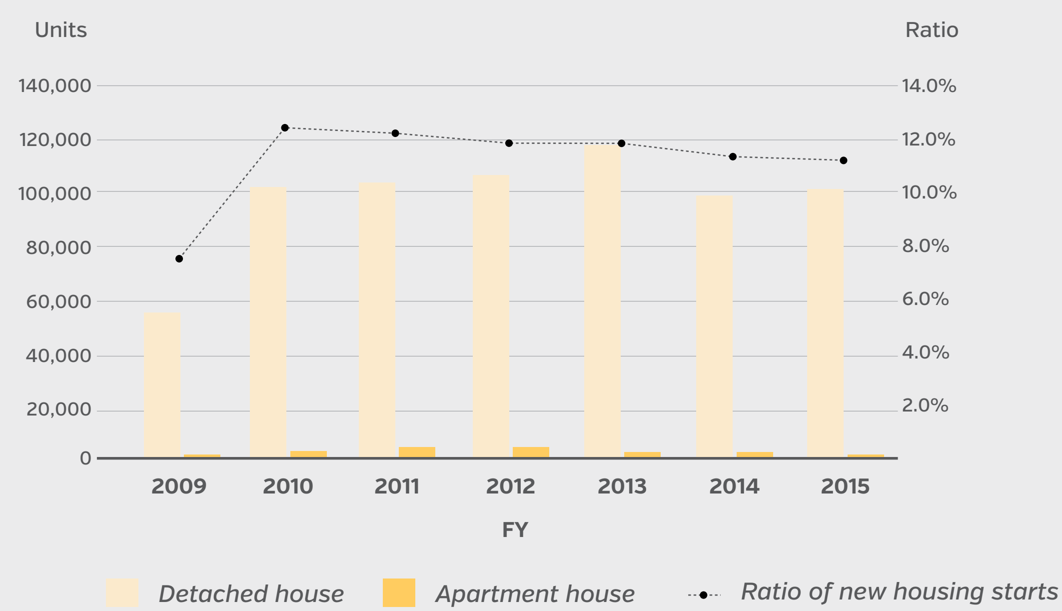
Figure 5D.3 Requirements for Long-Life Quality Housing (for wooden detached house)



Source: Building Center of Japan

Approved long-life quality housing is eligible for expanded housing loan tax deductions, exemptions from registration taxes, and reductions in real estate acquisition taxes and fixed asset taxes. Figure 5D.4 shows the trend in houses certified as long-life quality housing. Currently, over 10 percent of new housing is certified as long-life quality housing.

Figure 5D.4 Trend in Houses Certified as Long-Life Quality Housing



Source: Housing Performance Evaluation Association; Statistics Bureau.

The cost of housing under voluntary systems such as long-life quality housing includes the cost of enhancements (seismic stability, energy-saving performance, etc.). Such housing also qualifies for financial benefits such as tax deductions and preferential interest rates. These benefits offset part of the cost for high-quality, long-life housing.

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The Japan-World Bank Program for Mainstreaming Disaster Risk Management (DRM) helps developing countries drive large-scale investment to increase their disaster resilience. Through the Global Facility for Disaster Reduction and Recovery, the World Bank DRM hub in Tokyo connects officials, practitioners, and development professionals with leading Japanese and global DRM expertise and solutions.

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