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For discussion
on 11 June 2012

LEGISLATIVE COUNCIL
PANEL ON DEVELOPMENT

SUBCOMMITTEE ON BUILDING SAFETY AND RELATED ISSUES

INTRODUCTION OF SEISMIC-RESISTANT BUILDING DESIGN STANDARDS IN HONG KONG

PURPOSE

The purpose of this paper is to seek Members' views on the Administration's proposal to consult the building industry and relevant stakeholders on whether statutory seismic-resistant building design standards should be introduced for new buildings, as well as for major alteration and addition works in existing buildings in Hong Kong.

BACKGROUND

2. Hong Kong is not geographically situated within active seismic belts. Hence, the possibility of serious earthquakes striking the territory is relatively low. However, minor earthquakes of perceptible intensities are detected from time to time. While the current Buildings Ordinance (Cap. 123) does not require private buildings in Hong Kong to meet specified seismic-resistant design standards, internationally many major cities and economies located in areas of seismicity comparable to that of Hong Kong have all introduced statutory seismic-resistant design standards for new buildings.

3. Since Hong Kong is prone to typhoons, most buildings in the territory are, as required by statute, built with a load-resisting capacity to withstand strong winds. According to a consultancy study commissioned by the Buildings Department, local buildings are therefore basically safe in the event of an earthquake, although they may suffer some degree of structural damage depending on the intensity of the earthquake. The study also observed that the introduction of seismic-resistant building design

standards in Hong Kong should not, generally speaking, lead to a substantial increase in construction costs, but should significantly reduce the annual damage cost to the structural elements of the buildings due to earthquakes. Moreover, the number of fatalities in the event of an earthquake would also be significantly reduced.

PROPOSAL TO INTRODUCE SEISMIC-RESISTANT BUILDING DESIGN STANDARDS IN HONG KONG

4. Taking into account the international practice, the potential improvement in building safety standards, the anticipated increased protection for properties and lives, as well as the marginal impact on construction costs, we consider that there may be a case for introducing statutory seismic-resistant building design standards for new buildings, and for major alteration and addition works in existing buildings in Hong Kong. Details of the proposal are set out in the Legislative Council Brief entitled "Introduction of Seismic-resistant Building Design Standards in Hong Kong" (see Appendix) issued by the Development Bureau on 25 May 2012.

ADVICE SOUGHT

5. Members' views are sought on the proposed consultation on whether statutory seismic-resistant building design standards should be introduced for new buildings, as well as for major alteration and addition works in existing buildings in Hong Kong.

Development Bureau
June 2012

File Ref. : DEVB(PL-CR) 1-90/01

LEGISLATIVE COUNCIL BRIEF

INTRODUCTION OF SEISMIC-RESISTANT BUILDING DESIGN STANDARDS IN HONG KONG

INTRODUCTION

At the meeting of the Executive Council on 15 May 2012, the Council took note of a proposal to consult the building industry and relevant stakeholders on whether statutory seismic-resistant building design standards should be introduced for new buildings, as well as for major alteration and addition works in existing buildings in Hong Kong.

2. The Executive Council also noted that, subject to the outcome of the consultation, the Administration will consider whether to prescribe appropriate seismic-resistant building design standards by amending the Building (Construction) Regulations, Cap 123B.

JUSTIFICATIONS

Risk of Earthquake and International Practice

3. Buildings[1] in Hong Kong are currently not required by law to meet specific seismic-resistant design standards. Hong Kong is not geographically situated within active seismic belts. Hence, the possibility of serious earthquakes in the territory is relatively low. However, minor earthquakes of noticeable intensities are detected from time to time.

[1] In the Buildings Ordinance (BO), "building" is defined to include "the whole, or any part, of any domestic or public building or building which is constructed or adapted for use for public entertainment, arch, bridge, cavern adapted or constructed to be used for the storage of petroleum products, chimney, cook-house, cowshed, dock, factory, garage, hangar, hoarding, latrine, matshed, office, oil storage installation, out-house, pier, shelter, shop, stable, stairs, wall, warehouse, wharf, workshop or tower, sea-wall, breakwater, jetty, mole, quay, cavern or any underground space adapted or constructed for occupation or use for any purpose including its associated access tunnels and access shafts, pylon or other similar structure supporting an aerial ropeway and such other structures as the Building Authority may by notice in the Gazette declare to be a building".

Between 1905 (i.e. when seismic record began in Hong Kong) and February 2012, 168 earthquakes of varying intensities were registered in Hong Kong. Most of them were of Intensity V or below on the Modified Mercalli Scale[2] (MMS) and none had caused any casualties. The strongest earthquake ever recorded in Hong Kong measured Intensity VI to VII on the MMS. This earthquake occurred in 1918 with epicentre at about 300 kilometres away from Hong Kong in the neighbourhood of Shantou. In Hong Kong, it caused some damage, mainly cracks in walls, to a few buildings which were constructed to the less advanced building standards at that time. No injuries or casualties in the territory were reported. For reference, the MMS, with description of the impact at different levels of intensity, is attached at **Annex A**.

4. On the other hand, it is worth noting that, internationally, many major cities and economies located in areas of seismicity comparable to that of Hong Kong have all introduced statutory seismic-resistant design standards for new buildings. These include Shanghai, South Korea, Thailand, Australia, France, Germany and New York City.

Seismic-Resistant Building Design Standards and Possible Damage Cost

5. Although buildings in Hong Kong are not specifically built for earthquake-resistant, most of the buildings, as required by statute, have been designed and built with a relatively high load-resisting capacity to withstand strong winds as Hong Kong is prone to typhoons. As a result, they could generally meet the current performance-based seismic building design criteria accepted in international practice although they may still experience different levels of damage in an earthquake. Seismic-resistant building designs involve dedicated design and detailing requirements (e.g. detailing of steel reinforcement inside concrete structures, requirement for building separation to avoid pounding, etc.), which fall beyond the scope of Hong Kong's current statutory wind-resistant building design standards.

6. According to a consultancy study commissioned by the Buildings Department (BD), in the case of a low intensity earthquake measuring

[2] The Modified Mercalli Scale (MMS) indicates the intensity of an earthquake. The intensity of an earthquake at a particular locality is a measure of the violence of earth motion produced there by the earthquake. It is determined from reported effects of the tremor on human beings, furniture, buildings, geological structure, etc. The MMS classifies earthquake effects into twelve grades ranging from Intensity I: "Not felt except by a few under especially favorable conditions" to Intensity XII: "Damage total, lines of sight and level distorted, objects thrown into the air". For Intensity V, the description is: "felt by nearly everyone, many awakened, some dishes and windows broken, unstable objects overturned, pendulum clocks may stop".

MMS Intensity V to VI, which has an estimated return period of 1 in 72 years, 0.27% of the existing building floor area in Hong Kong may suffer "moderate damage", with large cracks in beams, columns, walls, etc. In a moderate earthquake of MMS Intensity VII, which has a return period of 1 in 475 years, 3.9% of the existing building floor area in Hong Kong will suffer similar damage. An earthquake of this magnitude may also cause "extensive damage", with spalling of concrete, deformation of reinforced concrete beams and columns as well as extensive cracking of unreinforced elements, to 0.19% of the existing building floor area. Besides, 0.003% of the existing building floor area may suffer "complete damage". A high intensity earthquake measuring MMS Intensity VIII, which has a return period of only 1 in 2 475 years, would, as can be expected, cause more severe damages. In such a serious earthquake, it is estimated that 16.5% of the existing building floor area in Hong Kong may suffer "moderate damage", 2.8% may suffer "extensive damage" and 0.19% may suffer "complete damage". Of the 0.19% which may suffer from "complete damage", between 5% to 15% of the buildings involved may collapse. Details of the consultant's assessment are tabulated in **Annex B**.

7. Taking into account the probability of occurrence of different intensities of earthquakes and the associated extent of damage, the annual damage cost to the structural elements of the existing building stock resulting from earthquakes is estimated to be around $600 million[3]. On the other hand, had the total building stock in the territory been constructed in accordance with the seismic-resistant design requirements of the United States' International Building Code 2006 (IBC 2006)[4], the estimated annual damage cost to the structural elements of the buildings due to earthquakes could be reduced by some 80%, to the order of only $120 million[3].

Seismic-Resistant Building Design Standards and Possible Injuries/ Casualties

8. Depending on the intensity, earthquakes may cause different levels of injuries or casualties. The estimated impact on lives, under different scenarios and with our existing building stock which are not built to seismic-resistant design standards, is presented in **Annex C**. According

[3] The annual damage cost is derived from the total damage costs predicted at 2011 price level under the three levels of earthquake intensities stated in Annex B. It is an average value estimated over an extended exposure period of hundreds of years.

[4] The IBC 2006 has been superseded by IBC 2009 which provides detailed refinement to the former without causing significant implications on costs.

to the consultant, the number of fatalities in case of an earthquake in Hong Kong would be significantly reduced if IBC 2006, or the current IBC 2009, is imposed on the total building stock in the city. For instance, in a high intensity earthquake (MMS Intensity VIII), the estimated average number of fatalities would fall from 130 - 150 to only three on average if IBC 2006 is adopted.

Seismic-Resistant Building Design Standards and Construction Cost

9. It is recognised that the incorporation of seismic-resistant standards into the design and construction of buildings could lead to higher costs. However, according to the consultancy study, the increase, especially for regular buildings, would not be high. As illustration, based on the structural forms[5] commonly adopted for residential buildings in Hong Kong and assuming the adoption of IBC 2006, the consultant estimates that the increase in construction cost (i.e. labour and material costs) of new residential buildings would range from 0% to 0.3%, or $40 per square metre of building floor area[6], compared to the medium construction cost of $13,400 per square metre[6]. If the Mainland's "Code for Seismic Design of Buildings[7]" is adopted, the corresponding increase in construction cost of new residential buildings would be about 0.9%, or $120 per square metre of building floor area[6]. Such increase in construction cost should be regarded as not so significant. As regards buildings with transfer plate[8] construction, they are classified as irregular structures under the Mainland's "Code for Seismic Design of Buildings" and may require specific study for each individual case. For the purpose of illustration, it is estimated that the increase in construction cost for new residential buildings with transfer plate construction may range from 0% to 5%, up to $670 per square metre of building floor area[6].

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[5] Reinforced concrete frame buildings and reinforced concrete shear wall buildings.

[6] The increase in construction cost was estimated at the price level of 2011. $13,400 per square metre is the medium construction cost of good quality high-rise residential buildings in Hong Kong recorded in 2011.

[7] The Mainland also issued a "Code for Seismic Design of Buildings" (GB50011-2001) in 2001 jointly by the then Ministry of Construction and the General Administration of Quality Supervision, Inspection and Quarantine. The Mainland's "Code for Seismic Design of Buildings" was superseded by GB50011-2010 in December 2010. As far as seismic-resistant design is concerned, the GB50011-2010 provides detailed refinement to the GB50011-2001 without having significant implications on cost terms.

[8] Transfer plate construction involves construction of plate structure that transmits heavy loads from columns or walls acting on its top and redistributes them to supporting columns or walls underneath. Spacing of vertical supporting elements above a transfer plate is usually closer than below it for easy and flexible architectural planning purposes.

10. Under section 41 of the BO (Cap 123), "buildings belonging to the Government" and "buildings upon any land vested in the Housing Authority or over which the Housing Authority has control and management" are exempt from the control of the BO and its regulations. This notwithstanding, it is established practice that Government buildings are designed and constructed to the same statutory standards for private buildings. Likewise, the Housing Authority follows the BO and its regulations even as it is not required to do so by law. Hence, if these established practices are maintained, the introduction of statutory seismic-resistant standards for private buildings could lead to a corresponding increase of a similar magnitude in the construction cost of Government and Housing Authority buildings, although they should have no impact on the recurrent costs including maintenance and electricity costs.

11. There are Government buildings which have few or no counterparts in the private sector, specifically public infrastructure and emergency relief facilities. While most of the earthquakes registered in Hong Kong have been of MMS Intensity V or below, various major infrastructures (e.g. airport, highway structures, railway bridges, reservoirs and sewage tunnels), including highway structures associated with private development, have been designed to withstand earthquakes measuring MMS Intensity VI to VIII. For projects built by Government, there are internal guidelines carrying these requirements. For those built by the private sector, BD has issued Practice Note which is generally followed. Hence, our intention is to maintain the status quo and will not suggest prescribing the seismic design standards by law.

12. On the other hand, existing Government buildings relating to emergency and rescue operations (e.g. fire stations, hospitals and police stations) are not designed to specific seismic-resistant design standards. This falls behind international standards where enhanced seismic-resistant design standards are imposed on special buildings such as hospitals, ambulance depots, fire and police stations, Police's and Fire Services Department's buildings that house mission critical facilities such as communication facilities, designated emergency centres, power stations, buildings housing water supply and sewerage facilities and other emergency backup facilities, aviation control towers, etc. Introduction of statutory seismic-resistant building design standards for such projects to be built by the private sector (e.g. private hospitals) may therefore have capital cost implications (say 0% to 5%) for the Government assuming the continuation of the established practice of applying all statutory building

design standards to Government buildings. However, the magnitude can only be assessed after the standards have been drawn up. Introduction of seismic-resistant building design standards on such special buildings should have no impact on the recurrent costs, including maintenance and electricity costs.

Application of Statutory Seismic-Resistant Building Design Standards to Major Alteration and Addition Works in Existing Buildings

13. As mentioned in paragraph 5 above, most existing buildings in Hong Kong, in particular the newer and high-rise buildings, possess a very high load-resistant capacity to withstand strong winds and therefore could generally meet the current performance-based seismic design criteria accepted by international practice. However, their construction was based on the statutory building standards prevailing at the time of their design and construction and it would not be a practicable option to require them to comply with the new statutory seismic-resistant building design standards if introduced. For instance, their occupants might have to move out for any such works to be carried out or the operations in them might be seriously disturbed and users inconvenienced. In some cases, the works would simply not be implementable technically. Besides, whilst some very old buildings (e.g. unreinforced masonry buildings) may suffer from different degrees of damage in case of a major earthquake, the damage risk to the vast majority of our building stock should remain small. Therefore, also as in line with international practice[9], any new seismic-resistant building design standards, if introduced, should not be applied retrospectively to existing buildings constructed.

14. Nevertheless, when major alteration and addition works are to be carried out for an existing building, we should require the incorporation of the new statutory seismic-resistant building design standards. The major alteration and addition works often involve extensive modifications of structural elements of buildings and it would be opportune to include the additional seismic-resistant requirements in the design[10]. Where historic buildings are involved, we would have to take into account the need to

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[9] In New York City, Shanghai, South Korea, Thailand, Australia, France and Germany, seismic rules have not been imposed on existing buildings.

[10] The definition of "major alteration and addition works" will be formulated at a later stage, by making reference to the scale and nature of the works involved as well as international practice. As illustration, in the regulations of New York City, United States, the extent of application of seismic requirements to the existing building, if so required, depends on the ratio of cost of the alteration and addition works to the value of the building.

maintain the authenticity and integrity of the buildings concerned in working out an appropriate mechanism.

Proposal

15. Taking into account the international practice and our status as an advance city of the world, the potential improvement in building safety standards, the estimated reduction in damage cost, injuries and casualties, as well as the marginal impact on construction costs, we consider that there may be a case for introducing statutory seismic-resistant building design standards for new buildings, and major alteration and addition works in existing buildings in Hong Kong, save for those infrastructural works mentioned in paragraph 11 above. If this is pursued, all Government buildings (except those belonging to the category mentioned in paragraph 11 above) should also abide by them as an internal arrangement. However, because of the cost and technical implications for the private sector, we propose that the building industry and the stakeholders concerned including the Legislative Council (LegCo) be consulted in the first instance so that we could take their concerns and suggestions into consideration in mapping out the way forward.

16. Since the specific ground motions, building designs, construction standards and practices of different localities are different, it will not be appropriate for Hong Kong to simply follow the seismic-resistant design requirements of other countries or territories. A tailor-made code, taking into account the relevant international standards and Hong Kong's geology, topography and construction practices, should be formulated if we are to introduce statutory seismic-resistant building design standards. We will take reference from the standards adopted by the United States, Mainland China and other cities/economies in devising Hong Kong's seismic-resistant design requirements. In line with international practice, consideration will be given to imposing more stringent requirements for new buildings, and major alteration and addition works carried out in special buildings having a post earthquake recovery role, the majority of which are Government buildings, as well as schools, etc. Such design requirements and the types of buildings to be covered will be worked out then.

A Relevant Issue: Building Services and Public Utilities

17. The proposed imposition of seismic-resistant building design requirements on future new buildings, and major alteration and addition

works in existing buildings aims to enhance safety of building structures and reduce building structure-related damages and injuries during earthquakes. If a building can remain intact during earthquakes, it will greatly enhance safety of the occupants and properties therein. The basic operations within the buildings could also be ensured. Any new requirements will only cover the general structural elements of buildings, but not the building services and utilities (e.g. fire service installations, water supply system, gas mains, telecommunication networks, etc.). Each of these installations in a building has its own unique features and will require dedicated specialist considerations of seismic design. While we encourage the voluntary incorporation of seismic design requirements in such items in individual Government or private developments, we do not propose to impose mandatory requirements at this stage.

OTHER OPTIONS

18. As an advanced international city, Hong Kong should catch up with the latest international safety standards for building design. Maintaining the status quo of not introducing statutory seismic-resistant building design standards for new buildings, and major alteration and addition works in existing buildings will render Hong Kong lagging behind other international cities of comparable seismicity in terms of building safety design standards. In the event of an earthquake, our buildings will be less resistant to damage. Although serious earthquakes have not occurred in Hong Kong as far as our official record shows, we should bring our building safety design standards on par with those of other cities/economies of comparable seismicity for a higher level of safety protection to occupants and users of the buildings.

IMPLICATIONS OF THE PROPOSAL

19. The implications of introducing seismic-resistant building design standards for future new buildings, and major alteration and addition works in existing buildings are set out at **Annex D**. This initiative is in conformity with the Basic Law, including provisions on human rights, and has no productivity implications and impacts on competition.

PUBLIC CONSULTATION

20. We aim to consult the stakeholders, including the building professional institutions, building contractor associations, developers'

association, local academics of the relevant fields, and the LegCo Panel on Development, etc. The consultation will stress that while the possibility of serious earthquakes occurring in Hong Kong is relatively low and most of the local buildings should be safe in the event of an earthquake, the introduction of seismic-resistant design requirements on new buildings, and major alteration and addition works in existing buildings is a cost effective way to further enhance building safety in Hong Kong in line with international standards.

PUBLICITY

21. A Government spokesman is available to answer media and public enquiries. We will also consult the LegCo Panel on Development through its Subcommittee on Building Safety and Related Issues.

ENQUIRY

22. Any enquiry on this brief may be addressed to Mr Victor Ng, Principal Assistant Secretary for Development (Planning and Lands)6 on 3509 8819.

Development Bureau
25 May 2012

Annex A

Modified Mercalli Scale

Mercalli Magnitude	Effects observed
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably by persons indoors, especially on the upper floors of buildings. Many do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all; many frightened and run outdoors, walk unsteadily. Windows, dishes, glassware broken, books off shelves, some heavy furniture moved or overturned; a few instances of fallen plaster. Damage slight.
VII	Difficult to stand. Furniture broken. Damage negligible in building of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture moved.
IX	General panic. Damage considerable in specially designed structures, well designed frame structures thrown out of plumb. Damage great even in substantial buildings, with partial collapse. Buildings shifted off foundations.

Mercalli Magnitude	Effects observed
X	Some well built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any masonry structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level distorted. Objects thrown into the air.

Source: US Geological Survey

Annex B

Estimated Building Damages under Different Intensities of Earthquakes

	Intensity of Earthquake					
	Low Intensity (Approximately MMS Intensity V to VI) (Probability of occurrence: 50% in 50 years, or frequency of occurrence: 1 in 72 years)		**Moderate Intensity (Approximately MMS Intensity VII) (Probability of occurrence: 10% in 50 years, or frequency of occurrence: 1 in 475 years)**		**High Intensity (Approximately MMS Intensity VIII) (Probability of occurrence: 2% in 50 years, or frequency of occurrence: 1 in 2 475 years)**	
Estimated building damage of significance and associated % of the entire building stock suffering from damage (expressed in % of building floor areas)	Moderate damage	0.27%	Moderate damage	3.9%	Moderate damage	16.5%
	Extensive damage	0.003%	Extensive damage	0.19%	Extensive damage	2.8%
	Complete damage	0%	Complete damage	0.003%	Complete damage	0.19%[1]

[1] In terms of number of buildings or dwellings damaged, 0.19% of building floor areas involves 1 000 village houses, 6 schools, 7 retail buildings, 5 public office buildings, 9 private office buildings, 5 industrial buildings, 2 emergency buildings, 1 carpark building, 640 public dwellings (not buildings) and 1 630 private dwellings (not buildings). Between 5% to 15% of the above buildings suffered from complete damage will collapse.

Damage level	**Description of damage**
Slight Damage	Hairline cracks in beams, columns and walls.
Moderate Damage	Large flexural cracks with some spalling. Large diagonal cracks in shear walls. Masonry walls may have large diagonal cracks.
Extensive Damage	Spalled concrete and buckled reinforcement in columns and beams. Visibly buckled reinforcement in shear walls. Most unreinforced elements will have suffered extensive cracking.
Complete Damage	The structure is in imminent danger of collapse due to brittle failure of beams and columns and most of the shear walls. Unreinforced masonry walls may collapse due to in-plane or out-of-plane failure.

Annex C

Estimated Injuries/Casualties under Different Intensities of Earthquakes

	Intensity of Earthquake					
Injury Level	**Low Intensity (Approximately MMS Intensity V to VI) (Probability of occurrence: 50% in 50 years, or frequency of occurrence: 1 in 72 years)**		**Moderate Intensity (Approximately MMS Intensity VII) (Probability of occurrence: 10% in 50 years, or frequency of occurrence: 1 in 475 years)**		**High Intensity (Approximately MMS Intensity VIII) (Probability of occurrence: 2% in 50 years, or frequency of occurrence: 1 in 2 475 years)**	
	Night	**Day**	**Night**	**Day**	**Night**	**Day**
Severity 1	85	120	880	1 380	4 900	7 800
Severity 2	4	5	75	110	730	1 050
Severity 3	0	0	1	1	65	75
Severity 4	0	0	2	2	130	150

Injury Level	**Injury Description**
Severity 1	Minor injuries requiring basic medical aid without hospitalisation
Severity 2	Serious injuries requiring a greater degree of medical care and hospitalisation, but not expected to progress to a life threatening status
Severity 3	Injuries that pose an immediate life threatening condition if not treated adequately and expeditiously
Severity 4	Instantly killed or mortally injured

Annex D

IMPLICATIONS OF THE PROPOSAL

Financial and Civil Service Implications

The consultation of the industry and other stakeholders on the proposal to enhance building safety under earthquakes per se has no financial and civil service implications as the relevant work will be carried out using the existing resources of the Development Bureau (DEVB) and BD.

2. If we are to proceed with introducing statutory seismic-resistant building design standards, an additional funding of about $6 million is required for commissioning a specialist consultant to devise a code of practice detailing the seismic design requirements for local buildings, taking into account local geological conditions, building standards and construction practices. The BD will absorb such additional cost from their existing resources. The manpower resources for taking forward the legislative amendments and subsequent enforcement of the seismic design requirements for private buildings will also be met by the existing resources of the DEVB and BD. Implementation of seismic-resistant design requirements for public housing may entail additional capital costs but these will be absorbed by the Housing Authority with no requirement for additional resources from the Government.

3. If seismic-resistant design standards are to be introduced on private buildings, similar design requirements will also be adopted for construction of new Government buildings as well as major alteration and addition works carried out in existing Government buildings. The manpower resources required for implementation of seismic-resistant design requirements on infrastructures, as well as new projects of and major alteration and addition works carried out in Government buildings, will be absorbed by the relevant works departments, with no requirement for additional manpower resources. Taking the Government building/capital subvention projects seeking LegCo's funding approval in 2011-12 as an example, the additional capital costs required for incorporating the seismic-resistant building design standards would range from $36.3 million to $109 million (assuming 0.3% to 0.9% of the total estimated construction cost of $12.1 billion).

4. If more stringent seismic-resistant standards are to be imposed on the design of special Government buildings relating to emergency and rescue operations, the construction cost for these buildings could increase by, say, about 0% - 5%. Taking the Government/capital subvention special building projects (including hospitals, schools, security-related and aviation-related projects) seeking LegCo's funding approval in 2011-12 as an example, the additional capital costs required for incorporating the seismic-resistant building design standards would be around $105 million (assuming 5% of the total estimated construction costs of $2.1 billion). This is however a very rough estimate. The actual magnitude of the increase would depend on the seismic-resistant standard to be drawn up and on the design of the individual buildings concerned. We will further assess the detailed financial implications before finalising proposals for implementation.

5. Introduction of seismic-resistant building design standards for Government buildings should have no impact on the recurrent costs including maintenance and electricity costs.

Economic Implications

6. BD's consultant estimated that if IBC 2006 is adopted to meet the proposed seismic-resistant design requirements, the increase in construction cost (i.e. labour and material costs) of new residential buildings will be up to $40 per square metre of building floor area[1]. If the Mainland's "Code for Seismic Design of Buildings" is adopted, the increase will be about $120 per square metre of building floor area[1]. In return, the present value of the resultant fall in damage cost to structural elements of buildings (if IBC 2006 were adopted) over 50 years design life of the building is estimated to be around $35 per square metre of building floor area[1]. The new seismic-resistant design requirements will also help reduce the number of casualties in the event of an earthquake.

7. The incorporation of seismic-resistant design will also raise the construction cost for major alteration and addition works, the amount of which will vary widely depending on the scope and nature of the works, the layout and structural form of the existing building, the selection of construction materials, etc.

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[1] The increase in construction cost and reduction in annual damage cost were estimated at the price level of 2011.

Sustainability Implications

8. Imposition of seismic-resistant design requirements on new buildings as well as major alteration and addition works in existing buildings will improve building safety standard, and reduce damage, injuries and the cost so resulted in the event of an earthquake. This initiative is in line with the sustainability principle of providing a living and working environment and pursuing policies which promote and protect the physical and mental health and safety of the people of Hong Kong.

Environmental Implications

9. The proposed imposition of seismic-resistant design requirements will bring about a positive environmental impact as it will reduce building damage, injuries and reconstruction cost in the event of an earthquake.