For discussion **FCR(2018-19)39**
on 29 and 30 June 2018

ITEM FOR FINANCE COMMITTEE

HEAD 159 – GOVERNMENT SECRETARIAT : DEVELOPMENT BUREAU (WORKS BRANCH)
Subhead 700 General non-recurrent
New Item "Construction Innovation and Technology Fund"

Members are invited to approve a new non-recurrent commitment of $1 billion under Head 159 Development Bureau (Works Branch) Subhead 700 General non-recurrent for the establishment of the Construction Innovation and Technology Fund.

PROBLEM

Facing the challenges of labour shortage, aging workforce and rising construction costs, and in anticipation of continuous strong demand for construction services in the coming years, we need to transform the construction industry through innovation and technology to boost our capacity to cater for such demand.

PROPOSAL

2. The Secretary for Development proposes the creation of a new non-recurrent commitment of $1 billion for establishing the Construction Innovation and Technology Fund (the Fund) to encourage wider adoption of innovative construction methods and technology in the construction industry, and to build up the capacity of construction professionals to leverage innovation for continuous improvement, with a view to promoting productivity, uplifting build quality, improving site safety and enhancing environmental performance.

/**JUSTIFICATION** …..

JUSTIFICATION

Local Construction Industry

3. The construction sector is Hong Kong's sixth largest employer, with a workforce of about 350 000[1] contributing 5.2% of our Gross Domestic Product[2]. It is pivotal in supporting our social and economic development. According to the Construction Expenditure Forecast released by the Construction Industry Council (CIC) in January 2018, the annual overall construction expenditure in Hong Kong in the coming five years will reach $250 billion to $305 billion, reflecting continuous strong demand for construction services.

Challenges Besetting the Local Construction Industry

4. However, Hong Kong is facing a number of challenges that might undermine our capability to cater for such demand, notably shortage of labour and an aging workforce. According to CIC's manpower forecast in January 2018[3], the construction industry will face a shortfall of 5 000 to 10 000 skilled workers in labour-intensive trades such as concretor, carpenter, welder, metal worker, plasterer, etc. from 2018 to 2022. Moreover, the average age of our construction workforce is 46, with about 40% of skilled workers already aged 55 or above. The overall labour force in Hong Kong will start to dwindle after 2022[4], making it even more difficult to recruit construction workers.

5. Furthermore, the local construction industry is also beset with the problem of rising construction costs in recent years. In 2018, our construction cost is ranked the third highest in the world[5], after San Francisco and New York.

/**Technology** …..

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1 Quarterly Report on General Household Survey (Fourth Quarter 2017), Census and Statistics Department.

2 Gross Domestic Product (Quarterly) (Fourth Quarter 2017), Census and Statistics Department.

3 The manpower forecast was done by comparing the manpower demand and supply in the industry. Manpower demand was derived by using both the expenditure forecast and the estimated labour demand by large-scale projects. For manpower supply, the CIC's annual training capacity for workers and the age profile of existing pool of registered workers were used to project the supply.

4 According to the Hong Kong Labour Force Projections for 2017 to 2066 published by the Census and Statistics Department in October 2017, the projected total labour force will reach about 3.67 million in 2022, and will decrease to 3.51 million in 2031. It will then hover between 3.49 million and 3.51 million from 2031 to 2038, after which it will start to drop again to 3.13 million in 2066.

5 According to International Construction Costs 2018, Arcadis.

Technology Adoption in the Construction Industry

6. Innovation and technology have been transforming the construction sector worldwide. For example, Building Information Modelling (BIM) allows visualisation of designs to enhance planning and co-ordination in the construction process, contributing to significant reduction in material wastage as well as pre-empting safety pitfalls and unworkable designs. The concept of Design for Manufacture and Assembly (DfMA) advocates off-site manufacturing for on-site assembly, which can reduce manpower and time requirements and minimise the environmental nuisance arising from construction. Modular Integration Construction (MiC), which replaces conventional site operations with off-site prefabrication, is an example of DfMA. Automating and mechanising repetitive construction processes can enhance productivity and safety. The use of advanced technologies would also uplift the professional image of construction practitioners and help attract new blood.

7. These benefits notwithstanding, Hong Kong is lagging behind in the adoption of new construction methods and advanced technologies. The use of new methods and technologies may incur additional investment in machinery and equipment, which would add to upfront costs. Due to the competitive operating environment in Hong Kong, investment in new technology is not the top priority of the industry. Moreover, the construction methods to be adopted in different projects are often dictated by the main contractors. It is necessary to provide incentives to forge different stakeholders in the construction supply chain to work in concert to transform the construction industry through innovation and technology.

Government Facilitation

8. The Government has been promoting technology adoption through its Capital Works Programme, with a spending of some $85 billion a year constituting about one-third of the total value of construction projects. For instance, with effect from 2018, capital works projects exceeding $30 million are required to use BIM from design to implementation. To promote a wider use of prefabrication, the Government has assisted in the establishment of large-scale, highly automated steel reinforcing bar (rebar) prefabrication yards and introduced measures to facilitate their operation and encourage contractors to use rebar products made by the approved rebar prefabrication yards. A few public works projects (demonstration project at CIC's Zero Carbon Building, student hostel of the University of Hong Kong and InnoCell of Hong Kong Science Park) will be piloting MiC. The Government is now considering gross floor area concessions to encourage MiC adoption in private projects.

/9. …..

9. To assist the industry in adopting innovative construction technologies, the CIC set up the Construction Innovation and Technology Application Centre in November 2017 to introduce the latest construction technologies.

Establishment of Construction Innovation and Technology Fund

10. The proposed $1 billion Fund will be open for application in the next five years (2018-19 to 2022-23). The Fund will cover two aspects – technology adoption and manpower development. It will be used to encourage the industry to use new but proven technologies developed within or outside Hong Kong. Research and development projects, which are already extensively covered by existing funding schemes, are excluded.

11. The second limb of the Fund will be used to build an innovative culture and foster the mind-set to espouse new technologies for the sustainable development of, and continuous improvement in, our construction industry.

(A) Technology Adoption

Target Beneficiaries

12. As the construction industry operates in an intertwined supply chain with multiple parties working in concert, the Fund will be open to all stakeholders involved in project design and implementation, as follows –

(a) Levy-paying Contractors

Under the Construction Industry Council Ordinance (Cap. 587) (CICO), contractors are required to pay a levy for construction works of total value at $1 million or above[6]. To ensure that the Fund supports bona fide contractors, this category includes contractors who have paid a levy to the CIC in the past 24 months at the time of application. At present, around 1 300 levy-paying contractors are eligible.

/**(b)** …..

[6] We are proposing to increase the levy threshold from $1 million to $3 million. Subject to the enactment of legislation, the new threshold will take effect in the second half of 2018.

(b) Registered Subcontractors

Hong Kong's construction system also comprises a large number of subcontractors who take up small-scale assignments under the levy threshold. These small and medium-sized enterprises (SMEs) should also benefit from the Fund to upgrade their operations. At present, subcontractors are not required to register with the CIC. To build up a pool of capable and responsible subcontactors, the CIC operates a Voluntary Subcontractor Registration Scheme (SRS)[7]. As of April 2018, about 5 900 subcontractors are registered under the SRS, constituting about a quarter of the total. For better quality management and safety performance, the CIC, with the Government's support, intends to introduce a mandatory subcontractor registration regime when the industry is ready. Requiring registration under the SRS as an eligibility criterion aims at encouraging subcontractors to join the scheme in order to benefit from the Fund.

(c) Consultants

Consultants play a key role in project design and management. They are sometimes instrumental in ushering in advanced construction technologies. For the purpose of the Fund, some 500 consultants[8] in the consultants lists maintained by the Government and the professional bodies will be covered.

(d) Other players in the construction process

The construction supply chain involves many players. Given the speedy and disruptive nature of innovation and technology development, the categories of target beneficiaries envisaged above cannot be exhaustive. In order not to rule out other local players who may come up with meritorious innovations that can transform the construction process, we propose that applications from non-prescribed players should also be considered on a case-by-case basis by a Steering Committee (paragraph 28 below).

/***Scope*** *…..*

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[7] The registration requirements include either one of the following: (a) completion of at least one job within the last five years, or having acquired comparable experience during the period by the company's directors, partners or proprietor; (b) on the list of relevant Government registration scheme; or (c) possession of recognised personal qualification by the company's directors, partners or proprietor.

[8] These include consultants on: (a) the directory maintained by the Engineering and Associated Consultants Selection Board; (b) the list maintained by Architectural and Associated Consultants Selection Board; (c) the Band 3 Architectural Consultants maintained by The Hong Kong Institute of Architects and The Association of Architectural Practices Ltd; and (d) a member company of the Association of Consultant Quantity Surveyors, The Hong Kong Institute of Surveyors, or the Association of Consulting Engineers of Hong Kong.

Scope

13. The Fund will be used to support the adoption of technologies (including machinery, equipment and software) with proven effectiveness in boosting productivity, uplifting build quality, improving site safety or enhancing environmental performance, through leveraging automation, industrialisation and digitisation rather than sheer innovative management practices. These criteria, detailed at Enclosure 1, will form the basis for assessing applications. While innovations still at research and development stages are excluded (paragraph 10 refers), the Fund will support local and overseas inchoate technologies at initial phases of commercialisation as well as mature ones to be adapted for local use.

Encl. 1

14. To simplify and expedite the application process, we will build up a list of pre-approved technologies meeting the criteria set out in paragraph 13 above. Applications for funding support to use them will be approved after ascertaining the bona fides of the applicant, details of the project, proportionality of the quantum applied for vis-à-vis the scale of project, etc. Examples of pre-approved technologies are set out at Enclosure 2.

Encl. 2

15. To help the industry overcome the impediments to the adoption of innovative technologies, i.e. upfront investment and lack of know-how, the Fund will provide financial support for –

(a) **experiential use** of innovative equipment, hardware or software (e.g. BIM system) to raise interest and awareness;

(b) **technology-specific training** to enable competent use of technology; and

(c) **adoption of technology** (e.g. procurement of plant and machineries, appointment of specialist sub-consultants specific for adoption of MiC by project consultants, etc.) in construction projects.

16. New items will be added to the pre-approved list once the technical capabilities of the new technologies are verified through review of documentation or outcome of trial use. Innovations and technologies outside the pre-approved list can also be subjects of funding applications in order to encourage trial use of other overseas technologies or self-initiated innovations. These applications will be subject to evaluation of their effectiveness in enhancing productivity, quality, safety and environmental performance.

/***Funding*** *…..*

Funding Arrangement

17. To ensure prudent use of the Fund, the following guiding principles will be adopted –

(a) Co-funding

The use of innovation and technology goes beyond the sheer acquisition of machinery and equipment. Very often, changes in established practices are required. Users' commitment is hence of paramount importance to achieve positive outcome. Funding support will be provided on a matching basis, with Government sharing the main bulk of the costs involved up to a specified ceiling. For some technologies (such as BIM) where manpower training is a pre-requisite for adoption, funding in full will be provided for such training subject to a prescribed ceiling as decided by the Steering Committee (paragraph 28 below).

(b) Prior approval

In the interest of proper funding control, applicants are required to obtain prior approval for the proposed innovation or technology before committing any expenditure on it. Expenses incurred before obtaining prior approval will not be reimbursed.

(c) Reimbursement

Successful applicants will be required to provide supporting documents as proof of purchase to facilitate disbursement.

18. These principles, broached during industry consultation (paragraph 30 below), are considered agreeable and effective in supporting and incentivising technology adoption, in particular among SMEs. In some cases, technology adoption is achieved through industrialisation processes, such as the use of prefabricated rebar produced by local steel prefabrication yards, MiC and DfMA, rather than software, machinery and equipment which will be funded by the above guiding principles. To encourage adoption of these industrialised processes, we will provide funding support through subsidy based on the levy payment under CICO or cash incentives calculated on a quantum basis subject to a prescribed ceiling.

/***Funding*** *…..*

Funding Control

19. To benefit more construction companies and support a wider array of innovative technologies, we propose to impose ceilings on the financial support for individual applications (one application for one technology) and the cumulative total of funding provided to each applicant. These ceilings will be decided by the Steering Committee (paragraph 28 below), and will be reviewed from time to time having regard to industry response and the costs of innovative technologies suitable for Hong Kong.

20. To ensure that the funded technologies are properly used to attain the intended improvements, spot checks will be conducted. Successful applicants will also be required to provide feedback on the effectiveness of the innovations and technologies procured with the Fund.

(B) Manpower Development

Target Beneficiaries

21. To enhance the capability of practitioners to harness technology for the continuous improvement in our construction industry, the Fund will support existing practitioners and prospective construction professionals to take part in courses and events on advanced construction technologies. Only Hong Kong permanent residents are eligible for funding support. Target beneficiaries are as follows –

(a) full-time undergraduates and post-graduates in construction-related disciplines of local higher education institutions;

(b) construction professionals holding membership of professional class or above of construction-related professional bodies[9];

(c) technicians and site supervisory personnel[10]; and

(d) Registered Skilled Workers under the Construction Workers Registration Ordinance (Cap. 583).

/***Scope*** *…..*

[9] Including The Hong Kong Institution of Engineers, The Hong Kong Institute of Architects, The Hong Kong Institute of Surveyors, The Hong Kong Institute of Construction Managers, and other overseas professional bodies having reciprocal recognition agreement with the above-mentioned local professional bodies.

[10] Practitioners below professional class of the construction-related professional bodies but above workers level in general will fall within the definition of technicians and site supervisory personnel.

Scope

22. The Fund will support industry-specific empowerment programmes focusing on construction innovation and technology. Such programmes would include training courses, visits and conferences organised locally or outside Hong Kong. Examples of the empowerment programmes are set out below –

(a) Collaborative Courses and Workshops

As suggested by industry practitioners and academia during industry engagement (paragraph 30 below), inviting local or overseas experts to share their insights and experience in construction technologies is a cost-effective means to upgrade the industry. We will invite local higher education institutions, professional institutions, trade associations and labour unions to organise technology training for industry practitioners including professionals, technicians, skilled workers and tertiary students. The Fund will cover the costs, in whole or in part, of organising the approved courses.

(b) Technology Enrichment Courses Outside Hong Kong for Students

The Fund will support eligible tertiary students to attend short courses (e.g. summer course or courses lasting a semester) on advanced construction technologies in institutions renowned for construction innovations, such as Massachusetts Institute of Technology, ETH Zurich, The Technical University of Munich, Tsinghua University, etc. The Fund will cover course fees, passage and subsistence expenses.

(c) Technology Training and Visits Outside Hong Kong for Practitioners

Certain advanced construction technologies are widely used elsewhere, e.g. use of robotics in Japan, MiC in the UK and Singapore. For technology exchange and knowledge sharing, the Fund will support training in the form of thematic visits or attachments in institutions outside Hong Kong and visits to projects applying innovative construction technology for professionals and technicians. Participants are expected to meet passage and accommodation expenses, while the Fund will support the training fees and other incidental expenses.

/**(d)** …..

(d) International Conferences for Enhancing Innovation Capability

To enhance the innovation capability of construction professionals, the Fund will support the organisation of large-scale international conferences on innovative and advanced construction technologies. Potential organisers of such international conferences include local higher education institutions or professional institutions. The Fund will cover part of the costs of organising the approved conferences.

Funding Arrangement and Control

23. Funding will be provided on a reimbursement basis subject to prior approval up to the specified ceiling for each of the empowerment programmes. These ceilings will be decided by the Steering Committee (paragraph 28 below), and will be reviewed from time to time having regard to industry response. To ensure prudent use of the Fund, proposed empowerment programmes will be assessed in terms of relevance to construction innovation and technology, training efficiency and cost-effectiveness. Successful applicants will be required to submit evaluation on the effectiveness of training.

FINANCIAL IMPLICATIONS

24. The Government's total commitment for the Fund is $1 billion. We will make a one-off injection to the CIC (the implementation partner of the Fund) upon Members' approval of the creation of the new commitment for establishing the Fund. The CIC will absorb the staffing and administration costs so that the entire Fund can be used for the direct benefit of the industry.

25. We propose to use the main bulk of the Fund for technology adoption, while the remainder of the Fund will be used for manpower development. Such allocation will be determined and reviewed regularly by the Steering Committee (paragraph 28 below) taking into account the latest development of the industry, its needs and responses.

IMPLEMENTATION PLAN

The CIC as Implementation Partner

26. The CIC, a statutory body established under CICO, is an effective platform for encouraging the use of innovative technologies to upgrade our construction industry. We will commission the CIC to administer the Fund,

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including processing applications, monitoring the progress of approved projects, fund disbursement, promotion, as well as carrying out spot checks on approved applications to ensure proper use. The roles and duties of the CIC as implementation agent for the Fund are detailed at Enclosure 3.

Encl. 3

27. The CIC will open a designated bank account and keep separate books for the Fund. The Development Bureau and the CIC will enter into a Memorandum of Co-operation setting out the governance, modus operandi, financial and monitoring arrangements (e.g. regular meetings, submission of annual plan and budget, audited financial statements, and use of investment returns[11]), etc. of the Fund. The CIC will set up a dedicated office to discharge the above duties.

Governance

28. A Steering Committee led by the Permanent Secretary for Development (Works), with members from industry stakeholders and major government departments, will be established to provide overall steer, decide on the key parameters of the Fund (such as allocation of the Fund for technology adoption and manpower development, eligibility criteria, funding scope, funding arrangement and control, etc.) and monitor the progress of implementation. The proposed Terms of Reference and composition of the Steering Committee is at Enclosure 4. The Steering Committee will meet regularly, say quarterly, to monitor usage of the Fund and, where necessary, make adjustments to the key operational arrangements to cater for the latest industry developments.

Encl. 4

Review

29. Within the initial five years, we will conduct a mid-term review after two years of operation to assess the effectiveness of the Fund and identify any need for improvement. For example, along with the uptake of technology in the industry, local suppliers for materials, plant and equipment may develop innovative products and solutions. Consideration may be given to expand the coverage of funding support up the supply chain if these products are conducive to the upgrading of the industry.

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[11] Any interest or dividends earned on investment will be credited to the Fund.

PUBLIC CONSULTATION

30. We have conducted a series of stakeholder engagement activities for some 200 industry players, including industry-wide consultation forums and focus sessions to canvass views on how the Fund should be used, technologies worthy of support, suggestions on application and verification process, manpower development arrangements, etc. They welcome this initiative and look forward to its early implementation. The proposals detailed above have taken into account their views.

31. The Fund aims at upgrading the industry as a whole. There is concern that the use of technology to replace manual work may lead to unemployment of skilled workers. In face of our aging workforce and the difficulty in worker recruitment, such replacement process is necessary for the sustainable development of the industry. Moreover, the transformation will take place gradually. The use of innovation and technology will make the operating environment safer and more amenable to construction workers, which will help modernise the workforce and attract new blood. The CIC will adjust and upgrade its training programmes to help construction workers become more versatile in the uptake of new construction methods.

32. We consulted the Legislative Council Panel on Development on 29 May 2018. Members were generally supportive of the proposal.

BACKGROUND

33. In his 2018-19 Budget, the Financial Secretary has set aside $1 billion for the establishment of the Fund to provide the impetus to transform the local construction industry through automation, industrialisation and digitisation.

Development Bureau
June 2018

Enclosure 1 to FCR(2018-19)39

Construction Innovation and Technology Fund

Assessment Criteria for Technology Adoption

Applications on technology adoption will be assessed on the basis of the following criteria, i.e. boosting productivity, uplifting build quality, improving site safety and enhancing environmental performance.

Criteria	Assessment Aspects	Examples
Boosting Productivity	• Promotes labour productivity • Achieves project time savings • Enhances buildability and minimises unworkable designs • Enhances cost-effectiveness	• Using technology that can save manual labour/enhance work efficiency, e.g. automated wall plastering machine which reduces wet trade finishes by workers • Adopting industrialised construction method to reduce manpower on-site, enhance buildability and shorten construction time, e.g. Modular Integration Construction (MiC)
Uplifting Build Quality	• Reduces unnecessary rework and defects • Improves design and construction quality by minimising on-site changes	• Applying machinery that can enhance construction quality, e.g. automated welding machine providing high quality and uniform weld • Using technology that allows visualisation of design and construction information on a shared digital platform to improve design and minimise site problems, e.g. Building Information Modelling (BIM) which minimises construction clashes
Improving Site Safety	• Enhances workplace safety and health for workers	• Using technology that can enhance workers' safety, e.g. automated traffic cone placement and retrieval vehicle to remove the risks to workers working beside live traffic lanes

Criteria	Assessment Aspects	Examples
	• Reduces safety risks to workers in construction operations through design management or provision of safety equipment	• Providing equipment to protect workers from injury and strain, e.g. robotic exoskeleton designed to assist and protect workers when lifting heavy objects • Reducing the need for working at height by adopting MiC
Enhancing Environmental Performance	• Reduces material wastage and/or pollutants during construction • Abates environmental nuisance to surroundings during construction	• Using technology that reduces material wastage, e.g. BIM which allows better construction sequence planning, or industrialised construction processes off-site

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Construction Innovation and Technology Fund

Examples of Pre-approved Technologies

(a) Building Information Modelling (BIM)

BIM digitalises the construction process. It can minimise clashes and abortive work and reduce the risks of project delivery failure through better co-ordination, hence achieving clearer programme and costs at all project stages. A case study in the UK has revealed that BIM could help achieve approximately 8% to 18% cost savings at the design stage, and about 8% to 10% cost savings during construction stage.

(b) Modular Integration Construction (MiC)

MiC transfers labour-intensive processes and site-bound wet works (such as concreting, screeding, plastering and most building services installations) to off-site manufacturing yards through standardisation, thus enhancing productivity, site safety, environmental performance and cost-effectiveness. The use of MiC will shorten construction time, in particular for interior finishes, fixtures and fittings on-site, and allow better quality control.

(c) Prefabricated Steel Rebar

The use of prefabricated steel rebar can reduce laborious bar-bending work in construction sites, improve productivity and reduce material wastage. Currently there are four major off-site prefabrication yards with a total production capacity of about 250 000 tons per year, which can potentially meet about 15% of Hong Kong's demand.

(d) Automation, Robotics and Innovative Equipment

With the advance in technology, many manual construction operations can be performed by machines and robots under the supervision of skilled and knowledgeable construction personnel, e.g. automated traffic cone placement and retrieval vehicles, robotic arms for lifting heavy construction materials, automatic welding machines for producing good quality uniform weld, automated wall plastering machines for performing plastering work, etc. The Construction Innovation and Technology Application Centre (paragraph 9 of the main paper refers) under the Construction Industry Council is sourcing and displaying technologies which are suitable for use in Hong Kong.

Enclosure 3 to FCR(2018-19)39

Construction Innovation and Technology Fund (the Fund)

Construction Industry Council's Duties

Duties	Description
Overall Management and Administration	• Conducting regular reviews of the funding scheme and advising the Steering Committee on any improvement measures to meet the needs of the industry • Conducting workshops/seminars to promote the Fund to the construction industry • Providing regular reports to the Steering Committee on the operation of the Fund, including the application and approval figures, issues identified in vetting process, etc.
Training Identification	• Liaising with local universities, professional institutions, trade associations and labour unions to explore the organisation of local or overseas courses
Vetting	• Vetting funding application proposals • Assessing cost estimates of applications • Conducting spot checks on successful applications
Financial Control	• Approving applications and disbursing funds • Providing accounting services and financial monitoring, and regularly reporting to the Steering Committee/Legislative Council • Conducting regular sample auditing of the approved cases to avoid abuse of the Fund and potential double-subsidy by other prevailing funding schemes

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Construction Innovation and Technology Fund

Proposed Terms of Reference and
Membership of the Steering Committee

- **Terms of reference –**

  (a) To steer the implementation of the Fund, including its scope, eligibility, and form of support;

  (b) To monitor the utilisation of the Fund;

  (c) To review the efficacy of the Fund in upgrading the industry in terms of innovation and technology; and

  (d) To consider any other related matters to facilitate the industry to adopt technology and enhance manpower development.

- **Membership –**

  Chairperson

  1. Permanent Secretary for Development (Works)

  Members

  Representatives from the following institutions/organisations –

  2. The Hong Kong Institution of Engineers
  3. The Hong Kong Institute of Architects
  4. The Hong Kong Institute of Surveyors
  5. The Hong Kong Construction Association, Limited
  6. The Hong Kong Federation of Electrical and Mechanical Contractors Limited
  7. Hong Kong Construction Sub-contractors Association Limited
  8. The Association of Consulting Engineers of Hong Kong
  9. The Real Estate Developers Association of Hong Kong
  10. A local university
  11. Construction Industry Council

/Official …..

Official Members from –

12. Buildings Department

13. Housing Department

Secretary

14. Representative from the Development Bureau

Ad-hoc members from relevant government bureaux/departments will be invited on a need basis.
