Lai, J.H.K., Yik, F.W.H., Chan, K.T., Lee, W.L. and Chau, C.K. (2011), Regulatory controls on building services works in Hong Kong, Construction Law Journal, Vol. 27, No. 6, pp. 459-479

A paper submitted to *Construction Law Journal*

Regulatory Controls on Building Services Works in Hong Kong

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Abstract

Building services embraces a variety of electrical and mechanical installations in buildings. In Hong Kong, regulatory controls over building services works are embedded in a wide range of statutes. Besides the relevant government departments, implementation of such controls involves a mix of authorised individuals and organizations. The diverse ways in which such controls are imposed are often found confusing by the practitioners and whether the controls are adequate and appropriate is hard to tell. Drawn from a research study on the building services profession of Hong Kong, this paper reports the findings of a review of the relevant laws and two surveys through which the views of building services practitioners and the authorities concerned were obtained. The need for changes to certain aspects of the controls, as perceived by the survey respondents, as well as the commonality and discrepancy between the opinions of the practitioners and authorities, are discussed to inform law-makers in future legal reforms. The regulatory framework described in the paper also provides a basis for inter-regime comparison.

Keywords: Building services; qualified professional; regulatory control; legal policy; Hong Kong

(July 2009)

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Introduction

The use of the term 'building services' to collectively denote the wide range of electrical and mechanical installations in buildings began in Hong Kong in 1966[1]. Building services engineering has emerged as a professional discipline and is one of the 16 disciplines embraced by the Engineers Registration Ordinance (Cap 409) enacted in 1990. Engineers registered under this Ordinance are entitled to use the title 'registered professional engineer (RPE)' and, for those in the building services discipline, also the abbreviated title RPE(BSS).

Driven by the ever-rising user demand and the constraints due to the dense built environment, the design, construction, operation and maintenance of building services in Hong Kong are becoming increasingly sophisticated. For ensuring safety and health of building occupants, building and related works in Hong Kong have been put under regulatory control since 1844[2]. Recently, concerns about global warming have led to enactment of new regulatory controls on the energy performance of buildings and building services[3].

In the UK, a directory of statutory requirements on building services is available[4] but one specific to Hong Kong is lacking. Although a similar directory in the local context has been made available[5], it focuses on the remits of construction professionals like architects, structural engineers and building contractors. An earlier review had identified the wide-ranging statutory controls that apply to building services maintenance works, which the

[1] Kwok, P.K. (2004), "The development of building services engineering in Hong Kong", In: CIBSE Hong Kong Branch 25th Anniversary, The Chartered Institution of Building Services Engineers, Hong Kong Branch.
[2] McInnis, A. (2002), Butterworths Hong Kong Building Law Handbook, HK: LexisNexis.
[3] EB (2007), "A Proposal on the Mandatory Implementation of the Building Energy Codes", Environment Bureau, Hong Kong.
[4] Pennycook, K. (2007), Building Services Legislation, UK: Building Services Research and Information Association.
[5] Chan, E.H.W., Mok, P.K.W. and Scott, D. (2001), Statutory requirements for construction professionals, HK: Pace Publishing Limited.

practitioners are often unclear or unaware of[6]. The range of controls over all life-cycle stages of building services works is even wider. Anecdotal evidence suggests that building services practitioners are dissatisfied with some aspects of the controls but a documented critical review is yet to be seen.

As part of an extensive research study on the building services profession of Hong Kong[7], a review of the laws in force that control the major trades of building services works has been conducted. A questionnaire survey for collecting the views of building services practitioners as well as face-to-face interviews with government departments having jurisdictions over the controls had also been carried out. Besides reporting the findings of these works, the areas of control in which professional building services engineers should assume a greater role and thus make a greater contribution to a better built environment are discussed in this paper.

Major Legislations Governing Building Services Works

The key ordinances that govern the major trades of building services works, including plumbing, drainage, ventilation, electrical, fire, lift and escalator, are summarized in Table 1. Also listed in the table are the subsidiary legislations that fill in details for the respective 'parent' ordinances[8]. A review of the major scope of control of these ordinances is given below, with specific reference to the persons and organizations designated with statutory duties under the legislations, the classifications of such parties, the works that they are authorised to perform and the minimum qualifications for their registration.

[6] Lai, J.H.K. and Yik, F.W.H. (2004), "Law and building services maintenance in Hong Kong", Transactions, The Hong Kong Institution of Engineers, Vol. 11, No. 1, pp. 7-14.
[7] Yik, F., Chan, K.T., Chau, C.K., Lee, W.L., and Lai, J. (2008), "Influential factors to the recognition enjoyed by building services engineers", Hong Kong Engineers, Vol.36, No.1, pp.16-18.
[8] Wesley-Smith, P. (1998), An introduction to the Hong Kong legal system, HK: Oxford University Press.

Table 1 Ordinances / regulations governing major trades of building services works

Trade(s)	Chapter no. and title	
Plumbing, Drainage, Ventilation	123	Buildings Ordinance
	123A	Building (Administration) Regulations
	123B	Building (Construction) Regulations
	123C	Building (Demolition Works) Regulations
	123F	Building (Planning) Regulations
	123G	Building (Private Streets and Access Roads) Regulations
	123H	Building (Refuse Storage and Material Recovery Chambers and Refuse Chutes) Regulations
	123I	Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations
	123J	Building (Ventilating Systems) Regulations
	123K	Building (Oil Storage Installations) Regulations
	123L	Building (Appeal) Regulation
	123M	Building (Energy Efficiency) Regulation
	123N	Building (Minor Works) Regulation
Electrical	406	Electricity Ordinance
	406A	Electricity Supply Regulations
	406B	Electricity Supply (Special Areas) Regulations
	406C	Electricity (Exemption) Regulations
	406D	Electricity (Registration) Regulations
	406E	Electricity (Wiring) Regulations
	406F	Plugs and Adaptors (Safety) Regulation
	406G	Electrical Products (Safety) Regulation
	406H	Electricity Supply Lines (Protection) Regulation
Fire	95	Fire Services Ordinance
	95A	Fire Service (Installation Contractors) Regulations
	95B	Fire Service (Installations and Equipment) Regulations
	95C	Fire Services Department (Reports and Certificates) Regulations
	95D	Fire Services Department (Welfare Fund) Regulations [Repealed]
	95E	Fire Services Department (Welfare Fund) Regulation
	95F	Fire Services (Fire Hazard Abatement) Regulation
Plumbing	102	Waterworks Ordinance
	102A	Waterworks Regulations
Lift / escalator	327	Lifts and Escalators (Safety) Ordinance
	327A	Lifts and Escalators (Safety) (Fees) Regulations

Buildings Ordinance

This Ordinance, together with its subsidiary legislations (Table 1), sets out the requirements on various aspects of the design, construction, maintenance and demolition of all kinds of 'building works' and 'street works' (for private street and access road). However, exemptions are provided for in the Ordinance (s.41) and in the Buildings Ordinance (Application to the New Territories) Ordinance (Cap 121).

Under the Buildings Ordinance (s.3), the Building Authority (BA) shall keep three registers of professionals, namely authorized persons, structural engineers and geotechnical engineers. The authorized persons' register contains a list of architects, a list of engineers and a list of surveyors. The other two registers are specifically for engineers in the respective disciplines.

The Ordinance (s.4) provides that every person for whom building works or street works are to be carried out shall appoint an authorized person (AP) as the coordinator of such works and, if so required by the Ordinance, a registered structural engineer (RSE) for the structural elements and a registered geotechnical engineers (RGE) for the geotechnical elements of such works.

The BA shall keep a register of general building contractors (RGBC) and a register of specialist contractors (RSC) for a range of specialist works (s.8A). At present, the categories of specialist works include: demolition; foundation; site formation; ventilation; and ground investigation. A person shall appoint a RGBC to carry out for him building works or street works, and a RSC to carry out for him specialist works of the category for which the contractor is registered (s.9).

The BA will not include an applicant in the register of RGBC unless he is satisfied with the adequacy of the applicant's management structure; the appropriate experience and qualification of his personnel; his ability to have access to plants and resources; and the ability of the person appointed by the applicant to act for the applicant for the purpose of the Ordinance to understand building works and street works through relevant experience and a general knowledge of the basic statutory requirements. The requirements for registration as a

RSC are the necessary experience and, where applicable, the professional and academic qualifications, to undertake work in the specialist category.

Among the regulations under the Buildings Ordinance, the Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations, the Building (Ventilating Systems) Regulations and the Building (Energy Efficiency) Regulation are particularly relevant to building services works.

Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations (Cap 123I)

This set of regulations comprises 91 regulations in 10 parts, with which plumbing and drainage works in buildings must comply. In particular, Regulation 10A of Part II stipulates that any building with sanitary fitments required to be provided by this set of regulations shall have adequate supply of water for flushing purpose. The supply of water shall be from the waterworks or, if the BA permits, from a well within the site of the building or other sources. A building owner seeking to obtain water supply not from the waterworks shall obtain approval from the BA. The yield of water from such well, however, has to be ascertained by a recognized method and certified by the AP.

Part VII is on testing of drainage work. Regulation 73 of this Part provides that the RGBC or RSC appointed in respect of any drainage works shall, on the completion of such works, but before any trenches in which drains or sewers have been laid are filled in, apply, in writing, to the BA for such works to be tested.

Building (Ventilation Systems) Regulations (Cap 123J)

This set of regulations governs the design, construction, inspection and certification of ventilating systems and sets out the responsibility of the owners of these systems. Instead of the BA, the Director of Fire Services is responsible for enforcing the regulations. Except where exemptions are applicable, every ventilating system that embodies the use of ducting which passes through any wall, floor or ceiling of the building in which the ventilating system is installed, from one compartment of such building to another, shall comply with this set of regulations.

The owner of any building in which there is installed a ventilating system to which these regulations apply shall keep such ventilating system in safe and efficient working order at all times, and cause every damper, filter and precipitator in such ventilating system to be inspected at intervals not exceeding 12 months. A building owner shall appoint a RSC in the category of ventilation works to carry out the inspection in accordance with the Practice Note for Registered Contractors (PNRC) 38[9].

An applicant for registration as an RSC for ventilation works must satisfy the BA on the aspects of adequacy of its management structure; appropriate experience and qualifications of its personnel; understanding of ventilation works through relevant experience and a general knowledge of the basic statutory requirements. The key personnel of the applicant include a person appointed to act as an Authorized Signatory, and a Technical Director to provide technical and financial support for the execution of ventilation works. Additionally, the applicant is required to demonstrate that he has employed appropriately qualified staff to execute, manage and supervise the ventilation works.

[9] BD (2004), "Practice Note for Registered Contractors", PNRC 38 Contractors Registration, Buildings Department, Hong Kong.

The requirements on the qualifications of the key personnel of a RSC for ventilation works, as stipulated in Appendix H of PNRC 38, include that the key personnel should have 3 to 5 years' local experience in ventilation works and an academic qualification of a diploma or equivalent in the field of building services, mechanical engineering or electrical engineering. Academic qualifications in other fields of studies will be assessed individually by the Contractors Registration Committee according to the relevance of the curriculum in relation to ventilation works.

Building (Energy Efficiency) Regulation (Cap 123M)

This regulation governs the design of building envelope for energy efficiency, which is meant to reduce building envelope heat gains and thus the electricity required for air-conditioning. It applies to hotels defined by the Hotel and Guesthouse Accommodation Ordinance (Cap 349) and commercial buildings, which include offices, shops, department stores, restaurants, places of public entertainment, places of public assembly and any other buildings used for commercial purposes.

A building to which this regulation applies shall be so designed and constructed as to achieve energy efficiency to the satisfaction of the BA. A building shall be regarded as in compliance with the regulation if its external walls and roofs have a suitable overall thermal transfer value (OTTV) to be determined in accordance with the Code of Practice for OTTV in buildings[10].

Role of Building Services Engineers under the Buildings Ordinance

[10] BA (1995), "Code of Practice for Overall Thermal Transfer Value in Buildings", Building Authority, Hong Kong.

Under the Buildings Ordinances, all the required submissions for seeking the BA's approval or consent have to be made by the AP employed to handle the building works. Despite the involvement of building services engineers, e.g. in the plumbing, drainage and ventilation works and in the preparation of the OTTV submission, they do not have an explicit statutory role to play, except those who act on behalf of a RSC for ventilation works.

Electricity Ordinance

The Electricity Ordinance (Cap 406) covers registration of electrical workers, contractors and generating facilities; safety requirements for electricity supply, electrical wiring and products; powers for electricity suppliers and the Government respecting electrical accidents and enforcement of this Ordinance; and measures designed to ensure that activities carried out in the vicinity of electricity supply lines do not prejudice safety or the continuity of the electricity supply. The authority in enforcement of this Ordinance is with the Director of Electrical and Mechanical Services.

Under the Ordinance (s.35), no person shall employ a party other than a registered electrical contractor (REC) or a registered electrical worker (REW) to carry out electrical works. Requirements on registration of contractors are specified in Regulation 3 of the Electricity (Registration) Regulations (Cap 406D), which states that to be qualified as a REC the applicant for registration must either employ at least one REW or, if the applicant is an individual, he must be a REW; or if the applicant is a partnership, one of the partners must be a REW. Regulations 4 to 8 define the requirements for registration of five different categories

of REW, which are summarized in Table 2. Note that corporate membership with a professional institution is not a requirement for REW registration at any grade.

Table 2 Grades, authorized works and minimum qualifications of REW

Grade	Electrical work	Qualification
A	Low voltage fixed installation not exceeding 400 A	Registered contract of apprenticeship under the Apprenticeship Ordinance (Cap 47); Certificate; prescribed period of experience
B	Low voltage fixed installation not exceeding 2500 A	Registered contract of apprenticeship under Cap 47; Higher Certificate or Diploma; prescribed period of experience
C	Low voltage fixed installation of any capacity	Degree; relevant training; prescribed period of experience
H	High voltage installation	Relevant training and experience
R	Electrical work on: neon sign installation, air-conditioning installation, and generating facility installation	Special training; prescribed period of experience

Fire Services Ordinance

In addition to the control of sale, supply, installation, repair, maintenance and inspection of fire service installations or equipment, the Fire Services Ordinance (Cap 95) regulates the registration of fire service installation contractors. The Fire Services Department is the enforcing authority of this Ordinance.

Under Regulations 6 and 7 of the Fire Service (Installations and Equipment) Regulations (Cap 95B), no fire service installation or equipment shall be installed in any premises by any person other than a registered contractor and no person other than a registered contractor shall maintain, inspect or repair any fire service installation or equipment which is installed in any premises. Regulation 4 of the Fire Service (Installation Contractors) Regulations (Cap 95A) defines the 3 classes of registered fire services contractors (RFSC) and their minimum qualifications for registration (Table 3).

Table 3 Classes, authorized works and minimum qualifications of RFSC

Class	Fire services work	Qualification
1	Install, maintain, repair and inspect any fire service installation or equipment (other than portable equipment) which contains an electrical circuit or other apparatus for the detection and warning, by alarm or otherwise, of smoke or fire.	Applicant holding a degree in electrical engineering; and being a manufacturer or designer of an electrical circuit or other apparatus; or being an authorized agent for a manufacturer of the type of apparatus specified
2	Install, maintain, repair and inspect any fire service installation or equipment (other than portable equipment) which contains pipes and fittings designed or adapted to carry water or some other fire extinguishing medium; or any type of electrical apparatus other than those specified in Class 1.	Applicant holding a Grade I plumber's licence issued under Cap 102 and a recognized diploma
3	Maintain, repair and inspect portable equipment.	Applicant shall satisfy at a written examination and at an interview that his knowledge of the function and maintenance of portable equipment and the regulations relating thereto is adequate.

Waterworks Ordinance (Cap 102)

Regulatory control over waterworks is governed by the Waterworks Ordinance (Cap 102). The Water Authority (i.e. the Director of Water Supplies) shall generally have the custody and control of the waterworks and of all water therein. The Ordinance (s.15) requires that all fire services or inside services shall be constructed, installed, maintained, altered, repaired or removed by licensed plumbers or public officers authorized by the Water Authority (except where relevant exclusions or exemptions are applicable).

More detailed statutory requirements on the engagement of a licensed plumber for carrying out waterworks are covered by the Waterworks Regulations (Cap 102A). According to Regulation 32A, a plumber's licence may be issued by an officer designated by the Water Authority which is referred to as "the licensing authority".

Table 4 Grades, authorized works and minimum qualifications of licensed plumbers

Grade	Plumbing work	Qualification
I	For the construction, installation, maintenance, alteration, repair or removal of a fire service or inside service of any type.	Two parts of qualifications are needed: • Part I: A Craft Certificate or an equivalent qualification. • Part II: A Certificate or an equivalent qualification.
II (Note 1)	For the maintenance and repair of a fire service or inside service; and for the installation, maintenance, repair or removal of water appliances.	Not stated. (Note 1)

Note 1: No new Grade II plumbers' license after 1 October 1993 will be issued[11].

The application requirements for a plumber's license are provided in Regulation 33 and applicants with "equivalent" qualifications will also be considered. Whilst it is merely stated that the meaning of "equivalent" means equivalent in the opinion of the Water Authority, some examples of equivalent qualification are given in the WSD's website[12]. According to Regulation 35, there are two grades of plumber's licenses. Each grade is authorized to carry out the type of work indicated in the license (Table 4).

Lifts and Escalators (Safety) Ordinance (Cap 327)

With its Director being the authority of the Lifts and Escalators (Safety) Ordinance (Cap 327), the Electrical and Mechanical Services Department (EMSD) is responsible for administrating and enforcing the provisions of the Ordinance, which provides that design, construction, maintenance, examination and testing of lifts and escalators must be undertaken by, as the case requires, registered lift engineers (RLE), registered escalator engineers (REE), registered lift contractors (RLC), or registered escalator contractors (REC).

The Ordinance (s.5) requires that an applicant for registration as RLE or REE has to attain a minimum qualification, which includes having: possessed a relevant higher diploma or higher

[11] WSD (2006), Handbook on Plumbing Installation for Buildings, Water Supplies Department, Hong Kong.
[12] WSD (2009), Website of Water Supplies Department, Hong Kong. (http://www.wsd.gov.hk/en/html/plumb/lplumber/)

certificate; completed a relevant apprenticeship; and obtained the prescribed period of relevant experience. The employment of RLE and REE (s.11C) is an essential condition for a company to be included in the registers of RLC and REC respectively.

Registration and Legal Protection of RPE

The above review makes clear that regulatory controls over building services works have been vested with a range of contractors, engineers or workers, whose registration as authorized parties is regulated by different statutes and the minimum qualifications thereof are low. In contrast, the Engineers Registration Ordinance (Cap 409) requires that a person may be registered as a registered professional engineer (RPE) if, in addition to some other conditions, he/she is a member of the Hong Kong Institution of Engineers (HKIE) in a discipline or has equivalent qualification and experience as the Engineers Registration Board may accept. Note that the normal route to becoming a member of HKIE requires that an applicant must possess a recognized degree plus post graduation training and experience at a responsible position.

As at 30 June 2009[13], there are 637 registered professional engineers in the building services engineering discipline (RPE(BSS)). Unlike the Architects Registration Ordinance (Cap 408) which protects both the title 'registered architect' as well as the title 'architect', Cap 409 protects only the title 'registered professional engineer' but not the more generic titles like 'professional engineer' or 'engineer'.

Views of the Practitioners

[13] ERB (2009), Website of Engineers Registration Board, Hong Kong. (http://www.erb.org.hk/)

In the research, a questionnaire survey was conducted to collect demographic information about building services practitioners in Hong Kong and their views on professional practices of building services engineers and regulatory controls over building services works. The way in which the survey was administered has already been described in a paper that reported the credentials, experience and scope of competence of building services practitioners in Hong Kong and the factors that affect their income[14]. Their views on regulatory controls over building services works in Hong Kong are summarized and discussed below.

A total of 196 building services practitioners responded to the survey. Ten of them did not have a degree, 100 had only one degree, 74 had two degrees and 12 had three or more degrees. As to professional qualification, which means membership with a recognized professional institution, 56 respondents did not have any professional qualification; the other 140 possessed from 1 to 4 or more professional qualifications. Among the 182 respondents who provided information for determining their years of work experience, the range is from 0 to 39 years and the mean value is 18.4 years, showing that the respondents, collectively, are highly experienced. The experience of respondents in the consulting field is relatively shorter (mean value 15.4 years) whilst those of the respondents in the other fields are similar: contracting (20.6); FM/O&M (21.4); project clients (19.3); government (21.2); others (20.4).

To enable a systematic analysis of the qualitative opinions of the respondents, a content analysis[15] was used to identify the key words and descriptions contained in the answers of the returned questionnaires. The steps taken for such purpose include entering the answers into an Excel spreadsheet which was embedded with tailor made functions and subroutines

[14] Yik, F.W.H., Chan, K.T., Chau, C.K., Lee, W.L., Lai, J.H.K. (2009), "A portrait of building services engineers in Hong Kong", Building Services Engineering Research and Technology (submitted for publication).
[15] Zikmund, W.G. (2003), Business Research Methods, US: Thomson Learning.

written in Visual Basic Applications (VBA) to facilitate data entry, sorting, retrieval, calculation, and statistical analysis of the responses.

Statutory role of BS engineers

A question requested the respondents to identify up to 3 regulatory controls over building services works which should be certified by professional building services engineers but this duty is currently assigned to professionals in other disciplines. The frequency and distribution of the answers to this question, categorized under different headings and subheadings, are summarized in Table 5. For instance, answers including fire protection, smoke extraction system, smoke control, etc. are grouped under the Fire Services (FS) subheading. An answer to this question that simply states the name of a trade of building services work was interpreted as a perceived inappropriate allocation of statutory duty pertaining to the relevant regulatory control over the stated trade of building services work. Answers not directly related to a specific trade of building services works, e.g. OTTV control, were all categorized under the BS Engineers' Role (BER) subheading.

Table 5 Opinions on aspects of controls that should fall within the ambit of professional building services engineers

Heading / subheading	No.	%*	Heading / subheading	No.	%*
Aspects of control:			*Control process and players:*		
Fire Services (FS)	44	24.04	BS Engineers' Role (BER)	46	25.14
Plumbing and Drainage (PD)	37	20.22	BS Engineers' Qualification (BEQ)	3	1.64
Air Conditioning (AC)	14	7.65	BS Engineers' Practices (BEP)	3	1.64
Miscellaneous Systems (MS)	12	6.56			
Electrical (EL)	8	4.37	*Others:*		
Lift and Escalator (LE)	7	3.83	Not Understandable (NU)	7	3.83
Testing and Commissioning (T&C)	1	0.55	Professional Body (PBD)	1	0.55

* Based on the total number of 183 answers

The respondents showed great concern on the limited role that professional building services engineers can play in controlling works in the Fire Services (24.04%) and Plumbing and Drainage (20.22%) aspects. As the answers reflect, they were discontented with the lack of a statutory role for professional building services engineers to play in the submission of design, supervision of installation and certification of proper functioning order of these installations.

The other issues raised by large numbers of respondents include the way in which OTTV submission shall be made under the current Buildings Ordinance and the emphasis on registered specialist contractors / workers rather than professional building services engineers in the regulatory controls over mechanical ventilation and electrical works. Some answers addressed the problems with the current system of Registered Professional Engineers (RPE), which will be further discussed in the following sections.

Little use of RPE(BSS)

Another question asked the respondents to state up to 3 reasons for the little use of registered professional engineers in the building services discipline (RPE(BSS)) in regulatory controls over building services works. A total of 125 respondents (64%) provided at least one reason for this and the total number of reasons given is 236.

In the analysis, the reasons were categorized under external causes and internal causes and under each further under a number of subheadings, as shown in Table 6. As an example, the category of "Government's Attitude" covers answers such as government's passive attitude, neglect or ignorance of government officers, lacking government support, etc.

Table 6 Reasons for little use of RPE(BSS)

Heading / subheading	No.	%*	Heading / subheading	No.	%*
External causes:			*Internal causes:*		
Government's Attitude (GAT)	32	13.56	Expertise (EPT)	41	17.37
Existing Arrangements (EXA)	29	12.29	Communication (COM)	15	6.36
Awareness (AWN)	25	10.59	Motivation (MOV)	6	2.54
Few or No Relevant Controls (FNC)	17	7.20	BS Engineers' Attitude (BAT)	6	2.54
Parties with Vested Interest (PVI)	13	5.51	The RPE Registration System (SYS)	6	2.54
Importance (IMP)	10	4.24	Enforcement (ENF)	6	2.54
Image (IMG)	10	4.24	Not in Support (NEG)	6	2.54
Building Services Practices (BEP)	6	2.54			
Culture (CUL)	5	2.12	*Others:*		
			Not Understandable (NU)	3	1.27

* Based on the total number of 236 reasons

Among the external causes suggested, the government's attitude (GAT) was alleged by the greatest amount of respondents (13.56%) to be the reason for the little use of the RPE(BSS) title. Indeed, the government is the key player in enacting regulatory controls and in devising the means of control, including to whom would be given a statutory role in implementation of the controls, which may include an authority within the government and external parties delegated with the associated right, power and responsibility. If the government and the general public do not see a need for wider use of RPE(BSS) (answers grouped under AWN), it will remain under utilized, as was perceived by the respondents to be the current situation (answers grouped under FNC).

Obviously, enactment of regulatory controls is driven by needs as recognized by the government and the general public but the consequences of improper execution of building services works are perceived by many as not important enough to justify more stringent controls (answers grouped under IMP). This view point may be right for some aspects of building services works but would not be generally true. For example, improper construction and/or O&M works for electrical, fire services, and lift and escalator installations can potentially lead to serious consequences, including loss of human life. The imminent need to

reduce energy use in buildings has become widely known and regulatory controls are increasingly used worldwide to help mitigate the problems[16].

The responses of the practitioners (grouped under EXA, PVI, GAT & BEP) suggest that they were dissatisfied more with the regulatory control framework, especially on the assignment of statutory roles to assist implementation, than with imposing regulatory controls over building services works. In fact, only a few statutes prescribe that the corresponding statutory works must be performed by RPE(BSS). Commonly, whenever RPE(BSS) is specified, other equivalent disciplines of RPE would also be specified. For instance, RPE(BSS) has a role to play under Cap 311A of the Air Pollution Control Ordinance (Cap 311) where statutory submission of drawings of furnaces, chimneys, etc. is required. This role, however, is not confined to RPE(BSS). RPE of other disciplines like gas, chemical, is also entitled to make this kind of submission.

Besides the external causes, the respondents did look inward into the shortcomings of the building services profession. Among the internal causes pointed out by the respondents, the problems with the variable competence of building services practitioners had been raised by the greatest number of respondents (41 answers under the EPT subheading) as a hurdle to wider use of RPE(BSS) in implementation of regulatory controls over building services works. The diversity in competence among professional building services engineers refers to the different combinations of trades of building services that the engineers are competent in handling, which is a consequence of the historical development of the building services

[16] Lee, W.L. and Yik, F.W.H. (2004), "Regulatory and voluntary approaches for enhancing building energy efficiency", Progress in Energy and Combustion Science, Vol. 30, pp. 477-499.

profession, the multi-disciplinary nature of the profession and the ways in which works are organized in building services firms and companies[17, 18].

The variable competence of building services practitioners is indeed the greatest hurdle and removal of other hurdles, such as communication problems (under the subheading COM) would be in vain if the competence represented by the RPE(BSS) title remains variable and confusing. Under this situation, lawmakers would be forced to create new statutory titles and stipulate specific requirements for conferment of such titles when new controls have to be enacted to address emerging needs. The proposed establishment of Registered Fire Engineers as third parties for certifying fire services installations is an example[19].

Number of categories of RPE(BSS)

The third question was for soliciting respondents' opinions about whether the RPE(BSS) registration system should be changed to address the diversity in core competence of professional building services engineers. They were asked to indicate whether they would prefer one single category of RPE(BSS), as it currently is, or refined sub-categories to be created to more accurately reflect the competence of professional building services engineers specialized in particular trades of works.

Out of the 180 responses to this question, 52% were in favour of separate categories whilst 43% preferred the current arrangement of one single category. Other suggestions include: abandon the system completely; establish a new statutory title "Authorized Person (Building

[17] Yik, F., Chan, K.T., Chau, C.K., Lee, W.L., and Lai, J. (2008), "Influential factors to the recognition enjoyed by building services engineers", Hong Kong Engineers, Vol.36, No.1, pp.16-18.
[18] Yik, F.W.H., Chan, K.T., Chau, C.K., Lee, W.L., Lai, J.H.K. (2009), "A portrait of building services engineers in Hong Kong", Building Services Engineering Research and Technology (submitted for publication).
[19] FSD (2007), "Consultation paper on the implementation of third party fire safety certification by introducing a registered fire engineers scheme in Hong Kong", Fire Services Department, Hong Kong.

Services)"; and simply use RPE in the mechanical (RPE(MCL)) and electrical (RPE(ELL)) disciplines.

Among the respondents in different job fields, the majority of those in the contracting and project client fields preferred to have separate sub-categories whilst over half of those in the FM/O&M and government fields preferred to have one single category (Table 7). However, the difference between the overall votes (93:76) for the two options is insubstantial, implying that this issue remains controversial and no consensus on a specific option can be seen.

Table 7 Respondents in favour of a single category or separate categories of RPE(BSS)

		Consulting	Contracting	FM/O&M	Client	Govn't	Others	Overall
No. of samples		80	30	20	20	32	11	193
One category	(No.)	28	7	11	6	18	6	76
	(%)	35.0	23.3	55.0	30.0	56.3	54.5	39.4
Separate categories	(No.)	37	19	8	12	13	4	93
	(%)	46.3	63.3	40.0	60.0	40.6	36.4	48.2

New controls and changes to existing controls needed

The respondents were further asked to indicate what aspects of building services works should be put under regulatory controls but such controls are at present lacking and for those currently under control, any changes to such controls are needed. Each respondent was requested to provide up to 4 answers.

Answers to this question were given by 140 respondents (71%) who jointly provided a total of 347 answers, which embrace a wide variety of issues and vary in details; some simply include the name of a trade of building services work or an aspect of performance of a building services system whilst some others point to the process of control and the way in

which statutory duties are assigned to professionals in different disciplines. The frequency and distribution of the answers, categorized in a way similar to that for Table 5, are summarized in Table 8. For instance, answers such as energy efficiency, energy saving, energy use in buildings are grouped under Energy Conservation (EC).

62 answers are about the need for regulatory control on energy performance of buildings (EC), of which a series of codes of practice and guidelines[20, 21, 22, 23, 24, 25, 26] had been issued to promote voluntary participation. Together with those that called for various means for its control (EM) and those that called for controls pinpointing at global warming (GW), these answers account jointly for about 25% of the total number of answers, which reflect the weight that the respondents placed on this issue. Indoor air quality (IAQ), indoor environmental quality (IEQ) and sustainable development (SD) are also issues where considerable numbers of respondents thought regulatory control should be in place. The answers under the subheading Design Issues (DGN) further support this observation.

Among the range of building services installations, the greatest attention was given to fire services (6.34%), followed by air-conditioning and mechanical ventilation (4.90%), plumbing and drainage (4.03%) and electrical (3.17%) installations. Judging from the answers categorized under the subheadings BS Engineers' Role (5.76%), Clarification of Controls (4.03%) and Modification to Controls (2.02%), their concerns would have included, on top of

[20] EMSD (2007a), "Code of Practice of Energy Efficiency of Lighting Installations", Electrical and Mechanical Services Department, Hong Kong.
[21] EMSD (2007b), "Code of Practice of Energy Efficiency of Air Conditioning Installations", Electrical and Mechanical Services Department, Hong Kong.
[22] EMSD (2007c), "Code of Practice of Energy Efficiency of Electrical Installations", Electrical and Mechanical Services Department, Hong Kong.
[23] EMSD (2007d), "Code of Practice of Energy Efficiency of Lift & Escalator Installations", Electrical and Mechanical Services Department, Hong Kong.
[24] EMSD (2007e), "Performance-based Building Energy Code", Electrical and Mechanical Services Department, Hong Kong.
[25] EMSD (2007f), "Guidelines on Energy Audit", Electrical and Mechanical Services Department, Hong Kong.
[26] EMSD (2007g), "Hong Kong Energy Efficiency Registration Scheme for Buildings", Electrical and Mechanical Services Department, Hong Kong.

the scope of controls over the design and installation works, issues of to whom should be given the statutory role for inspection and certification of these installations as well as confusions in the existing controls.

Table 8 Opinions on new controls or changes to existing controls

Heading / subheading	No.	%*	Heading / subheading	No.	%*
Aspects of control:			*Control process and players:*		
Energy Conservation (EC)	62	17.87	BS Engineers' Role (BER)	20	5.76
Indoor Air Quality (IAQ)	32	9.22	BS Engineers' Practices (BEP)	4	1.15
Energy Management (EM)	23	6.63			
Sustainable Development (SD)	22	6.34	*Competence of BSE as statutory actors:*		
Fire Services (FS)	22	6.34	BS Engineers' Qualifications (BEQ)	6	1.73
Air Conditioning (AC)	17	4.90	Training (TRN)	6	1.73
Plumbing and Drainage (PD)	14	4.03			
Safety and Occupational Health (SH)	11	3.17	*Others:*		
Electrical (EL)	11	3.17	Design Issues (DGN)	15	4.32
Indoor Environmental Quality (IEQ)	9	2.59	Clarification of Controls (CLC)	14	4.03
Local Environment (LEV)	7	2.02	Modification to Controls (MCT)	7	2.02
Extra Low Voltage Systems (LV)	7	2.02	Not in Support (NEG)	5	1.44
Operation and Maintenance (O&M)	7	2.02	Not Understandable (NU)	3	0.86
Health and Hygiene (HH)	3	0.86	Lessening Controls (LCT)	2	0.58
Lifts and Escalators (LE)	3	0.86	Ethics and Liability (E&L)	2	0.58
Building Automation (BA)	3	0.86			
Miscellaneous Systems (MS)	3	0.86			
Design for T&C and O&M (DTO)	3	0.86			
Global Warming (GW)	2	0.58			
Testing and Commissioning (T&C)	2	0.58			

* Based on the total number of 347 answers

Opinions of the Authorities

In parallel to the above survey, a series of face-to-face interviews was conducted with 6 government departments having jurisdiction on building and building services works. The departments include the Buildings Department (BD), the Electrical & Mechanical Services Department (EMSD), the Environmental Protection Department (EPD), the Fire Services Department (FSD), the Planning Department (PnD) and the Water Supplies Department (WSD). The questionnaire used for these interviews was semi-structured. Each question typically asked the interviewees to choose any number of the given options as their answers

or supply other answers as appropriate, followed by eliciting their detailed opinions in an open-ended manner. The opinions were sought on two main areas: (i) the general principles that underpin the formulation of new and revision of existing regulatory controls, including the framework of control; and (ii) regulatory controls that apply to building services works and the role of building services engineers in such controls.

Invitations for the interviews were sent to the respective department heads. Upon receiving their consents, the questionnaire was sent to pre-inform them the questions. Although the interviewees were not expected to complete the questionnaire before the interview, most of them did, which greatly facilitated smooth conduction of the interviews. Eventually, either the heads or their delegates took part in the interviews. Each interview, handled by two of the Study Team members, took about 1.5 hours.

Circumstances under which regulatory control should be introduced

The first question asked in the interviews was: "Under what circumstances would your Department consider there is a need to introduce regulatory controls?" The interviewees pointed out that the government always prefers voluntary actions by the public to imposing regulatory controls; legislation is a step to take only when voluntary action is proved unsatisfactory, as in the case of mandatory implementation of the Building Energy Codes[27], or when there are overriding reasons such as those options suggested in the questionnaire (Table 9). Among such reasons, safeguarding the interest of the public comes first. Therefore, in considering imposing any new or revising any existing regulatory control, whether the public sees the need for such action has to be ascertained.

[27] EB (2007), "A Proposal on the Mandatory Implementation of the Building Energy Codes", Environment Bureau, Hong Kong.

Table 9 Opinions on conditions for introducing regulatory controls

Option		Vote
A:	When incident(s) with severe consequences, such as loss of human life or large economic losses, have occurred which could have been avoided had certain precaution measures had been taken.	3
B:	When high risk is perceived but can be averted by ensuring certain precaution measures are taken.	3
C:	When it becomes clear that imposing such controls is in the interest of the public.	4
D:	When necessitated by the implementation of certain government policy.	2

Factors determining whether or not to designate qualified persons outside the government

Under some ordinances, the duty of verifying compliance of regulated works with the regulatory requirements is delegated to qualified persons outside the government. Table 10 shows those regarded by the interviewees as valid factors that would determine whether this means should be adopted in regulatory controls. On this issue, varied opinions were received. Three of the four factors listed in the questionnaire, including workload on the responsible department, availability of qualified persons and duration of the approval process, were regarded as valid factors by no more than one-third of the interviewees. None of them considered the social (public plus private) cost for enforcement to be a determining factor. Yet, some considered that 'third-party certification' is in line with the government's intention to achieve 'small government, big market'. Nonetheless, the interest of the public, in terms of efficiency and flexibility of control[28], and the availability of expertise and capacity in the market, were important considerations.

[28] Marriott, A. (1998), "Does Hong Kong Need a New Construction Law?", Construction Law Journal, Vol. 14, No. 2, pp. 94-100.

Table 10 Opinions on factors determining designation of qualified persons

Factor	Vote
A: The workload on the Department with and without designating qualified persons to assume such duties	2
B: The availability of suitably qualified persons in the government and in the industry	2
C: The duration within which approval needs to be given	1
D: The costs (public plus private) for enforcement	0

None of the four factors was regarded as a determining factor in respect of enforcement of the Buildings Ordinance, which provides for registration systems for Authorized Persons (AP) and Registered Structural Engineers (RSE). It was opined that the government, adhering to the 'small government' principle, inclines to allowing, as far as possible, professionals in the private sector to check and ensure works done by themselves or by others under their supervision are in compliance with the relevant regulatory requirements. The current AP/RSE systems, which were established a long time ago, have been serving well their purposes.

The responsibilities and duties of FSD in respect of building fire safety were considered extensive and onerous when compared to those of its overseas counterparts. Though being the regulator on fire safety, FSD should minimize its involvement on day-to-day certification. Rather, it should focus on ensuring compliance on a wider perspective, providing guidance to, and setting standards for the industry. As a long term objective, the responsibility of fire safety certification would be shifted to the industry through third party certification.

Integrated or separate categories of RPE(BSS)

In spite of the multi-disciplinary nature of building services works, consensus is lacking with respect to the need for refined categorization of RPE(BSS) for facilitating regulation of building services works (Table 7). Among the representatives of the six authorities, one had

no comment and another one preferred a certification system that would require RPE to meet specific qualifications and experience specified in individual ordinances. The other four representatives were split in the ratio of 2:2 in their opinions on whether there should be one integrated category or separated categories of RPE(BSS) registration, e.g. RPE(BSS: Energy), RPE(BSS: Fire Safety), etc.

A view point, which had the support of some of the practitioners, was that qualifying assessment (interview, exam, etc.) is crucial to ensuring only the right persons would be permitted to undertake specific statutory work. RPE(BSS), though being a professional engineer, should register under individual ordinances if he/she would want to be qualified to undertake statutory works prescribed by the respective ordinances. For improving the registration system of RPE(BSS), it was suggested that the statutory definition of 'building services works' should be set first, and the assessment for registration should be through an independent body. These opinions of the authorities also reflect the government's attitude (Table 6), which was perceived by the practitioners as a major cause for the little use of RPE(BSS).

Establishment of Registered Building Services Engineers

During the analysis of the findings summarized in Table 5, it was noted that some practitioners voiced out the need to establish under the Buildings Ordinance a registration system for Registered Building Services Engineers, similar to Registered Structural Engineers or Registered Geotechnical Engineers. Some also considered that professional building services engineers should be allowed to act as Authorized Persons (AP) under the Buildings Ordinance. This view, however, was not supported by the interviewees. They

opined that the work of building services engineers has little to do with structural safety, which is the main concern of the Buildings Ordinance. The ways in which fire safety and health are regulated were considered adequate, as an AP with the assistance of a building services engineer would be able to handle the issues well. Besides the Buildings Ordinance, there are other ordinances that regulate building services works, e.g. Electricity Ordinance, Fire Services Ordinance, and so on.

The above reasons explain why professional building services engineers have no role to play in the Mandatory Building Inspection Scheme[29], which targets private buildings aged 30 years or above and the building elements to be inspected in a 7-year cycle include external elements, structural elements, drainage, fire safety (but excluding those fire service installations currently regulated by the Fire Services Department), and unauthorized building works.

Existing controls – changes needed

The authorities' representatives did not find any existing regulatory controls over building services works that should be abolished or relaxed. Nevertheless, they opined that the following aspects should be tightened:

i) *Expertise required of persons undertaking fire engineering analysis*. This kind of analysis is accepted as an alternative route for demonstrating compliance with fire services requirements specified in statutes but, currently, there are no specific requirements on the expertise of persons who carry out such analysis. This opinion

[29] HPLB (2005), "Building Management and Maintenance – Public Consultation on Mandatory Building Inspection", Housing, Planning and Lands Bureau, Hong Kong.

concurs with a large number of survey respondents who indicated their concerns over the limited role that building services engineers are authorized to play in controlling statutory fire services works (Table 5).

ii) *Submission of drawings of water supply systems in buildings.* Whilst only licensed plumbers can carry out waterworks (Table 4), there is, as yet, no specific requirement on the eligibility of the person / company who submits plumbing drawings before work commencement. Furthermore, imposing stricter requirements on the minimum qualification for licensed plumbers was considered desirable. These suggestions, as Table 5 shows, are supported by a significant number of survey respondents.

iii) *Qualification required of the technical director, authorized signatory or the other officer of a company for registration as a RSC(Ventilation).* As reviewed earlier, the current requirement on such qualification is just a diploma or a higher certificate or additional years of work experience in lieu. The criticality of ventilation systems should justify higher qualification required of such key personnel.

iv) *Facade signage lighting and performance of air-conditioning systems.* It was suggested that specific controls on these two aspects should be introduced but, as constrained by the limited period of the interviews, no further elaboration was made by the interviewees.

The following aspects of building services works, which are currently not under regulatory control but were considered by the authorities' representatives that they should be, include:

i) *Energy efficiency of building services installations.* This is well supported by the overwhelming response from the practitioners (Table 8). In fact, arrangement for introducing new regulatory control on this aspect is underway[30].

ii) *Carbon auditing and mitigation measures for climate change.* Rather than a mandatory requirement, a document of guidelines to account for and report on greenhouse gas (GHG) emissions was only recently published[31] to encourage building users / managers to measure and improve their GHG performance.

iii) *Green building design*. This suggestion is in line with the opinions given by those practitioners who expressed their concerns over controls in the sustainable development aspect (Table 8). In fact, efforts made by the government in promoting green building design can be traced back to the launch of a series of Joint Practice Notes since 2003[32, 33, 34]. Nevertheless, this design approach remains as voluntary instead of mandatory.

iv) *Certification of design for mechanical ventilation system*. Except the requirement that only RSC(Ventilation) is authorized to carry out ventilation works as specified under Cap 123J and the advice in PNAP301 that RPE(BSS) should be engaged to design large-scaled or complex ventilation systems[35], there has been no statutory requirement

[30] EB (2007), "A Proposal on the Mandatory Implementation of the Building Energy Codes", Environment Bureau, Hong Kong.
[31] EPD-EMSD (2008), "Guidelines to account for and report on greenhouse gas emissions and removals for buildings (commercial, residential or institutional purposes) in Hong Kong", Environmental Protection Department and Electrical and Mechanical Services Department, Hong Kong.
[32] BD *et al.* (2003), "Re-engineering of Approval Process for Land and Building Developments", Joint Practice Note No. 3, Buildings Department, Lands Department and Planning Department, Hong Kong.
[33] BD *et al.* (2004), "Green and Innovative Buildings", Joint Practice Note No. 1, Buildings Department, Lands Department and Planning Department, Hong Kong.
[34] BD *et al.* (2006), "Second Package of Incentives to Promote Green and Innovative Buildings", Joint Practice Note No. 2, Buildings Department, Lands Department and Planning Department, Hong Kong.
[35] BD (2007), "Practice Note for Authorized Persons and Registered Structure Engineers", PNAP 301, Provision of Mechanical Ventilation under Building (Planning) Regulation 34, Buildings Department, Hong Kong.

on certification of the design for ventilating systems in new buildings and in existing buildings after major alteration and addition works.

Besides, the following examples were cited where the regulatory controls should be the responsibility of building services engineers but are currently assigned to professionals in other disciplines or persons without relevant and appropriate professional qualification:

i) Ventilation inspection is now under BD's control, which in fact is dealt with by EMSD's engineers seconded to BD. EMSD had dialogues with BD before, discussing the feasibility of transferring this control function to EMSD.

ii) For historical reasons, which may include effective use of resources (manpower), inspection and certification of boilers, lifting appliances, etc. are now under the purview of the Labour Department whose focus is primarily on workers. EMSD may be the more appropriate department to enforce these controls.

iii) Submissions for ventilation inspection and OTTV calculation are currently through APs, but this was not considered a problem, as APs are always assisted by the relevant experts who are often professional building services engineers.

iv) Submission of fire services installation drawings to FSD is currently through registered fire services contractors rather than professional building services engineers.

It was further pointed out that registration and disciplining of RSC(Ventilation), under the Buildings Ordinance, are currently enforced by BD. FSD will refer to BD cases of

malpractice or substandard performance of RSC(Ventilation) in compliance inspection or audit check of Annual Inspection Certificate of ventilating systems. As noted from the interviews, a study conducted by the Efficiency Unit of the government in 2004 recommended the transfer of such controls to FSD.

Conclusions

Buildings Ordinance is an extensive ordinance which covers not only aspects of builder's works, but also some basic issues of building services installations such as hygiene associated with plumbing and drainage systems, and fire safety of ventilation systems. Statutory parties, essentially authorized persons, registered structural engineers and registered general building contractors, are authorized by the Ordinance to play a dominant role in the regulatory controls.

Major trades of building services works, which involve sophisticated engineering matters, are governed by other ordinances scattered over various chapters of the law of Hong Kong. Rather than professional building services engineers, these ordinances commonly require the execution of building services works by registered parties specialized in individual trades of work. Their minimum qualifications, in contrast to those required for registration as professional building services engineers, are typically low. Given the long history of the registration systems, their vested interests are likely to be a hurdle to upgrading the qualifications for registration even if there is a proven need.

'Building services engineer' is not a statutory title and hence there is no restriction on the qualification or experience of one who claims to be such an entity. Although the RPE title is

given legal protection under the Engineers Registration Ordinance and RPE(BSS) is a statutory title that empowers building services engineers possessing this title to undertake certain statutory works, such empowerment is often non-exclusive to RPE(BSS). A prerequisite to widening the use of RPE(BSS) is a set of clearly defined core competence which is unique to RPE(BSS), without which determining whether or not its authority should be sub-categorized is indefinite, not to mention if a new list of Registered Building Services Engineers should be established under the Buildings Ordinance.

The industry's view on the changes needed to the controls over building services works and the government's perspective on circumstances which call for regulatory controls and factors leading to designation of qualified persons for their implementation have been unveiled. Whilst the opinions of the two sides are not entirely congruent, mutual agreements appear in tightening controls on fire services, plumbing and ventilation works. Further work on formulation of their details can provide opportunities for enhancing the roles and functions of professional building services engineers, for the betterment of the built environment.

Acknowledgement

The work reported was carried out in collaboration with and with funding support from the Building Services Division of the Hong Kong Institution of Engineers.