ICEC2012 – 55

An empirical investigation to eliminate unauthorized building works

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ABSTRACT

Purpose

Unauthorized building works (UBWs) and unattended building defects affecting the overall building safety have long been major problems in Hong Kong Special Administrative Region. A mandatory building inspection scheme (MBIS) is proposed locally, especially for aged buildings to help improve the poor situation and also to enhance individual building safety as well as public safety. This paper is targeted to investigate the effects of the proposed legal enforcement, attitude of the major stakeholders, and any problematic issues not yet identified.

Method

The research will be processed in three phases, i.e. firstly, a complete revamp of some selected buildings with repair orders issued by local government, as primary data; secondly, dispatch a structured questionnaire to owners of these targeted buildings to gather their respective views in executing such rectification of UBWs and building defects; and finally, analyze the returned data with recognized statistical software's to come up with feasible solutions.

2.0 Background

The HKSAR government intends to introduce a mandatory building inspection scheme (MBIS) requiring owners to inspect their own buildings of a certain age periodically and to carry out the necessary repairs of defects identified. The scheme is going to cover essential safety items and all UBWs whether in private ownership or encroaching into common parts of the building, which constitute an obvious or imminent danger to the occupants or the public and actionable under existing enforcement policy of HKSAR Buildings Department (BD, 2010). Tsang (2002) advocates that corrective maintenance is often dominated by unplanned events, i.e. functional failure, malfunction, or breakdown of equipment; which should be avoided.

The BD may take enforcement actions and issue orders requiring building owners to remove any illegal or dangerous structures from their property within a specified period. Examples of UBW include flower racks, abandoned metal racks, concrete canopies, structures with projection, light weight canopies, drying racks, shop fronts exceeding 500mm, air-conditioning racks exceeding 600mm, metal cages, supporting frame for cooling towers, canopies, flat roof structures, rooftop structures, subdivision of flats, structural alterations, and drainage connections not complying with the relevant regulations. The BD would also implement action to defects of external walls, pipe works and UBWs or element in dilapidated condition.

3.0 Literature Review

The common defects of external walls in Hong Kong are crack and spalling, owing to its sub-tropical climate with high temperature, high humidity and frequent rainfalls. These problems are usually found in the building finishes such as rendering and mosaic tiles. The materials for external renderings are cement, lime and sand together with water and, sometimes, an admixture (Monks, 1988). The quality of the cement and lime is carefully controlled during manufacture, but it is not always easy to obtain good quality sand. Natural sands may be more readily available in suitable gradings, although crushed rock fines may be used provided the grading is satisfactory. The BS4049 (BSI, 1996) was complied in an attempt to clarify the terminology used, in order to avoid possible confusion and to promote effective communication throughout the industry. Ranges of rendered finished are roughcast, dry-dash, scraped finish, English cottage style, patterned finishes, tyrolean finish and travertine finish. Resistance to moisture penetration depends primarily on the design details of the building and the mix used for rendering. Water is less likely to penetrate through rendering of an absorbent character than through cracks in a dense rendering caused by the use of a strong mix, as explained in the following extracted from BS5262 (BSI, 1991).

> *"Water may penetrate either through the pores of a rendering or through cracks or both. The extent of penetration through the pores will depend upon the permeability of the various coats, upon the permeability of the various coats, upon the relative suction of the rendering and the backing and also upon the quantity of water at any one point upon the surface. Rain falling upon a relatively smooth surface with little or no absorption does not distribute itself evenly, but tends to run down the surface in streaks. A rough surface, on the other hand, will break up the flow and so avoid the concentration of water at any point."*

Where cracks occur, particularly in a dense and impermeable rendering, water may enter and find its way between the rendering and the background, or directly into the background. When this happens, the water is liable to cause trouble in one or more of several ways. It may cause loss of adhesion, further cracking or complete disintegration of the rendering through action upon the cement of soluble sulphates that may be present in the walling material; it may soak through the wall and cause dampness, loss of adhesion or disintegration of plasterwork inside; or it may have other deleterious effects. A rendering will generally absorb some water falling directly on it and retain this until conditions change and it can be evaporated outwards; the denser and more impermeable the rendering, the less water it will retain and the greater will be the risk of water penetrating through cracks into the background. A rough texture and porous rendering is normally more effective than a dense and impermeable paint finish.

Furthermore, mosaic tiles may be either glazed or unglazed, and either porcelain or natural clay based. Edges are usually cushioned (slightly rounded). ANSI Standard A137.1 (ANSI, 2008) requires ceramic mosaic tiles to have less than six square inches (3871 mm2) of face area. It is available in a variety of size and shapes including 1 by 1 inch (25.4 by 25.4 mm), 1 by 2 inches (25.4 by 50.8 mm), and 2 by 2 inches (50.8 by 50.8 mm). Usual thickness is 1/4 inch (6.35 mm), but some thicker ceramic mosaic tiles may be found. Slip-resistant surfaces are available. Conductive ceramic mosaic tile is also available, but only from limited manufacturers. Mosaic tiles are usually sheet mounted for application. Some are pregrouted with electrometric materials. Matching trim is available in mosaic tiles. Shapes include beads, coves, and surface bullnoses in various sized. Trim edges may be square or cushioned. Mosaic tile is used on either walls or floors and on both interiors and exterior surfaces.

In addition, most tile failures can be traced to one or several of the following sources: structure failure; structure movement; solid substrate problems; other building element problem; bad tile; improper design; bad workmanship; poor maintenance procedure; and miscellaneous source that are not easily categorized. Occasionally, it will not be possible to ascertain for a tile failure. It usually takes several improperly selected or installed elements to cause one visible tile failure. Often the individual errors are insignificant alone. For example, a properly constructed reinforced cement mortar setting bed with a cleavage membrane, and with properly located expansion joints, will withstand normal deflection and creep in the supporting concrete slab. The system might not fail if one of the component, say, part of the cleavage membrane, were omitted. It still might not fall if the reinforcement were laid across an expansion joint in the substrate or if the substrate were too rough to permit the cleavage membrane portions that were installed to slide freely. But with each omission or improperly constructed part, the chance of failure increase, until one error too many causes the system to fail. Many tile failure results from problems with the tile itself, its setting bed or joint grout. Other tile failures, though, result from problems with the construction underlying the tile and its setting bed. Those problems include structural failure and movement, and problems associated with solid substrates.

In general, aluminum window should confirm with ASTM Standard B221 (ASTM, 2008) and usually made from alloy 6063-T5 or T6. Sheet aluminum and bent plate products are also used. They are usually required to have the properties recommended in ASTM Standard B209 (2007) and are made either from alloy 5005, 5086, or 6061, as is suitable for the required finish. While field painting and other factory-applied finishes are also used, the exposed surfaces in most aluminum windows are either clear or color anodized or finished with a fluorocarbon polymer-based coating. Exposed fasteners for aluminum windows should be countersunk aluminum or stainless steel screw finished to match the windows or doors. Concealed fasteners may be aluminum or stainless steel, cadmium or zinc-plated steel or epoxy adhesive (Simmons, 1991). Anchors, clips, reinforcements, and accessories are usually either aluminum or stainless steel. Iron, carbon steel, and hot-dip galvanized steel may also be used if they are properly separated from the aluminum. There are at least twenty aluminum window types in the market, the most commonly used in buildings include awning, casement, single hung, double hung, horizontal sliding, top hung, vertical pivoted, and fixed windows.

Moreover, windows and their finishes fail for many reasons, most of which can be grouped into three categories. The first consists of problems with the surrounding or supporting construction. It includes excess structural movement, and failure in steel, concrete structure or partition framing. While the failure causes in the first category may not be the most probable ones for the failure of metal windows or their finishes, they are usually more serious and costly to fix than the other possible causes. Consequently, the possibility that they are responsible for a failure should be investigated. The second category concerns the materials and finishes used in the metal windows. It includes bad materials, inappropriate finish selection, improper preparation for an application of finishes, failure of the immediate substrate, failure to protect materials and finishes, failure to properly maintain applied finishes, and natural aging (Simmons, 1990). The third category includes improper design, inappropriate window selection, inappropriate hardware selection, improper fabrication, improper installation, and natural aging.

Under the Section 14 of the Building Ordinance (HKSAR, 2010), it is stipulated that:

(1) Save as otherwise provided, no person shall commence or carry out any building works or street works without having first obtained from the Building Authority-

(a) his approval in writing of documents submitted to him in accordance with the regulations; and
(b) his consent in writing for the commencement of the building works or street works shown in the approved plan. (Amended 68 of 1993 s. 6)

(2) Subject to section 28B(4), neither the approval of any plans nor the consent to the commencement of any building works or street works shall be deemed- (Amended 41 of 1982 s. 3)
(a) to confer any title to land;
(b) to act as a waiver of any term in any lease or licence; or
(c) to grant any exemption from or to permit any contravention of any of the provisions of this Ordinance or of any other enactment.

UBW are building works that have been carried out without the approval and consent of the Building Authority. They could be divided into two categories namely, “High-risk” and “Low-risk”, depending on their nature and degree of danger with respect to public health and safety. Light-weight canopies of less than 500 mm projection, A/C metal supporting frames of less than 600 mm projection and laundry racks are common domestic amenities. These would not be regarded as UBW for the purposes of the assessment unless they are in a poor and dangerous condition. “High-risk” items would involve solid projection, canopy exceeding 500 mm projection, flower rack, A/C unit projection more than 600 mm, A/C unit suspended from canopy, abandoned/dilapidated A/C rack, projecting or suspended advertising signs in poor condition, projecting metal cage/frame, encroachments on canopy or architectural fins, etc. “Low-risk” items would include suspended advertising signs, roof top structures, flat roof structures, laundry racks, etc.

Besides, there are growing concerns about the problems caused by poor maintenance of buildings. There are about 40000 private buildings in Hong Kong, where 17000 buildings are aged 30 years or above and some 4000 buildings aged 50 years or above as stated by HKSAR Home Affairs Department (HAD, 2010). The safety of both the occupants and the public are at stake. A Mandatory Building Inspection Scheme (MBIS) would be framed under the existing enforcement policies, while owners would bear the ultimate responsibility. All building works without the approval of Building Authority are defined as UBW. Meanwhile, the existing policies could not pose adequate control to eradicate all UBWs within a short duration. The danger of having more UBWs in a high density district would escalate the chance of more injuries and damages.

4.0 Methodology

Ten target aged buildings have been identified randomly from an old district SKW (anynomous), for a pilot study; through the Buildings Department's record of all the Occupation Permits attained by each building in Hong Kong. Each building's existing status and extent of UBWs like age, storey number, unit number, defects, potential and non-potential unauthorized building works are surveyed per local regulations. These crucial factors will be checked against one another for any positive or negative correlation, at 1 tailed significance level (either $p < .05$ or $p > .05$). Thus, we may then judge the way forward to tackle the problem more effectively. Due to resources limitation, only 10 of such aged buildings will be surveyed on the spot. The findings and analysis will hopefully shade some light for further research in this area. In addition, a structured questionnaire is prepared to obtain the major stakeholders' comments (i.e. owners and occupiers) on the potential effects of MBIS upon enhancing building safety.

5.0 Findings and Analysis

The following findings have been obtained after the site survey of the 10 buildings:

Name of Building	Building A	Building B	Building C	Building D	Building E
Age of Building (years)	41	39	28	24	39
No. of Storey	9	11	24	23	10
No. of Unit	64	105	78	63	31
Defective Light Weight Canopy (No.)	20	89	47	9	46
Defective Laundry Rack (No.)	110	103	37	9	67
Defective A/C Rack (No.)	84	167	88	123	69
Total non-potential UBWs (% over unit no.)	214 (334%)	359 (342%)	172 (221%)	141 (224%)	182 (587%)
Defective Advertising Sign (No.)	4	9	8	6	1
Defective Shop Front or Flower Rack (No.)	4	5	5	7	2
Defective & Abandoned Metal Rack (No.)	9	6	7	7	3
Illegal Structure (No.)	6	13	2	6	5
Total potential UBWs (% over unit no.)	23 (36%)	33 (12%)	22 (28%)	26 (41%)	11 (35%)

Total potential & non-potential UBWs (% over unit no.)	237 (370%)	392 (373%)	194 (249%)	167 (265%)	193 (623%)

Table 1 Defective Condition of Building A – E

Name of Building	Building F	House G	Building H	House I	House J	Total
Age of Building (years)	43	42	41	41	40	
No. of Storey	13	13	13	13	13	
No. of Unit	48	36	72	60	96	653
Defective Light Weight Canopy (No.)	147	115	201	150	199	
Defective Laundry Rack (No.)	21	30	97	30	36	
Defective A/C Rack (No.)	132	70	142	140	125	
Total non-potential UBWs (% over unit no.)	300 (625%)	215 (597%)	440 (611%)	320 (533%)	360 (375%)	2703 (414%)
Defective Shop Front or Flower Rack (No.)	4	0	1	3	0	
Defective & Abandoned Metal Rack (No.)	1	2	4	3	3	
Illegal Structure (No.)	4	3	6	3	6	
Total potential UBWs (% over unit no.)	9 (19%)	5 (14%)	11 (15%)	9 (15%)	9 (9%)	158 (24%)
Total potential & non-potential UBWs (% over unit no.)	309 (644%)	220 (611%)	451 (310%)	329 (548%)	369 (384%)	2861 (438%)

Table 2 Defective Condition of Building F – J

The general conditions of these buildings are found not satisfactory, as revealed from the above figures. The rendering are very old and without maintenance, while the numbers of UBWs are relatively high and some have been newly installed. Though the steel windows of some aged buildings were modified to aluminum windows, yet some remaining steel windows are defective. UBWs bring hygienic problems especially on flat roof structures such as blocking of drainage system. The roof-top structures also pose danger in fire rescues. The conditions of “low-risk” UBWs would turn to “high-risk” in few years if no prompt action is taken. The passive rate of controlling would be a reason leading to the increasing numbers of UBWs. Most aged buildings are not managed/maintained by owner's committees nor owners corporations, thus problems are getting worse. Furthermore, some statistical analysis are performed.

As revealed in Table 3, there is a significant positive relationship existing between *Total non-potential UBWs (VAR2) and Age of Building (VAR4)* (r=.593, p <.05). From this finding, more attention should be paid for non-potential UBWs for aged buildings.

Correlations

		VAR00002	VAR00004
VAR00002	Pearson Correlation	1	.593*
	Sig. (1-tailed)		.035
	N	10	10
VAR00004	Pearson Correlation	.593*	1
	Sig. (1-tailed)	.035	
	N	10	10

*. Correlation is significant at the 0.05 level (1-tailed).

Table 3 Correlation between Variable 2 and 4

As revealed in Table 4, it appears that there is no significant correlation between *Total potential UBWs (VAR3) and Age of Building (VAR4).* However, there may be a barely significant negative relationship between the two variables (r= -.548, p barely at .05). Yet, this potential UBW issue for aged buildings could not be disregarded by owners.

Correlations

		VAR00003	VAR00004
VAR00003	Pearson Correlation	1	-.548
	Sig. (1-tailed)		.051
	N	10	10
VAR00004	Pearson Correlation	-.548	1
	Sig. (1-tailed)	.051	
	N	10	10

Table 4 Correlation between Variable 3 and 4

As revealed in Table 5, it reveals that there is no significant correlation between *Total potential and non-potential UBWs (VAR5) and Age of Building (VAR4)* (r= -.426, p > .05). Yet, this potential and non-potential UBW issue for aged buildings could not be disregarded by owners.

Correlations

		VAR00005	VAR00004
VAR00005	Pearson Correlation	1	.426
	Sig. (1-tailed)		.110
	N	10	10
VAR00004	Pearson Correlation	.426	1
	Sig. (1-tailed)	.110	
	N	10	10

Table 5 Correlation between Variable 4 and 5

As revealed in Table 6, it demonstrates that there is no significant correlation between *No. of Unit (VAR1) and Total potential and non-potential UBWs (VAR5)* (r= .512, p > .05).

Correlations

		VAR00001	VAR00005
VAR00001	Pearson Correlation	1	.512
	Sig. (1-tailed)		.065
	N	10	10
VAR00005	Pearson Correlation	.512	1
	Sig. (1-tailed)	.065	
	N	10	10

Table 6 Correlation between Variable 1 and 5

However, as revealed in Table 7, the relationship between *No. of Unit (VAR1) and Total potential and non-potential UBWs (VAR5) is significant* (r= .655, p < .05), having controlled for Age of Building. For estate with more unit numbers, more attention should be paid to control potential and non-potential UBWs.

Correlations

Control Variables			VAR00001	VAR00005
VAR00004	VAR00001	Correlation	1.000	.655
		Significance (1-tailed)	.	.028
		df	0	7
	VAR00005	Correlation	.655	1.000
		Significance (1-tailed)	.028	.
		df	7	0

Table 7 Correlation between Variable 1 and 5, control Variable 4

Furthermore, 174 questionnaires (out of 653 randomly sent) were received, with the following findings and analysis.

1. Do you agree that a MBIS should be implemented?

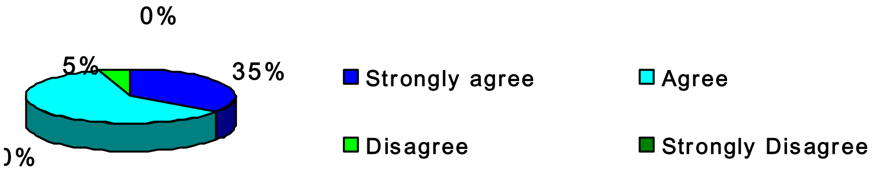


Figure 1

The majority, 95% agree to implement MBIS.

2. Age of buildings subject to regular inspection should be______.

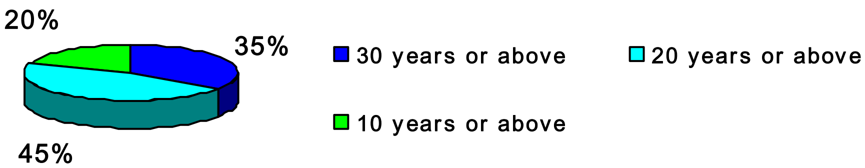


Figure 2

The majority, 80% agree that buildings over 20 years to be regularly inspected.

3. Inspection intervals to be adopted.

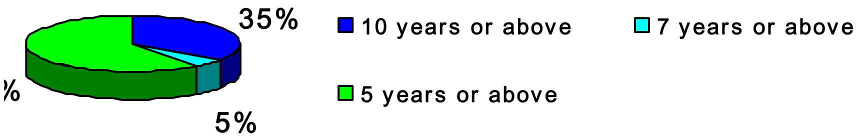


Figure 3

The majority, 95% agree to adopt 5 to 10 years inspection intervals.

4. Do you agree that private domestic buildings of 3 storey or less

should be exempted from the MBIS?

Figure 4

The majority, 75% agree that private domestic buildings of 3 storey or less should be exempted from the MBIS.

5. Do you agree that the proposed MBIS should be accompanied with a mandatory building insurance scheme for further protection of the public?

Figure 5

The majority, 90% agree that the proposed MBIS should be accompanied with a mandatory building insurance scheme for further protection of the public.

6. Do you agree that Building Safety Loan Scheme (BSLS) can encourage the private building owners to carry out repair works or removal of all unauthorized building works (UBWs)?

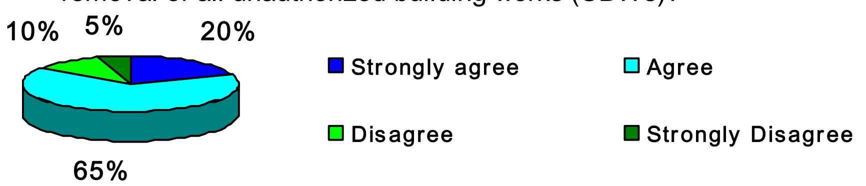


Figure 6

The majority, 85% agree that the BSLS can encourage the private building owners to carry out repair works or removal of all UBWs.

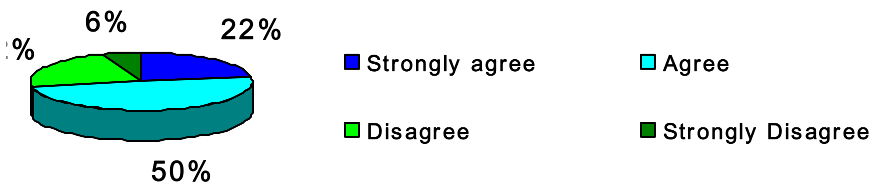
7. Do you agree that UBW can be divided into two categories, low risk

and high risk?

Figure 7

The majority, 75% agree that the UBW can be divided into two categories, low risk and high risk.

8. Do you agree that flat roof and roof top structures will increase the

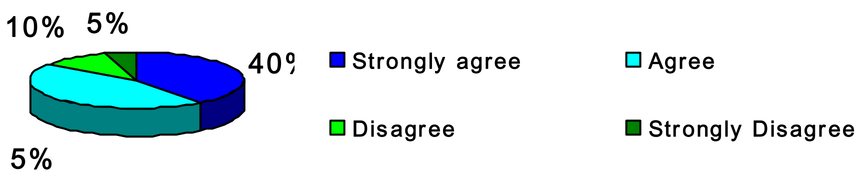


risk of danger to health as well as fire rescue?

Figure 8

The majority, 72% agree that flat roof and roof top structures will increase the risk of danger to health as well as fire rescue.

9. Do you agree to launch a scheme like Mandatory Window Inspection



Scheme as well?

Figure 9

The majority, 85% agree to launch a scheme like Mandatory Window Inspection Scheme as well.

10. Do you agree that window workers should be registered with a government licence authority to carry out installation and repair works

of window?

Figure 10

The majority, 85% agree that the window workers should be registered with a government licence authority to carry out installation and repair works of window.

6.0 Conclusion

As revealed from the statistical analysis, more attention should be paid for non-potential UBWs for aged buildings. For estate with more unit numbers, more attention should be paid to control potential and non-potential UBWs. The result of the questionnaires survey indicates MBIS should be launched, for buildings aged above 20 years, with an inspection interval of 5 to 10 years, including a mandatory window inspection; where not more than 3 storey private domestic buildings would be exempted. Registration of window workers can provide a more professional and responsible service, while project better confidence to the public. Roof top and flat roof structures should be removed to enhance fire safety and health. The deterioration of old building would increase the danger to public. MBIS would be accompanied with a mandatory building insurance scheme for further protection of the public. The majority, 85% agree that the BSLS can encourage the private building owners to carry out repair works or removal of all UBWs. This study reveals the above fundamental concerns, threshold, constraints and actions to be implemented to enhance for better building safety for a potential long-outstanding problem in Hong Kong.

Reference

- ANSI Standard A137.1, 2008, *American National Standard Specifications for Ceramic Tile,* American National Standards Institute, p.13-14.
- ASTM B209, 2007, *Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate,* American Society for Testing and Materials, p.7.
- ASTM B221, 2008, *Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes,* American Society for Testing and Materials, p.17-18.
- British Standard 4049, 1996, *Glossary of terms applicable to internal plastering, external rendering and floor screeding,* British Standard Institution, p.21.
- British Standard 5262, 1991, *Code of practice for external renderings,* British Standard Institution, p.9-10.
- HKSAR Buildings Department, Proposed Legislation on Mandatory Building Inspection Scheme, web site http://www.bd.gov.hk/, accessed 12/2010.
- HKSAR Buildings Ordinance, 2010, *Chapter 123,* HKSAR Government.
- HKSAR Home Affairs Department, Information on Buildings, web site http://www.had.gov.hk/, accessed 12/2010.
- Monks W., 1988, *Appearance Matters; 2 External Rendering,* British Cement Association Publication 47.102., 8th edition, Wexham Springs, Slough : British Cement Association, p.34-35.
- Simmons H. L., 1990, *Repairing and Extending Finishes*, AIA, CSI, Van Nostrand Reinhold, New York, p.56-57.
- Simmons H. L., 1991, *Repairing and extending doors and windows : metal, wood, entrances, store fronts, curtain walls, glazing***,** AIA, CSI, Van Nostrand Reinhold, New York, p.68-70.
- Tsang, A., 2002, Strategic dimensions of maintenance management, *Journal of Quality in Maintenance Engineering,* Vol. 8, No. 1, p. 7-39.