Building conditions in Yau Tsim Mong, Hong Kong: Appraisal, exploration and estimation

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Yung Yau

is currently conducting research and lecturing at the City University of Hong Kong. Before joining the university, he practiced building control in the Buildings Department, the Government of Hong Kong Special Administrative Region. His research interests include housing studies, urban renewal, heritage conservation, real estate economics and finance and building performance assessment.

Correspondence: Yung Yau, Department of Public and Social Administration, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong; Tel: +852 2788 8958; Fax: +852 2788 8926; E-mail: y.yau@cityu.edu.hk

Abstract

Like many other developed cities, Hong Kong has been suffering from acute problems of urban decay. To solve this building crisis, knowledge of the condition profile of all buildings in Hong Kong is vital. A territory-wide evaluation of building conditions is required for providing valuable information to public organisations to prioritise action areas and facilitate resource allocation. Through such an exercise, the inherent problem of information asymmetry in building conditions can be resolved by means of screening or labelling. Buildings in better condition will be rewarded with a premium in property price, and this can foster a culture of building care through market forces. Assessing the performance of the whole stock of buildings in the city, however, can be a lengthy and costly process. In this light, this study proposed a practical but justifiable alternative for jump-starting the process. In the proposal, exogenous factors that could explain the variations in building conditions are explored using actual assessment information, and these determinants are used to estimate the conditions of other buildings without the need of actual assessments. The empirical findings show that this proposed estimation algorithm works and has a number of practical and policy implications.

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BACKGROUND

Today, sustainable development is on the top of policy agendas in the development of almost all countries and cities in the world. Other than ecological and environmental concerns, liveability is another important issue to be addressed (Boelhouwer, 2002; Omuta, 2004). The habitat must be safe and hygienic or occupants are prone to various safety and health risks. This is a golden rule to be followed by public administrators, urban managers and building professionals. In particular, the linkage between the quality of the built environment and the well-being of people is very close in compact ‘mega-cities’ such as Tokyo, Beijing, Shanghai and Hong Kong. Although the compactness of these cities offers economic efficiency in the communal usage of facilities and services, problems also often arise from high population density (Lynn, 1999; Vlahov and Galea,

2002). For example, community epidemics of infectious diseases spread considerably faster in such environments, as was vividly illustrated by the outbreak of Severe Acute Respiratory Syndrome (SARS) in Hong Kong in 2003 (Lau *et al.*, 2005). In addition, the densely populated built environment means that any failures of the buildings can lead to catastrophic consequences. The fatal incidents of falling building fabrics, like aluminium windows and concrete pieces in Hong Kong in recent years, have demonstrated the gravity of the problem (Bowring, 2005; Information Services Department, 2005; Lo, 2005; Buildings Department, 2007).

Although Hong Kong is regarded as one of the most vibrant cities in the world, its citizens have been suffering from the problem of building dilapidation for a long time. This problem was ascribed to the lack of a comprehensive government policy on building management and maintenance, together with an unawareness of building care among building owners. With a view to the sustainable development of a city, the health-state of the built environment in the city has to be well-maintained. Yiu (2007), in particular, highlighted the significance of maintaining building conditions with respect to the sustainable economic development of a city. Owing to limited resources, however, it is necessary to prioritise the actions needed to tackle the current building problem. In this light, this study explores the conditions of private buildings in Hong Kong and proposes an 'estimation algorithm' that can be used to estimate the conditions of the whole building stock in a quicker and less costly manner than would be required to perform a survey of all buildings. This study is also a response to the call by Sime (1991) for more research on the environmental factors affecting safety in built environment. He believed that safety in built environment should be defined in terms of people, actions and environment. Although the relationships between the first two factors and accident occurrence have been studied extensively in social and psychological research, environmental factors have received relatively less attention. Although this study does not look into any epidemiological linkage between accidents and the quality of the built environment, it attempts to contribute to the body of knowledge by developing a protocol for benchmarking physical conditions across buildings.

EVALUATION OF BUILDING CONDITIONS: A MISSED ESSENTIALITY

In view of the problem of building dilapidation in Hong Kong, it is essential to identify those buildings that perform poorly but as yet there has been no mass evaluation of building conditions in the city; the local government, however, has surveyed buildings in an *ad hoc* manner. The government proposed a Building Safety Inspection Scheme in 1997 (Buildings Department, 1997) under which building owners would have to employ professionals to inspect their buildings regularly and who would have to submit inspection reports to the Buildings Department for auditing purposes. No concrete plan for the implementation of the scheme, however, was ever concluded due to political objections. Subsequently, the outbreak of SARS in 2003 again raised public concern over the quality of buildings in Hong Kong, so the government launched a public consultation on the proposed Mandatory Building Inspection Scheme (MBIS) in 2005. Under the proposal, owners of all private buildings that are over 30 years old have to employ building professionals to inspect their buildings every ten years (Housing, Planning and Lands Bureau, 2005, 2007). Not only can the MBIS eliminate building neglect by legislation, it also can offer valuable information of building conditions to various stakeholders and therefore can reduce the potential of long-term building decay. These benefits are further expounded below.

Policy making and action prioritisation

In spite of the gravity of building problems in Hong Kong, the government has long been subject to very tight budget constraints, which makes it almost impossible to take care of all buildings in the city simultaneously (Ho *et al.*, 2005). Therefore, a rational allocation of available resources is required. To this end, it is necessary to know which buildings are good and which are bad with respect to their conditions. In other words, the conditions of buildings should be benchmarked by some means (Chau *et al.*, 2004). In this climate, the information of building conditions obtained from the MBIS can serve as essential input for this benchmarking exercise, giving public administrators precious insights by which they can formulate the policies regarding the upkeep of built environment. Based on the information of building conditions, for example, the government can prioritise areas for redevelopment. Needless to say, benchmarking of such kind should be underpinned by the development of a tool for evaluating or even grading buildings with reference to their existing physical conditions.

Fostering building care culture by market forces

With the availability of the building condition evaluation tool and building information obtainable from the MBIS, the conditions of all buildings in Hong Kong can be compared on a common basis. This benchmarking exercise helps lessen the problems arising from information asymmetries in the second-hand housing market. The idea of asymmetric information proposed by Akerlof (1970) is potentially an issue in any market where the quality of goods is difficult to discern by anything other than close inspection. In the case of buildings there are certain characteristics that are not apparent or easily observable by the home purchaser or prospective tenant, such as the condition of the plumbing and drainage systems (Ben-Shahar, 2004). If the purchasers cannot distinguish the conditions of a building before the deal is made, there will be no incentive for the sellers to provide good-quality housing, and the average quality of second-hand housing on the market will eventually decline. As a consequence, the situation would lead to adverse selection. When imperfect information is given to potential purchasers, sellers of low-quality housing may crowd out sellers of high-quality housing from the market, hindering mutually advantageous transactions. Theoretically, when this crowding-out process continues, low-quality housing would be further replaced by products of even lower quality, and this would finally make the second-hand housing market collapse (Chinloy, 1978; Chau *et al.*, 2004).

The input of information by means of benchmarking aids the market and can help to solve the problem of information asymmetry. When communities know more about the conditions of their built environment, they can price building conditions more appropriately. In this case, a value league will be created, in which buildings with better conditions are rewarded by higher property prices. With a view to the potential increments in their housing values, building owners become more willing to invest in building maintenance and repair. This driving force is particularly noticeable for those buildings with prominent localities because the owners of these buildings, with a view to fully realising the potential value of their buildings, do not want to see that their properties are affected by dilapidation problems. When this climate sweeps through the city, a culture of building care can hopefully be fostered by means of market forces.

APPRAISAL OF BUILDING CONDITIONS IN HONG KONG

Although the government's MBIS initiative was well received by the public, it cannot be implemented in the short term because legislative processes take time. More importantly, market forces will not provide the necessary push towards a general acceptance of building care until a critical mass of buildings have been benchmarked with respect to their condition. Given that evaluation of building condition is labour-intensive and thus costly, it is impossible to evaluate the whole building stock in Hong Kong within a short period of time (say 3–5 years). While the building crisis is a matter of urgency in Hong Kong, some method has to be devised to jump-start the benchmarking process.

As a potential solution to the current problems and delays, this study proposes an estimation algorithm to kick-start the process. The conceptual flow of the proposed method is graphically illustrated in Figure 1. In this study, the existing conditions of 200 buildings in Yau Tsim Mong were benchmarked with the use of a building evaluation protocol. The condition state of a building was defined with reference to a number of intrinsic building factors (ie those factors incorporated in the evaluation framework such as hygienic and physical conditions) as identified in the literature and suggested by local building professionals and experts. To facilitate benchmarking, the results of evaluation against each of these intrinsic factors for a particular building are aggregated to give a single building condition index (BCI).

In principle, the intrinsic building factors identified have a direct bearing on building conditions. In contrast, there exist some other factors that are not involved in the evaluation of the conditions of a building but which also influence building conditions. For example, property management companies assist building owners in managing their buildings so their presence should be associated with better building performance. In this study, building data of 100 out of the 200 evaluated buildings were used to identify the exogenous factors that could explain the variations in building conditions, and give an estimated regression model of the building conditions.

Using the estimated regression model, conditions of the other 100 buildings from the same pool were predicted. The predicted conditions of these buildings were compared with the actual evaluation results (ie the *in situ* BCIs) to see if the proposed statistical approach could reliably estimate building conditions without the need for actual evaluation of the buildings.

Structured evaluation system of building conditions

To achieve a high level of creditability of the benchmarking results, a structured evaluation system was adopted to determine the BCI for each building. In the construction of the framework for building condition evaluation for this study, references were made to Ho *et al.* (2006, 2008). In the evaluation framework, each building was assessed with

Figure 1: The conceptual framework of the proposed statistical approach

Figure 2: Criteria matrix for the evaluation of building conditions

reference to 16 criteria as shown in Figure 2. These criteria are grouped under four categories, namely *Health and Hygiene*, *Structures and Fabrics*, *Fire Safety*, and *Utilities and Services*. A brief elaboration on the evaluation criteria is given in Table 1. The BCI is taken as a weighted arithmetic mean of the ratings received by a building with respect to the evaluation criteria.

For each assessment criterion, a score ranging from 1 (for the worst scenario) to 5 (for the best scenario) was assigned. Following this logic, the BCI of each evaluated building also falls within the range between 1 and 5. With a view to the consistency in the evaluation with respect to each criterion, a pre-determined rating scale was followed (Baird *et al.*, 1996). In the development of the rating scale, references were made to local building laws and trade practices. Practically speaking, the standards prescribed by laws or codes form the starting point for benchmarking the worst practice (Then, 1996). These standards are generally regarded as bottom-lines, the non-fulfilments of which are totally not accepted. If legal source is not available for referencing, current trade practices will be consulted. In the other extreme, the best practice is determined by the highest standards achievable at the time being or in the near future. Table 2 shows the rating scale for the criterion *Internal Hygiene* as an example. The global weightings of the evaluation criteria are shown in parentheses in Figure 2. The weightings were determined by 20 local building professionals using the Analytic Hierarchy Process developed by Saaty (1980). Of the 16 evaluation criteria, *Means of Escape* was perceived as the most important criterion in the evaluation of building conditions and *Conditions of Fittings and Finishes*, the least important.

Descriptions of the building evaluation results

In this study, a total of 200 private multi-storey residential buildings randomly selected in Yau Tsim Mong, Hong Kong were surveyed and their conditions were benchmarked using the BCI evaluation framework. This sample set represented about 6 per cent of the total building stock in Yau Tsim Mong. The characteristics of the evaluated buildings are summarised in Table 3 and the evaluation results are presented by sub-district in Table 4.

Table 1: Descriptions of the evaluation criteria

Criterion	Description
External hygiene	Hygienic conditions in the building's exterior (eg rear lanes, light-wells and flat roofs)
Internal hygiene	Hygienic conditions in communal areas inside the building (eg communal staircases, corridors and lift lobbies)
Natural lighting and ventilation	Presence of blockages of the windows or fixed lights which limit the natural lighting and ventilation enjoyed by the residents
Water quality	Conditions of the fresh and flushing water plumbing systems in the building
Structural integrity	Physical conditions of the structural elements (eg walls, slabs columns and beams) of the building
Unauthorised appendages	Presence of unauthorised building works projecting from the external walls of the building
Conditions of fittings and finishes	Conditions of the fittings (eg drying racks) and finishes for walls, floors and ceilings used in the exterior and interior of the building
Unauthorised use of building	Presence of unauthorised uses (eg illegal conversion of the residential units into shops) in the building
Means of escape	Conditions of the exit routes, including the corridors and exit staircases, in the building
Means of access	Conditions of the means of access for fire-fighting and rescue (eg entrance point, access staircases and fireman's lifts) in the building
Fire resistant construction	Conditions of the fire resisting doors and enclosures of the exit routes
Fire service installations	Conditions of the fire service installations in the communal areas of the building
Drainage and sewage	Conditions of the communal drainage system (eg vertical soil and waste stacks) and sewage system (eg septic tanks) for the building
Electrical installations	Conditions of the communal system for electricity supply (eg main switch room) and distribution (eg electrical wires) in the building
Gas installations	Conditions of the communal system for supply and distribution of town gas or liquefied petroleum gas in the building
Lifts and escalators	Conditions of the communal lift and/or escalator systems for vertical transportation in the building

Table 2: Rating scale for the evaluation criterion Internal Hygiene

Score	Description
5	Clean and tidy in the internal communal areas (eg lift lobbies, corridors, staircases and lifts); <i>AND</i> refuse disposed by the residents being well covered; <i>AND</i> none of the situations below.
4	Clean floors of the corridors and staircases; <i>AND</i> a few stains on wall or floor; <i>AND</i> none of the situations below.
3	Clean floors of the corridors; <i>AND</i> rubbishes scattering in staircases; <i>AND</i> none of the situations below.
2	Rubbishes scattering in the corridors and staircases; <i>OR</i> bad odour; <i>OR</i> moss on walls or floors; <i>OR</i> sticky or slippery floor; <i>AND</i> not the situation below.
1	Proliferation of rubbishes in the common areas; <i>OR</i> pest problems; <i>OR</i> ponding of water.

Table 3: Characteristics of the evaluated buildings

Building characteristic	Maximum	Mean	Median	Minimum	Standard deviation
Building age (years)	56	35.37	39	3	12.64
Number of units	440	40.99	28	3	51.67
Number of storeys	28	10.69	9	2	6.49
Mode of building management	Number		Percentage of the sample (%)		
Buildings with both IO and PMA	55		27.5		
Buildings with IO but no PMA	39		19.5		
Buildings with PMA but no IO	15		7.5		
Buildings without any IO or PMA	91		45.5		

Note: IO denotes incorporated owners and PMA denotes external property management agent.

Table 4: Summary of BCIs of the evaluated buildings by sub-district

	Number of buildings	Maximum	Mean	Median	Minimum	Standard deviation
Jordon	28	4.15	2.59	2.58	1.41	0.69
King's Park	28	4.62	3.02	2.97	1.72	0.85
Mongkok	30	4.71	2.97	2.93	1.49	0.77
Prince Edward	30	4.08	2.98	3.09	1.42	0.63
Tai Kok Tsui	28	4.42	2.35	2.31	1.18	0.78
Tsim Sha Tsui	29	4.70	3.39	3.57	1.55	0.74
Yau Ma Tei	27	4.21	2.56	2.41	0.83	0.90
Overall	200	4.71	2.84	2.80	0.83	0.82

EXPLANATORY ANALYSIS OF BUILDING CONDITIONS IN HONG KONG

The study does not end with the mere evaluation of building conditions. A further step is taken to explore the exogenous factors affecting the condition of a building. Through a literature review, a number of determinants of building conditions were identified. These determinants include building age (Carley, 1990; Diacon, 1991; O'Dell, 1991; Spivack, 1991; Wong *et al.*, 2005a, b; Ho *et al.*, 2008), development scale (Werczberger and Ginsberg, 1987; Leather and Mackintosh, 1992) and building management mode such as whether a statutory owners' association has been formed or if an external property management company has been employed (Werczberger and Ginsberg, 1987; Ho *et al.*, 2006).

An exploratory function of building conditions

Founded on the findings of these previous studies, the conditions of a private multi-storey residential building (*BC*), measured by the BCI, can be expressed as a function $f(\cdot)$:

$$BC = f(AGE, UNIT, PMOA, OA, PM) \quad (1)$$

where *AGE* denotes the age of the building in years; *UNIT* denotes the number of dwelling units in the building, serving as a proxy for development scale; *PMOA* is a dummy variable that equals one if a statutory owners' association and a property management company exist for the building, and zero if otherwise; *OA* is a dummy variable that equals one if the building has a statutory owners' association but no property management company, and zero if otherwise; and *PM* is a dummy variable that equals one if the building has a property management company but no statutory owners' association, and zero if otherwise.

For the dummy set of building management mode, the reference or benchmark category contains those buildings with neither statutory owners' association nor a property management company. The functional form of the function $f(\cdot)$ is not known *a priori*, and thus it is taken as a linear function for the sake of simplicity. After transformation, the function becomes

$$BC = \alpha_0 + \alpha_1 AGE + \alpha_2 UNIT + \alpha_3 PMOA + \alpha_4 OA + \alpha_5 PM + \varepsilon \quad (2)$$

Results of the regression analysis

The data of 100 buildings randomly selected from the 200 evaluated buildings in Yau Tsim Mong were fitted into Equation (2) for estimating the coefficients by way of Ordinary Least Square (OLS) regression. The adjusted *R*-squared for this regression was 0.78 and all estimated coefficients of the constant term and independent variables were

found to be statistically significant at the 5 per cent level. In other words, the five independent variables incorporated in the regression model showed significant relationship with building conditions, measured by the BCI. About 78 per cent of the BCI variation could be explained by the variations in these exogenous variables. As a result, the OLS regression analysis returned the following estimated equation:

$$\widehat{BC} = 2.581 - 0.014 AGE + 0.002 UNIT + 0.437 PMOA + 0.296 OA + 0.311 PM \quad (3)$$

Confirming our conventional wisdom, the empirical studies found that younger buildings generally had better conditions, other things being constant. On average, the BCI of a building dropped by 0.14 for every ten-year increase in the age of the building. On the other hand, conditions of buildings with more residential units were better, *Ceteris paribus*. The probable reason for these findings is that the benefit of scale economy outweighed the cost of coordination among the building owners in the process of building upkeep. For every increase of 100 residential units, the BCI of a building rose by 0.2. As for the dummy variables representing building management mode, the coefficients of *PMOA*, *OA* and *PM* were found to be about 0.437, 0.296 and 0.311, respectively. These findings suggest that the existence of statutory owners' association and/or a property management company in a building were conducive to better conditions of the building. In addition, the coefficient of *PMOA* was significantly different from those of *OA* and *PM* at the 1 per cent level, signifying that buildings with both a statutory owners' association and a property management company outperformed buildings managed by either one of the two. Nevertheless, although the magnitude of the coefficient of *PM* was greater than *OA*, their difference was statistically insignificant even at the 10 per cent level. Thus, there is a lack of evidence to distinguish whether or not buildings managed by a property management company, but without any statutory owners' association, perform better than buildings managed by a statutory owners' association only.

PREDICTION OF BUILDING CONDITIONS IN HONG KONG

An estimated regression model in Equation (3), which denotes the empirical linkages between building conditions and those exogenous building factors, was established. This was then used to predict the performance of the other 100 evaluated buildings in Yau Tsim Mong using the model to compare the predicted BCIs with the *in situ* physically surveyed BCIs. The predicted BCIs for the second group of buildings in Yau Tsim Mong ranged from 1.08 to 3.92, with a mean of 2.67 and standard deviation of 0.78. The *in situ* BCI was then regressed against the predicted BCI using the OLS technique. Eventually, the estimated coefficient was found to be 0.94 and statistically significant at the 1 per cent level. The adjusted *R*-squared for the regression was 0.97.

The results of the analysis above suggest that a highly positive correlation existed between the *in situ* BCIs and predicted BCIs of the buildings evaluated in this study. By these findings, the predicted BCI can be taken as a good proxy for the *in situ* BCI. Nonetheless, notwithstanding the high *R*-squared and close-to-unity coefficient returned from the regression analysis, whether the proposed evaluation algorithm suggests reliable comparison benchmarking on a building-by-building basis is still questionable. A pair-wise comparison of the *in situ* BCIs and predicted BCIs of the evaluated buildings was conducted. The resultant difference ranged from 0.02 to 1.15, with a mean of 0.47 and standard deviation of 0.17, suggesting that benchmarking of building conditions using predicted BCI should not be highly reliable on a building-specific basis.

Figure 3: An illustrative example of the GIS application in building condition evaluation

Yet, this limitation does not render the proposed statistical approach useless in Hong Kong. In fact, statistical error can be largely reduced when the sample size (ie the number of buildings involved) is larger in the prediction process. In other words, building condition benchmarking carried out on a more macroscopic level (eg a street-block or even a district level) could be reliable. In fact, a similar estimation algorithm was adopted by Hiller *et al.* (2003) to find out the properties that were at the greatest risk of abandonment in the United States. In their study, a very high degree of accuracy for the building-specific prediction of abandonment risk was not the main objective, but the prediction results should be reliable when applied to a large area.

By the same token, the statistical approach proposed in this study can offer a broad prediction of the existing conditions of buildings in Hong Kong, serving as an early warning against urban decay on an area basis. This prediction exercise can provide the government with condition profiles of buildings in different areas so they can prioritise action areas and better allocate public resources to community building management at a relatively low cost. For instance, street blocks with comparatively high concentrations of poorly performing buildings, as indicated by the predicted BCI scores, should be accorded more attention. The buildings there should be evaluated in detail to confirm the situation. The findings from these actual evaluations can then serve as extra inputs for re-running the explanatory model in Equation (2). By reiterating these processes, more and more buildings can be evaluated, starting with the most problematic areas.

With the application of a geographic information system (GIS), the BCI prediction process can be further facilitated. An illustrative example of the GIS application in showing the condition profile of the buildings in a Jordanian sub-district is shown in Figure 3. Not only does the GIS allow graphical presentation of the results of building condition prediction but also enables spatial analyses of the building conditions in the city. For example, analyses of clustering phenomenon can be done. This may be constructive for further exploration of the factors determining urban decay in Hong Kong.

CONCLUSIONS

The problem of building neglect is not new in Hong Kong. Deaths, injuries and ill-health have long been caused by a series of misfortunes arising from building problems. Given that the number of buildings susceptible to dilapidation in the next ten years is expected to increase swiftly, the health and safety of the built environment in Hong Kong is at risk. As detailed previously it is crucial to have an evaluation of the conditions of all buildings in Hong Kong. This exercise can go into the heart of the problem through two pathways. First, the information of building conditions can offer valuable insights to the government in order to make more informed decisions in the process of urban regeneration. Secondly, with such information released to the community, market forces can be mobilised to foster a building care culture in Hong Kong. In spite of these potential benefits and the urgency of the building problem, it is practically impossible to have all the buildings in the city evaluated quickly on account of the lengthy evaluation process. Therefore, we need some measures to jump-start the process.

In this study, 200 buildings in Yau Tsim Mong, Hong Kong were surveyed, and it was found that building age, development scale and building management structure could explain the variation in the conditions of these surveyed buildings. Based on these findings, an estimation model was established. Using this model, the conditions of other buildings in the district and in the whole territory can be predicted without the need of actual building survey. This short-cut approach provides a transitional pathway to the mass evaluation of building conditions in Hong Kong. By this means, an approximate indication of the health and safety conditions of all buildings in the territory can be acquired in a quick and inexpensive manner. Prioritised detailed investigations are accorded to those buildings with poor predicted conditions. In this case, sensible resource allocation for the urban regeneration process can be achieved.

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