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[trend@building.com.hk](mailto:trend@building.com.hk)

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Keynote Presentation

# Failures – Avoidance and remedies for building defects – What's the missing link

By Willis Yu and Daniel Brown

**Prologue:** For many years, construction professionals have been trying to find ways to improve the finished quality and maintainability of building works. There have been some systematic changes to enhance these along the line, but not necessarily addressing the fundamental issues in the delivery and problem avoidance. Apparently, labours should now be more skillful compared to one or two decades ago. Many of them have the opportunities to attend structured training and have obtained skill certificates in their respective trades. They are now generally more highly academically qualified. Many construction companies and consultants have obtained their quality certificates. On the other hand, complaints of building defects have not been reduced – simply looking at how the inspection, testing and construction litigation businesses have flourished would demonstrate the case. These maintenance problems have been causing nuisance to occupants or safety hazards to pedestrians. Cases of these have been reported from time to time raising public concerns in regular spells. Are we just more sensitive to these incidents these days in a litigative society or are we actually addressing the fundamental issues?

### What constitutes failure and how to address them

When building maintenance is concerned, failure usually refers to the loss of serviceability, that is, the loss of the ability to provide its intended services. The loss of

serviceability causes the occupants nuisances which may include:

- loss of function
- inconvenience, e.g. leakage
- aesthetics impairment, e.g. surface blemishes
- safety hazard, e.g. falling of loosened materials
- property value reduction

The direct approach to address the failure is to tackle the defect itself, e.g. by locating the source of leakage and sealing it, by removing the broken render and re-rendering etc. This approach is known as 'Remediation'.

Remediation is not sufficiently good because it does not help with the situation that the failure has already occurred and the failure has caused nuisance. The industry understands that the more fundamental aspects of workmanship issues should be looked at - hence training provisions to workers of various categories of work and quality certification of companies. There have been various marking or grading of organizations in many cases associated with awards for good performers and penalties for non-compliance. Much of these have led to clearer responsibilities, and the culprit of failure could be more easily identified when it does occur. The reality is that even though the accountability is more established, the incidents of building defects occurring continue to grow. One school of thought believes that the building construction works these days are becoming more and more complicated, so

there has got to be more problems. But have the ultimate fundamental issues been addressed yet? Since the construction works are more complicated, should we be using a better approach than the traditional 'discovery and fix' or 'train, certify and forget' approaches to resolve the problems? How actually should the industry work together to 'Avoid' the problem?

### **Pay more attention to serviceability integrity**

None of us will ever doubt the importance of structural integrity since we all know that an inadequate structural design could have disastrous consequences. Considering a building constructed of reinforced concrete. The structural materials involved include steel reinforcement and concrete. Concrete itself could be considered as made up of cement, water, aggregates and some additives. The requirements for inspection and testing of reinforced concrete are plentiful and onerous. The steel reinforcement and each concrete constituent material would be tested prior to mixing. There are many testing and inspections that would need to be done when the concrete is in the fresh state. After the concrete has hardened, there are further tests and inspections to be done on site and in the laboratories.

On the other hand, the serviceability integrity affecting future maintenance has generally been receiving insufficient attention. Take an example of a tiled facade. It does not normally have reinforcement (except sometimes a mesh is used) but the render system includes all the ingredients used in reinforced concrete, in addition to the tile, the tile grout, the tile bedding, the bond coat or spatterdash applied over the concrete substrate. The construction processes of the tile finishing are also multi-steps with the application of each layer of materials being a separate process. The tiling system is actually technically more complicated than the reinforced concrete. With less attention generally given to the construction of a tiling system compared to reinforced concrete structure, the consequence is that the chance of some problems occurring in the tiling system is much higher than some problems occurring in the reinforced concrete.

Certainly the consequence of failure of a tile system would not be as disastrous as failure of the reinforced concrete. This is correct if we consider the worst failure type, however, in Hong Kong, we probably have much

fewer cases of structural failure causing serious injury compared to the occasional pedestrians seriously injured or killed by a falling window or a piece of falling render, in addition to the thousands if not tens of thousands of cases each year of occupants complaining about defective finishes, detached tiles, seepages, loosened windows or other building maintenance nuisances. When a problem is identified, there is no lack of skills to do the remediation. The level of attention has to be raised to the avoidance of these maintenance problems, by paying more attention to the serviceability requirements and reinforcing the checks on these aspects, as well as accounting for future deterioration of the materials in such contexts.

### **Alignment of interests and suitable appropriation of risks**

The roles of the developer / property owners and the contractor are complementary. However, the prevalence of the competitive lump sum tendering using a very long list of tenderers with the client placing most of the risks onto the contractor is not conducive to a good quality output. To align the interests, there are four elements:

- Each party: the client, the consultant and the contractor should bear the risk that each party would most capable in handling
- The requirements for the works affecting future maintenance must be clearly and accurately described in the specifications and drawings
- The supervision to these works by the consultant or the clients representative must be executed competently and thoroughly
- The client should demand high quality outputs from the consultant and contractor and pay for them

The logic could be demonstrated with the purchase of a car. Consider if we want to buy a good quality and durable car, we would:

- Firstly shortlist several good brand and be ready to pay a reasonable price
- Secondly specify the requirements clearly
- Thirdly ask for quotes from those car makers who are technically competent to manufacture the car with the specified requirements
- Fourthly, we check that the right car model with the right specification is delivered

To buy a good and durable car, as said, we probably pick

a few good brands to concentrate our selection efforts. I guess very few of us will select vigorously from a list of 8 or more brands. Put it simply, if you want a cheap car, you select from the cheap brands, but if you want a reliable car or a car with status, you select some other list. These days, it simply often becomes a practice to squeeze the last drop of blood out from the contractor by inviting as many as over 10 tenderers to tender for a job. This will probably make sure that the winning bid is free from a reasonable profit since with the tens of thousands if not millions of items and clauses in the bills of quantities and numerous specifications and conditions, it is probably certain that one tender will contain some errors that would lead to certain underpricing that could contribute to the success of the tender. One may argue that there are much fewer car brands compared to contractors. However, it must be noted that there are probably fewer reliable contractors than good car brands, because those reliable ones who diligently do a good job has largely been forced to reconsider the value of their existence. To ensure that the reliable contractor could work with a reasonable margin to sustain their reliability, the number of contractors tendering should be reduced, with extra scrutiny given to the understanding of the contractor's ability and competence during the prequalification and / or tender evaluation stage.

Too often, clients incline to place too much on us, whether technical, contractual or uncontrollable items onto the contractor. While it is reasonable to impose liquidated damages to contractor, it is dubious whether certain uncontrollable factors, e.g. weather conditions or delay by nominated suppliers / subcontractors under certain conditions should be the responsibility of the contractor. Very often, some of these avenues to allow EOT are crossed out from the standard conditions in the particular specifications. We are all aware that in so many situations, the culprit of poor workmanship has been caused by rushing the deadlines, especially when working on weather dependent procedures adopted in the external finishes and waterproofing works such that proper application of the materials, supervision and remediation could not be carried out even under mildly adverse weather.

The other risk that clients often ask the contractor to take up is the quantities of repair for exterior render / tile repair and they often ask the contractor to price a lump sum for

such a repair contract. It should be emphasized that all external facade repair work involving repair of delaminated finishes should be administered by using a remeasurement contract. The drawing up of a bill of quantities or schedule of rates should also be preceded by a good delamination survey that could allow estimation of quantities of repair for tender purposes, though this quantity would rarely be the final quantity of repair. There are several reasons for this:

- It is not possible for the quantity of delamination to be estimated based on a visual survey
- It is not possible for the quantity of delamination to be estimated by distant non-destructive methods unless the ideal observation conditions are available
- The amount of delamination will grow over time

Clients often would like to do away with the initial proper investigations because they want to save the relatively small amount of money for the investigation. The initial investigation when done properly in fact could allow better estimation of the quantities to be repaired, which in turn give better assurance of a suitable timeframe and budget of repair.

It would be like gambling when the contractor realizes that there is a risk not controllable by them and which they need to price for. The contractor could either price for it or take a gamble to absorb it, not to mention that in some cases the risk may not necessarily be priceable. In competitive bidding with contract price chiefly determining who would win the tender, the contractor who price for such risk will significantly be disadvantaged in its odds of winning the tender. The contractor who likes to take a gamble would probably look for loopholes in the conditions and specifications such that in one way or another, they are going to 'save' the money back in case the uncertainty eventuates to their disadvantage. The outcome is substandard workmanship or materials and superficial repair, associated with poor collaboration between the client and the contractor. It must be noted that most of these superficial repairs and faulty materials / workmanship will not reveal themselves until after the normal DLP of 12 months.

Paying a reasonable price to a brand name for a product does not warrant that you receive one of good quality. We do need to check it against the requirements. For a car, we would need to test drive it and check that all the features

ordered are available and working properly. If you order a 10 disc CD player, we need to check it is not 4 disc, we would also need to make sure the air-bag is provided and not to wait until the crash occurs. We should not take for granted that the product provided by the contractor would be deemed to be of adequate quality and supervision of the works needs to be executed with care.

There are no free lunches. That applies to construction works which demands a competent contractor supervised by a competent project consultant. These parties need to be adequately compensated. The specifications prepared by the consultant is the most important document that need to be carefully written so that it covers all aspects of the works scope, the technical requirements on materials and workmanship, the testing requirements, the supervision requirements and warranty period required. More often, however, these specifications are copied from a previous not identical contract by a junior staff. If the modification of the clauses are not done carefully to suit the current project requirements and fully reviewed a few times by some experienced senior staff, it would guaranteed to become the source of discrepancies and omissions in the requirements.

The discussions in this section apply generally to any new or repair construction works. When the tendered price is deem to be a loss by the contractor, as said earlier, it would try to save it back through areas that may receive less scrutiny or check. In the nineteen-eighties, probably the façade would be one such area that was prone to non-discovery of workmanship defects, since under a new beautiful coat of fresh paint or tiles etc, these defects will not be readily detected or revealed until several years later, and in unlucky cases, could be as early as 1-2 years.

### **Compensation commensurate with accountability**

The various parties involved in a project should all have the same common objective, which is to complete the construction works in a timely manner with the appropriate quality, and all are driven by an ultimate goal – to make profit for business enterprises or to ensure accountability is accomplished for public entities. The project directors and project managers will also have their separate objective which may not necessarily align with the organization's. One notable aspect is that

avoidance of problems that would not surface in the short term may not necessarily be the concern of any of the organizations or the personnel concerned. If we assume every person's action is determined by whether he would be accountable for the consequence of the actions, most likely these personnel will concentrate their attention to avoid only the problems that would surface quickly and which they do not have any excuse of their occurrences.

The way to overcome such misalignment is to make each party know that they will be accountable for what they have done. For contractors, a longer warranty period of their supplied materials and workmanship from defects not arising from normal wear and tear will be essential. For consultants, they should be held accountable for discrepancies within the specifications, and any wrong specifications or errors and omissions in their design or drawings. For clients, they would need to make sure that such items of work provided by the contractor and the services provided by the consultants are adequately compensated. Otherwise, it would be similar to buying a luxury car using the cost of an economy model, which is never achievable. With adequate supervision, you get what you pay. Without adequate compensation, you cannot get what you want to get.

### **The technical side**

The considerations described in the preceding sections are mostly non-technical in nature and undoubtedly more variable and difficult to control. It is still important to understand the technical issues in order to effectively work out the technicalities to avoid and remedy the defects. The technical side of things requires specialist knowledge and demands hands-on experience. It needs considerable time for any one to acquire the specialist knowledge and the technical aspects are important as they are the prerequisites for the avoidance and remediation of the maintenance problems.

It is not the intention to go into the details of the technical considerations in this paper, but merely keep a list of items as reminder to ask whether these issues have been addressed. It would enable better appreciation and monitoring of the work of the contractor and consultant and minimizing and avoiding of the potential problems.

## Conclusion

Avoidance of failures is much more effective than remediation of failures in achieving good quality and durable building works.

Advancement in technology could help in the detection and remediation of the problem, but it is unable to help on the avoidance of the defects unless the avoidance aspects are better appreciated, namely;

- Specification and use of appropriate materials and methods
- Be prepared to pay reasonably for quality work
- Be prepared to execute tight supervision to both the work of consultant and contractor

When all parties diligently take up their roles, and take the risks that they could best handle, the end product will then be most agreeable and economical in the long run and everyone will more likely find the relationships amicable. There are fewer disputes and the lawyers businesses are reserved for the short sighted. The quality and durability of building works are better warranted saving costs in the long run. The reliable professionals will stay on and the building construction business will healthily sustain.



### Willis Yu

Ir Willis Yu is Technical Director of Maunsell Consultants Asia Limited. He graduated in Civil Engineering from the University of Hong Kong and has an MSc from UMIST and MBA from the University of Melbourne. He has over 20 years experience in structural design, concrete technology, durability assurance, corrosion engineering and defects investigation.



### Daniel Brown

Ir Daniel Brown is a Chartered Materials Engineer and Chief Engineer of Maunsell Consultants Asia Limited. He is a leading specialist and frequently provides litigation support in dispute cases involving building finishes (tiles, render, waterproofing, coatings, etc.) and concreting issues. He has a Manufacturing Engineering degree from the University of Bristol and 13 years of consulting and contracting experience.

Vulnerable building element	Common Defects	Details to attend to
Rendering	Cracking Staining Delamination Inclusions	Use of appropriate materials Adequate movement allowance Adhesion considerations Misalignment rectification Correct application - mixing and batching
Tile over render	Delamination Sealant problems	Adhesion considerations Inspection considerations and sealant replacement
Stone cladding	Cracking Sealant problems Corrosion of fixing	Adequate movement allowance Structural and durability considerations for fixings Inspection considerations and sealant replacement
Metal cladding	Sealant problems Corrosion of fixing Distortion	Adequate movement allowance Structural and durability considerations for fixings Fixing and positioning
Glass	Cracking Sealant aging	Production considerations Handling and replacement Sealant replacement
Exposed concrete	Cracking Spalling Reinforcement corrosion	Adequate cover Coating protection
Windows	Leakage from joints Leakage from surrounds Hinge and fixing corrosion	Watertightness considerations Grouting Avoid galvanic corrosion
Roof waterproofing	Materials aging Incomplete sealing	Durability of materials Allow for replacement Detailing and application considerations