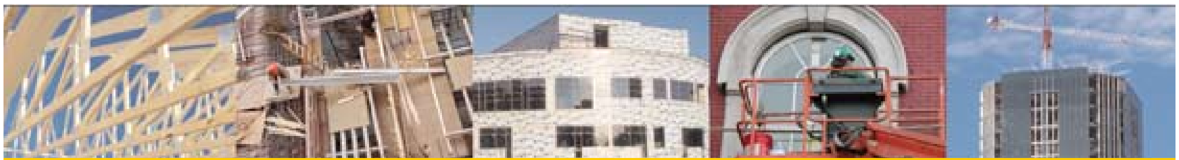
Building Envelope FORUM



Design *** Construction / Installation *** Maintenance / Retrofit *** Material & Components

Managing Moisture Risk – A risk management approach to moisture in building enclosures

By Kevin C. Day

The design intent of any building is to prevent moisture accumulation within the enclosure; notwithstanding, problems still occur when there is inadequate design details, workmanship, construction sequencing, and/or supervision.

The risk of moisture accumulation in building assemblies becomes increasingly less tolerable with the adoption of less robust building materials – specifically those which are moisture sensitive. In particular, concerns for mould have pushed this issue from the realm of building science to a public health issue, and unnecessarily so…

Practitioners of building envelope engineering around the world (whether knowingly or not) employ risk management techniques as part of their service (and duty) to their clients. Although this aspect of engineering practice is not often referred to as risk management per se, mitigating liabilities (of both the practitioners and owners) ultimately determines the conclusions drawn from an in-situ assessment, i.e., “how wet is it?” and “how much damage has occurred?” A risk analysis is often necessary.

A simple analogy for risk…

Assessing the risk of an undesired event (water leak, flood, or other catastrophe) can be summarized as follows:

Magnitude of Risk = Probability X Cost

Where:

Magnitude of Risk = the legitimate, literal consequence should a critical event (failure) occur, including damages and repairs to return to a usable state.

Probability = the occurrence of loads that may cause failure to occur.

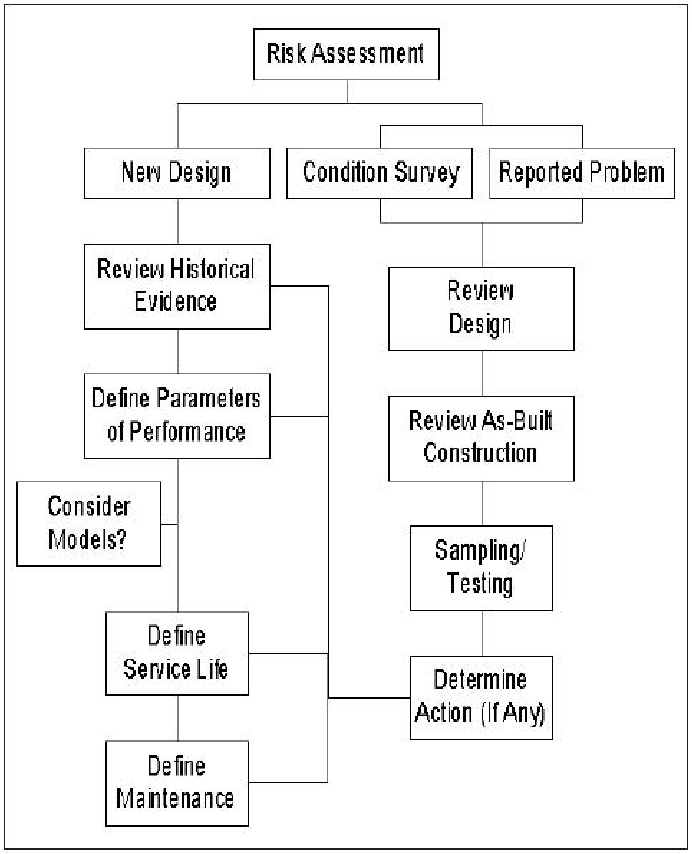
Cost = the implication of damages & repairs, the financial obligation to restore the assembly, and associated costs

Although the above equation is subjective, it is supported by fact. Warranty claims against the Ontario New Home Warranty Program (ONHWP, now called Tarion) totalled over $20,000,000.The Canada Mortgage & Housing Corporation’s research later confirmed that water penetration was the chief cause of the warranty claims. Hence, when perceived minor building envelope details are ignored, the magnitude of risk can be quite high due to the cost associated with repairs which inevitably follow.

Building quickly, thereby reducing the developers’ burden of financing, often leads to fast-tracking processes that do not facilitate the proper attention to building envelope construction. The costs are normally high when water penetration has occurred (both damages and repairs), so it is in the designer’s best interest to be conservative during the design process, thereby mitigating their risk. Yet, the construction of many of our buildings are still not tolerant to periodic water penetration or moisture accumulation, because many of the specified assemblies do not safely allow for moisture storage without damage ensuing.

Recent lessons (harshly) learned…

An examination of the premature building envelope failures in the Lower Mainland of British Columbia provides ample evidence that poor design, poor construction, and the selection of inappropriate materials caused widespread failure in numerous building enclosures. It wasn’t a “stucco” or “EIFS” problem; it was a fundamental breakdown in the building construction process. Unfortunately, the knee-jerk reaction was to condemn anything that wasn’t already a drained or rainscreen system (whether the wall systems were deteriorated or not)… Can you say “band-wagon”?



Also, where initial performance is inadequate and building envelopes have failed prematurely, the failure cannot be blamed on the lack of maintenance nor the vague interpretation of applicable building codes.

On the global scale of building envelope failures, the problems in the Lower Mainland of BC are rivalled only by the cost of repairs witnessed in New Zealand with the failure of face sealed cladding systems installed on wood-framed single-family dwelling units. The BC and NZ experiences have taught us that; a) undermining the faith of consumers, and b) the cost for repairs, reflect poorly on the construction industry and all of its authorities.

Managers and owners may ask, what do our building codes and standards do to prevent this scale of failure, and why didn't the designers check that these problems were mitigated. Firstly, our codes and standards do not intend for there to be such scale of premature failure even though there may be room for improvement. Secondly, the construction schedule and financing time-line often dictate the relative workmanship quality.

Common responses to building envelope failures range between denial or over-zealous expectations for repair and retribution. The litigation that may follow is unconcerned with the relative risk – it is only concerned with a) alleged damages, b) alleged blame, and c) the available assets of potentially liable parties (which can pay for damages). Unfortunately, it's a black-hole of lost opportunity… However, there is hope in understanding what moisture risk factors are most significant.

The 2006 model National Building Code does provide the following requirement in regard to performance of the building envelope:

Indoor Conditions: An objective of this Code is to limit the probability that, as a result of the design or construction of the building, a person in the building will be exposed to an unacceptable risk of illness due to indoor conditions. The risks of illness due to indoor conditions addressed in this Code are those caused by—

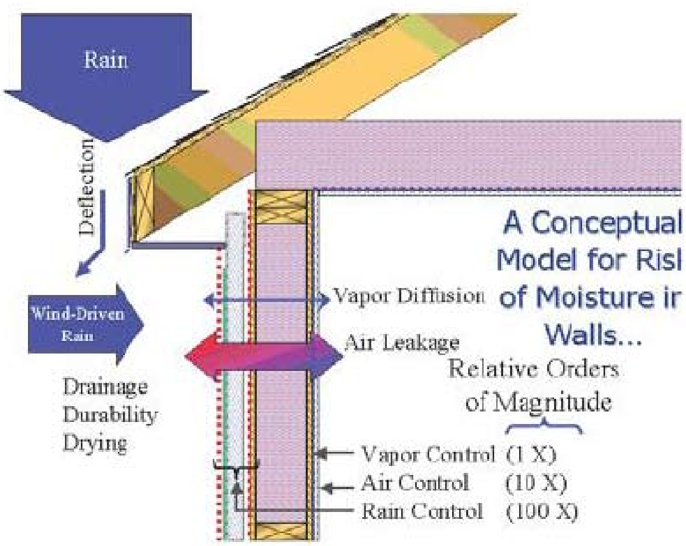
OH1.1 inadequate indoor air quality

OH1.2 inadequate thermal comfort

OH1.3 contact with moisture

Until this code change was made, many consumers suffered from the unfortunate combination of circumstances, i.e., those who fairly expected a building to not permit widespread structural failure, much less damage to interior finishes, all within the first 10 years of service. Does this mean the code was originally inadequate? Not really because the code never permitted leakage to a point where problems would ensue. However, the code has gone further to require buildings constructed now are more expressly required to "not grow mould". This means water must be managed by design and construction.

As North American building practice has changed over the last hundred years, the consumer-purchase-value has been reduced. Wood (and composites) as well as light gauge (cold formed) steel framing are included in the vast majority of exterior wall assemblies being constructed today on the continent. Solid concrete and masonry mass walls (not including veneer systems) are less common, and are typically relegated to low-rise and institutional-type buildings. The selection and use of wood and galvanized steel framing in exterior walls are less moisture tolerant than those with concrete and mass-masonry walls. Albeit, stud systems may be preferred when considering cost-savings, seismic (earthquake) performance, among other factors.



Defining relative risk of moisture in building enclosures…

A risk management approach to building envelope moisture forces us to return to the risk equation discussed previously, and determine the probability of failure and the cost of damage. Thereby indicating our magnitude of risk. If we look at most of the problems in building envelope systems, more often than not, rain is the single largest factor. Condensation from air leakage represents a smaller proportion of building envelope failures, followed by even less failures attributable to poor vapour diffusion control. Is it fair to say "rain is 10x more important than air leakage?" Perhaps not, but it conveys the relevance of where owners should focus their attention.

How can you apply the risk equation presented here? Compare the following, and you determine the "magnitude of risk"…

Magnitude of Risk = Wall 1 x Climate 1
Where:
- Wall 1 is concrete block wall clad with face-sealed stucco
- Climate 1 is Regina, SK

Magnitude of Risk = Wall 2 x Climate 2
Where:
- Wall 1 is wood-framed wall clad with face-sealed EIFS
- Climate 1 is West Vancouver, BC

Would you agree that the magnitude of risk with Wall 2 is greater than Wall 1?

Reference

1. K.C. Day, "Risk Management of Moisture in Exterior Wall Systems" Proceedings – 2nd International Conference on Building Physics, September 2003.

About the Author

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