

# Waterproofing Failures That Can Lead to Costly Repairs

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The sole purpose of waterproofing is to protect the structural components of the building envelope from water penetration. Waterproofing systems protect above- and below-grade structures such as underground parking garages and basements consisting of conventionally reinforced or prestressed concrete that have living, working, storage, and service room spaces.

The performance of the waterproofing system during its entire useful service life will be dependent on factors such as design, workmanship, assessment, maintenance, and repairs. Upon closer examination of these factors, one gains a deeper understanding of how the integrity of the waterproofing is undermined and how the structural components are affected.

## DESIGN

The design methodology has a significant impact on the overall outcome of the waterproofing performance beyond adhering to minimum code requirements. Here are some common questions to consider during the preliminary design stage:

- Does the below-grade surrounding area have a high water table, or is the area prone to flooding?
- Are the materials selected durable and suitable for the specific application?
- Are there penetrations and sections of the expansion joint directly above critical infrastructure?
- Do the floor slabs and foundation walls have enough provisions for drainage?

Without considering these types of questions, the designer can create vulnerabilities once the project is initiated. Locations and detailing of expansion joints and other types of penetrations, like drains, is critical since these areas are the most susceptible to failure of the waterproofing systems. During a recent garage condition assessment, we observed a concrete ledge beam supporting the intermediate slab was experiencing delaminated concrete due to premature failure of the preformed expansion joint installed less than 10 years ago (see photo below).



*A concrete ledge beam supporting an intermediate slab experiencing delaminated concrete due to premature failure of the preformed expansion joint installed less than 10 years ago.*



## WORKMANSHIP

This factor is determined based on how the design is executed by the contractor, from a workmanship perspective, and the quality control measures implemented during construction. Deviation from a sound design by ignoring standard waterproofing installation standards and procedures can also lead to premature failure. Misguided practices include, but are not limited to, improper concrete surface preparation, a high moisture content on the concrete slab surface, or not following application procedures from the manufacturer, which include mixing of material, curing, application temperature, thicknesses, etc.

Throughout my entire career, I have only seen two garage roof slabs-to-wall junctions with missing waterproofing. The absence of proper waterproofing on below-grade walls and slabs is a huge risk—and one of the major factors that contributed to the collapse of the Algo Centre Mall roof located at Elliot Lake in 2012, according to the forensic engineering report.

## ASSESSMENT

Underground parking garage and basement condition assessments should be performed by licensed professional engineers with experience in identifying problems early on, like water penetration at walls and slabs, expansion joints, concrete deterioration, drainage issues, etc. A condition assessment report should include quantified observations, conclusions, and recommendations for repairs, complete with budget estimates.

Unfortunately, many building owners request a condition assessment far too late after the waterproofing membrane breaches have caused significant deterioration to the concrete. The only way to stop this from reoccurring is to legislate mandatory garage condition assessments every three to five years as enacted by New York State and Quebec, respectively.

Recently, a 98-year-old detached house was undergoing basement renovations, and the contractor discovered major sub-floor damage caused by water penetration from the exterior concrete block foundation wall. The wall was observed to be protruding 50 to 75mm out of plane, likely from frost (see photo on page 24). This is a very serious condition, with potential for the foundation wall to catastrophically collapse. Emergency shoring has been installed, and the wall





Localized repairs and replacement of worn and debonded membranes should be addressed as part of a maintenance plan to avoid leaving the concrete unprotected and exposed to water and de-icing salt, which can lead to corrosion of the embedded reinforcing steel.

is scheduled to be replaced with new waterproofing and drainage installed along the entire length of the wall elevation.

**MAINTENANCE**

The minimum maintenance standards involve annual reviews by building staff, ensuring the slabs’ drains are free of debris and vehicle traffic waterproofing systems are cleaned on a regular basis. Part of this review should include accessing the hydro vault to ensure there is no evidence of water penetration, which could cause a potential fire or explosion. Localized repairs and replacement of worn and debonded membranes should be addressed as part of a maintenance plan to avoid leaving the concrete unprotected and exposed to water and de-icing salt, which can lead to corrosion of the embedded reinforcing steel (see photo above).



During renovations to a 98-year-old detached house, a contractor discovered major sub-floor damage caused by water penetration from the exterior concrete block foundation wall. The wall was protruding 50 to 75mm out of plane, likely from frost.

**REPAIRS**

Full replacement of waterproofing membranes at the end of their service life is inevitable and requires diligent financial planning since these types of projects can be quite costly when major structural restoration is involved. Depending on the first four factors, this can have a tremendous impact on both the service life of the waterproofing and the repair strategy. For the waterproofing system to perform to its maximum potential, action must be taken promptly when problems initially occur. ■

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