The Basis for Developing Consensus Standards for Exterior Insulation Finish Systems (EIFS)—Encompassing Durability

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ABSTRACT

Standards that encompass durability for EIFS have not been a primary mandate for standard-writing bodies thus far in North America. Durability typically has not been incorporated into standards for building material components or systems, in particular, where a system would be tested and evaluated as part of a complete assembly.

Durability considerations for EIFS, insofar as (a) aesthetics and maintenance issues and (b) serviceability (on the basis for replacement), are being explored through the work of ULC-S716. However, in the development of these standards, the requirements for rainwater management on framed wall construction have set the precedent such that durability of the EIFS becomes secondary to the moisture management properties of the assembly.

ULC-S716 has determined that framed wall construction requires a moisture barrier for protection of moisture-sensitive substrates; hence, the durability of the EIFS becomes intrinsic with the substrate wall.

INTRODUCTION

The development of consensus standards for exterior insulation finish systems (EIFS) in North America has been not less than a 20-year endeavor. Both in Canada and the United States, building code and enforcement authorities as well as evaluation authorities have sought the basis to evaluate and approve the use of EIFS in their respective jurisdictions. Consensus standards for EIFS, both for testing and installation, have been published only within the last ten years.

Water penetration problems in the early 1990s changed the focus from fire safety concerns to rainwater management, notwithstanding that drained EIFS were introduced beforehand (yet not widely used or specified).

The assessment of durability requires consideration of the anticipated in-situ service requirements and loads. Loads will vary from region to region due to climate, seismic, and other parameters; however, the general expectation of the end users of the proposed ULC-S716 would be that a minimum level of service life can be secured.

CSA-S478—GUIDELINE FOR DURABILITY OF BUILDINGS (STRUCTURES)

As an overview, the Canadian durability standard requires that buildings of different occupancy/use have minimum service life, such that most industrial, commercial, and institutional buildings should be expected to provide 25 to 99 years. The standard also requires consideration of major components, accounting for

- exposure conditions,
- difficulty and expense of maintenance,
- consequences of failure,
- current and future availability of components,
- design service life of the building, and
- technical or functional obsolescence.

When considering the durability of exterior walls, the cladding combined with the structural makeup are the major considerations. There is a functional relationship between the durability of the cladding configuration and the structure itself. As summarized by Day (2003), there is an associated

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risk with each type of wall structure selected (concrete, masonry, steel, or wood stud, etc.), especially with regard to long-term exposure to moisture ingress.

DURABILITY FOR EIFS

Empirical evidence suggests that the hygrothermal resistance of the lamina is seen to be paramount for the predicted longevity of the cladding system; the combined cycles of wetting, freezing, heating, and flexure (movement) are the prudent approach to qualifying the durability of these assemblies. In this regard, there are existing methods, which are summarized in the following section. The phrase *hygrothermal resistance* is new; however, this author proposes that the testing of a system (not individual components) for the combined loads described above.

Assessing the durability of EIFS was first presented in 1988; the European Union of Agrément (UEAtc) published the document, *M.O.A.T. No 22—UEAtc Directives for the Assessment of External Insulation Systems for Walls (Expanded Polystyrene Insulation Faced with a Thin Rendering)*. The UEAtc later became the European Organization for Technical Approvals (EOTA). In March 2000, *ETAG 004—Guideline for European Technical Approval of External Thermal Insulation Composite Systems with Rendering* was published with more advanced requirements, such that EIFS lamina is expected to resist multiple cycles of moisture content and temperature change.

In North America, the only attempt to assess durability of EIFS was initiated by the Canadian Construction Materials Centre, within the Institute for Research in Construction, a division of the National Research Council of Canada. The test method was devised with some similarities to the M.O.A.T. No 22 document. However, the EIFS must be exposed to the combination of temperature changes, moisture content, and deflection caused by wind pressure:

- Initial saturation of the panel with 13.5 L of water, applied at 15 L/h for not greater than two hours, and allowed to drain for one hour
- The panel is subjected to 60 cycles, 66°C with wetting and then freezing at –20°C, ±1200 Pa
- Tensile adhesion performed on specimens cut from the panel cannot lose more than 20% of original strength
- Water penetration through the substrate water penetration barrier is not permitted

Based upon the CCMC methodology, three key aspects of EIFS durability can be demonstrated: (a) the exterior lamina must be hygrothermally stable and watertight, (b) the lamina must be resistant to flexure while under hygrothermal loading, and (c) the water penetration barrier and related components must prevent water (introduced while in the initial wetting stage or during the water spray cycles) from making contact with the sheathing.

Except for the durability aspects of EIFS performing as a composite system, resistance to ultraviolet, fungus, water penetration, wind, etc., have all been fairly benchmarked (Day 2001). Beyond the consideration of the hygrothermal resistance, the general performance of the assembly should be tied to the serviceability of the cladding. In the case of EIFS, the following deductions are reasonable service life expectations:

- Sealants require replacement every 5 to 20 years (varies widely due to application issues)
- Surface cleaning of dirt and dust, every 3 to 15 years, depending on color and owner requirements
- Painting of the finish, or refinishing due to color fading or stains (due to improper rain deflection/flashing), every 10 to 25 years

Abnormal repairs could include:

- Cracking due to unexpected substrate movement or workmanship defects can be patched as required; older systems could be overclad with new lamina (this is a rare requirement).
- Water penetration and damage to substrate, which would require substrate repairs and/or replacement, thereby requiring EIFS replacement.

Despite the media and public perception of problems associated with EIFS, and the admittedly higher associated risk of water damage in walls due to a reliance on many face-sealed EIFS, well over 5,000,000,000 ft^2 of EIFS has been installed in North America and, statistically, there has not been sufficient evidence to suggest that face-sealed EIFS is any more problematic than other types of cladding systems relying on face-sealed exterior barriers.

The situation remains that the assessment of EIFS durability is necessary; however, the scale at which it is being tested does not account for project-specific conditions or exposure. The dichotomy of the testing and evaluation of EIFS lamina components forming part of a large-scale assembly versus having redundant moisture protection for EIFS-clad substrates elicits the following queries:

- Assessment of lamina durability is useful; however, moisture protection of the substrate system reduces the necessity to substantiate that the durability will remain watertight for the life cycle of the cladding (not that this should be ignored, only that the emphasis on watertight lamina could be reduced in view of added protection provided by preventing incidental moisture from contacting the substrate).
- If EIFS lamina durability is not the paramount concern of EIFS durability, then the watertightness of the substrate barrier, water penetration barrier, or drainage plane (by whatever definition may be preferred) must be qualified as being (a) a waterproofing material, capable of withstanding up to 1000 Pa of static water pressure,

not exceeding a level of moisture absorption coefficient of 0.004 kg/($m^2 \cdot s^{1/2}$) or (b) a water-shedding material such as housewrap or building paper that requires a defined capillary gap, thus preventing the potential for static water pressure to cause moisture infiltration.

- Definition for a capillary gap for EIFS having a water shedding and/or waterproofing substrate barrier is still required; however, capillary entrapment of moisture within EIFS clad wall assemblies should not be expected to occur when a drainage medium of greater than 1 to 3 mm is provided with an open pathway for egress.
- Since the normal level of incidental moisture that could enter the concealed plane of an EIFS clad wall is far less than the volume of water being tested by any of the current methods described here, research into the net effect of drying has yet to be qualified.

As the ULC-S716 standards continue to develop, the validity of the conclusions put forward here should be accepted by the larger building science community.

Many years have passed since face-sealed EIFS was introduced, and only in the last ten years has the realization occurred that moisture management should focus on interface and joint detailing and deflection of rainwater (Day 2003). Beyond this realization, there have been widespread failures of various building envelope systems, most of which fell victim to poor design, inadequate quality of construction, and unacceptable selection of materials. As the construction industry takes these lessons and makes the necessary corrections, it is prudent to research the actual variables affecting building envelope performance.

Ultimately, consensus standards that address the durability of EIFS will always rely upon component testing as the qualification for constituent materials and assessment of the interrelationship of the same components, and durability will be defined first by design of the wall, then by selection of the system, and then by the capabilities of the system itself. In short, by virtue of the moisture management requirements set forth for EIFS, durability of the lamina (although important) should not be the primary objective of evaluation; rather, it is a byproduct determined by the evaluation of the components and the design intent of the wall assembly.

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