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Research to Improve the Performance of Stucco

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It's impossible to drive through a new suburb without noticing the rise in popularity of stucco, or portland cement plaster, as an exterior finish. Relatively inexpensive, durable, attractive — it makes a fine finishing for a home. Unfortunately, in some cases, wood-frame exterior walls with a stucco cladding have failed to perform to design expectations in locations with heavy or sustained rainfall.

Studies show that stucco cladding with low liquid diffusivity and high water vapour permeability can positively influence the overall moisture management capacity of wood-frame stucco walls. For this reason, the NRC Institute for Research in Construction (IRC), in cooperation with Canada Mortgage and Housing Corporation (CMHC), is working on a project to improve the performance of stucco cladding by modifying existing mix designs and testing new materials.

NRC-IRC researchers have worked to develop a portland cement stucco material that would limit liquid water entry on its exterior surface and at the same time allow water vapour to transmit through it. For the purposes of the project, they considered the stucco as an isolated component of the exterior wall system: they did not investigate system performance of the wall assembly with stucco as a cladding. The effects of imperfections, defects and anomalies typically found in exterior wall systems also fell outside the scope of investigation.

For comparative purposes, Phase I of the research established the basic moisture transport properties of stucco mixtures presently used in Canadian housing construction (i.e. base case stucco materials). Phase II investigated the performance of modified stucco materials. The four novel stucco materials included:

1. Hydrophobic coating on exterior surface

The first trial used a hydrophobic (water repelling) coating (Triethoxy-N-Octylsilane) applied directly to the exterior face of one of the base case stuccos. Although the hydrophobic coating was likely to reduce liquid water entry (low water absorption coefficient), it was known that it could also reduce the water vapour transmission rate.

2. Hydrophobic aggregate

The second mix used hydrophobic aggregates in the likelihood that they would reduce the water absorption capacity of the stucco material without reducing its ability to transport water vapour through it.

3. Aggregates coated with hydrophobic chemical

The third trial mix used graded dry natural sand that was soaked in a hydrophobic liquid and then dried. This treated sand was then used as hydrophobic aggregate for the stucco mix design.

4. Zinc stearate admixture

The fourth and last mix used zinc stearate as an admixture. When added to plaster, zinc stearate is known to decrease the liquid water transport properties and water vapour sorption capacity of plaster; it also changes water vapour permeability. In this study, zinc stearate was used as an admixture.

The results of these limited tests showed that the hydrophobic coating reduced the water absorption but also resulted in low water vapour permeability. The stucco mix that contained the hydrophobic aggregate had the highest water absorption coefficient among the modified stucco materials.

The trial stucco mix using aggregates coated with hydrophobic chemical and the mix using zinc stearate as an admixture showed promising results. Both had relatively low water absorption coefficients combined with high water vapour permeability compared to the common stucco materials used in Canada.

This pilot project, which involved studies on small-scale specimens, investigated the possibility of improving the moisture management performance of stucco materials. The research showed that it is possible to alter stucco mix designs to reduce the liquid water absorption coefficient of the stucco material without reducing water vapour permeability. Based on these positive results, further work is required to refine the stucco mixtures and validate the utility of these results through full-scale system investigation and numerical modelling. NRC-IRC has initiated a new research project to examine all these issues.

If you have questions on this project, or if you are interested in participating as an industry partner, please contact Dr. Phalguni Mukhopadhyaya at (613) 993-9600, or e-mail: phalguni.mukhopadhyaya@nrc-cnrc.gc.ca.

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