BY DON PROCTER

A Case For Hydraulic Nortar

Like everything old, hydraulic lime mortars are new again, finding a place in historic restorations



illions of dollars a re spent each year on repointing mortar and associated masonry repairs to old commercial and residential buildings in Toronto's predominantly brick 19th century inner city. This thriving business for Canada's conservationists is bound to grow as buildings age and incompatible mortars from recent decades fail.

In the 1960s and 1970s, portland cement-based repointing mortars were applied with good intentions to old brick- and stone-clad buildings. But as is sometimes the case, those good intentions ran amok: The marriage of old with new has not always worked.

While the walls of modern buildings are designed to be impervious to air and vapor movement in and out, the walls of older building stock generally were made permeable, allowing the slow flow of moisture and heat from the inside out. When historic buildings are repointed with modern, impermeable mortars, moisture and heat are released only through the masonry units. As a result, the masonry units may incur extensive damage in as little as 5 to 10 years. The masonry industry has learned from its mistakes and now looks to repointing and repairing historic masonry structures with mortars that are similar, or at least equivalent, to the original hydrated lime mortars. But in recent years there has been a growing debate over the use of one of those perceived equivalents: hydraulic lime mortars, a distant cousin of hydrated lime mortars. Unlike hydrated lime mortar, which sets via the absorption of carbon dioxide in conjunction with dampness, hydraulic mortars set under water.

Hydraulic mortar is not new. In Europe, evidence of the product has been found in buildings 1000 years old. Today, hydraulic mortars are enjoying a comeback in countries like England, where they are increasingly being specified in masonry repairs of historic buildings.

A question of testing

While proponents say hydraulic mortars have proven themselves in Europe and have earned a place in North American masonry buildings, critics claim that hydraulic mortars have not undergone comprehensive testing in North America. Much of the debate centers on the use of hydraulic mortar on two of Canada's most important historic buildings: The Peace Tower and the Library of Parliament, both part of the Parliament Hill complex in Ottawa.

As part of a multiyear restoration of the complex, work on the 74-year-old Peace Tower was completed in 1996, and a 3-year restoration is in progress for the older Library of Parliament, which opened in 1876. Hydraulic lime mortar was used to restore the Peace Tower and now is specified for the Library. Both buildings originally used hydrated lime.

Opinions vary on what defines comprehensive testing methodologies and procedures and whether the hydraulic mortars being used on Parliament Hill have received a passing grade. Standards for mortar in modern buildings in Canada are specified by the Canadian Standards Association (Guideline A179 Mortar and Grout for Use in Masonry) and are included in the national and provincial building codes. Bond, moisture migration, and resistance to freeze-thaw cycles are key testing formats. However, more testing leeway is given to materials used in historic buildings, with only guidelines, rather than standards, mandated.

Margaret Thomson, a technical expert with Chemical Lime Co. in Las Vegas and a former research scientist at Canada's National Research Council's Institute for Research in Construction, is familiar with the events on Parliament Hill. She fears that the important historic structures there are being used as guinea pigs for a relatively untested product.

Thomson says to properly evaluate the properties of the hydraulic mortars used on the Peace Tower 5 years ago and now on the important Library of Parliament, testing should involve a group of experts who have collected data on the product over time and have come to a consensus on the product. "To date there's never been any of this," she says.

However, users such as conservation architect Spencer Higgins of Toronto-based Spencer R. Higgins Architect Inc., are at odds with critics like Thomson. Higgins, who specified the mortar in question at Parliament Hill, contends that hydraulic mortar did meet testing procedures at the time of the Peace Tower restoration. Since completing that project, the Toronto-based architect has used hydraulic lime mortars throughout Canada and as far away as Nebraska, where he helped a stonemason develop a hydraulic lime mortar specified for the stonework of a large custom home in the city of Lincoln. An architect from England designed the house.

The definition of the testing process itself continues to be a big question between the two sides in the debate. Higgins has designed his own testing facility, which contains a unidirectional freeze-thaw machine that exposes the exterior face of a test wall to a series of 50 to 100 freeze-thaw cycles over a period of seven to 14 days. Based on a European standard, the idea is to try to closely match field conditions, he says.

Higgins says experiments conducted at his Toronto lab point to an airentrained hydraulic lime grout as an ideal replacement for deteriorated grout at the famous 19th century library on Parliament Hill. The mortar's "micro-pore structure" demonstrated that it would absorb the stresses caused during the building's many



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Five years and holding

The hydraulic mortar specified by Higgins for the Peace Tower has stood up well over the past 5 years, according to Lyse Blanchet, senior conservation engineer with Heritage Conservation, the sector within the Canadian federal government's department of public works responsible for monitoring the mortar on the project. Blanchet also is national coordinator of the development of national masters specifications on historic mortars, which has yet to be completed.

"The key is to be careful and do some testing," Blanchet says. "We've realized hydraulic mortars stay as the sacrificial component [whereas] some of the other mortars that have been used on historic structures damage the masonry."

A 5-year track record does not impress Michael Hatzinikolas, executive director of the Canadian Masonry Research Institute based in Edmonton, Alberta. "We should be damned sure that we are restoring our buildings to last at least as long as they lasted the first time around," he says. "Why do we have to restore them with materials whose properties are unknown?"

Hatzinikolas says that while a project architect or structural engineer should be responsible for submitting such new materials to standard testing methods, the project's owner also should demand testing. Ideally, analysis would be conducted at two unaffiliated labs, he says. Many university and public labs in Canada have the capability to test these mortars.

An ancient history

Over his 30-year career, the respected heritage conservation consultant Keith Blades has used a wide variety of mortar types ranging from hydraulic mortars to portland cement-based mortars. Blades sees a place for hydraulic mortars in the North American historic fabric. Citing evidence that some of the earliest buildings in Canada contained feeble hydraulic mortars, Blades says even the ancient Romans created hydraulic mortar by adding volcanic ash to lime. Fired brick or terra cotta was discovered to produce the same hydraulic properties.

"It's what enabled the Romans to build harbors and aqueducts," Blades says. "In fact, the ancient Hadrian's Wall running through England and Scotland was built with a hydraulic lime." Even so, critics use climatic distinctions as a case against hydraulic mortars, which are made primarily in Europe.

Paul Maurenbrecher, research officer at the Institute for Research in Construction in Ottawa, sees a market for hydraulic mortars in Canada, but he insists conservationists should take a cautious approach. He echoes Blades' comments that hydraulic mortars unable to quickly dry after exposure to moisture may deteriorate and fail rapidly.

"I wouldn't say 'Amen' on projects like the Peace Tower or the Library of Parliament, and I think its general use should be restricted to restoration projects and conservation work and even there we have to be careful until more testing is done on it," Maurenbrecher says. "Having said that, if an existing mortar is weak, there may be a case for using hydraulic mortar."

Most experts agree that mortars containing a high lime content offer significant advantages for the restoration of older masonry buildings. About the worst said by practitioners is that while hydraulic mortars are highly workable and set hard in 24 hours, they can be tricky to use and take months to gain their full strength. However, many of the techniques for producing and applying traditional lime mortars were lost and must be relearned. These mortars are also less forgiving of poor construction practices; good quality control and site supervision (material proportioning, mixing procedure, joint preparation, pointing procedure, and curing conditions) are needed to ensure success.

A mistake contractors make when using lime-based mortar, be it hydraulic or hydrated, is to apply it too late in the building season. Unlike denser, modern mortars, the soft mortar must be kept moist for at least a week. If neglected the lime can be "sucked" out by the masonry units, causing shrinkage and cracking. Contractors should apply lime mortar at least three months before the first freeze.

One deterrent to hydraulic mortar is its price. It costs up to five times more than hydrated lime mortars. Both Higgins and Blades maintain that when compared to the costs of labor, the price distinction is insignificant. "Whether you are using a \$5 material or a \$50 material you are still spending \$500 in labor to put it on," says Higgins, who uses hydraulic mortar imported from Italy and France where it has been extensively tested.

He says Canadian and American conservationists and contractors should be open to using hydraulic lime mortars. "Because of Canada's connection with the United Kingdom there's been a good relationship between professionals there and here. That is now starting to spread down to the United States."

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