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IMPACT ON THE INDUSTRY

Research says new test reveals the hard truth about exterior claddings

Fig 1 - Exterior wall repair.

Picture a bustling schoolyard at recess with children everywhere, swinging on swing-sets, chasing one another, playing ball-and against the school walls over and over. Now picture the same schoolyard late in the day, after all the children have gone home: lonely maintenance person mixing up stucco patching material, repairing holes and damage in the stucco walls.

If you have not guessed already, we are going to talk about impact resistance. I would start the article off with the story of the flimsy wall system that was installed next to the golf course, but I couldn't do it justice without any photos. Just picture a large slice of Swiss cheese.

School buildings are not the only structures subject to high abuse. Prisons, commercial buildings, hospitals, even single family homes can be put to the test when it comes to the durability of their exterior claddings. Impact resistance besides being something our lonely maintenance person wishes the school architects had thought of-can be defined as the relative abilities of materials to resist the impact of a foreign object.

We have all read the literature about products claiming to have "such and such" impact resistance according to "such and such" test procedure, but the truth is that there is no widely accepted standard test method for determining the impact resistance of an exterior cladding, or wall system. Some commonly used procedures subject a test specimen to impact with increasing amounts of force until failure. However, these methods best measure the ultimate strength of the sample, and often do not compare different types of systems accurately (conventional three-coat stucco vs. EIFS).

Another test method involves dropping a steel ball on a horizontally oriented specimen, and measuring the vertical I rebound of the steel ball. The reasoning is this: We know ' what the potential energy of the steel ball at the drop was (by its height and mass). If we subtract from that its energy at the lop of the rebound, by the laws of physics we arrive at the amount of energy absorbed by the wall sample. Other than the fact that most walls are vertical-and this Lest method doesn't exactly work well with a vertical sample – it is also difficult to measure the exact height of the rebound of the steel ball. Again, since most of the types of materials we deal with are fairly inelastic and absorb a majority of the impact energy-giving a low rebound-it becomes very difficult to measure the difference between test samples.

ANOTHER WAY

A testing method I recently developed at the University of California, Los Angeles, overcomes these problems. The idea is similar to the steel ball that is dropped on the test sample. However, the new method uses a steel ball that pivots on a rod, similar to a pendulum. See the diagram of the test setup, in Figure 2. A test specimen is constructed to replicate the actual wall system as closely as possible. In this case, the test specimens were square frames made up of 2-by-4s at 16 inches on center, with the wall system applied to replicate an actual installation. At rest and hanging vertically, the steel ball just touches the wall specimen.

While sample "walls" were used in this test, the machine can also be used to test actual walls. To test the impact resistance of the wall, the rod is set at 90 degrees to the vertical and released. The rod pivots as the ball accelerates due to gravity. AL the bottom of the arc, the ball strikes the

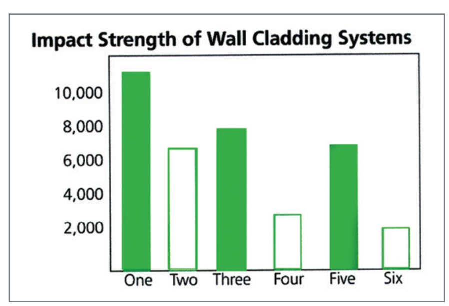

Fig 2 - The test specimens were square frames made up of 2-by-4s at 16 inches on center, with the wall system applied to replicate an actual installation.

wall and rebounds. The rod then pivots back to a certain angle, which is precisely measured by a ratcheting pointer with a one-way latch.

From the recorded angle, and with a little math, we can find the height of the rebound and determine the energy absorbed by the wall. This absorbed energy is used to cause damage to the wall. Therefore. the wall that absorbs less energy-that with the greatest rebound-is more resistant to damage. We can also measure the damage caused to the wall and factor that into the measurement, as well. This gives us the energy required for a certain amount of damage-the "impact strength" of the wall.

Several wall systems were evaluated in the development of this testing method, and the results can be seen in the graph, figure 2. "Walls" 1 through 3 were three-coal exterior plaster; number I was made with high-performance "premium" plastic cement, number 2 was made with Portland plastic cement and number 3 was made with a Portland cement and lime blend. Walls 4, 5 and 6 were popular one-coat systems.

Different size and weight steel balls can be used to pound the test walls into oblivion, and while it was a lot of fun to watch these walls "blow up" (some literally exploded), the most interesting results came from those tests that produced the walls with the least damage. When the porosity of the materials was tested, it was found that the systems utilizing the least porous materials (those with the greatest density) had the highest impact strength.

VIVE LA RESISTANCE

While this makes perfect sense and sounds intuitive, it is not always easy to prove. Therefore, as a rule of thumb we can look for the material with the highest density and be pretty safe in the assumption that it has higher impact strength, right? Well, not exactly. The density rule sometimes breaks down when we compare systems of entirely different construction, such as conventional three-coat vs. EIFS. However, the measured impact strength does not lie.

While the initial study concentrates on exterior cladding systems, the procedure and testing apparatus developed can be used to measure the impact strength of virtually any coating material, interior or exterior. The driving force behind my research and development of this method was the desire to produce a reliable, universal test method that can be utilized in the field as well as the laboratory. With the development of highly advanced, stronger and more impact resistant construction materials, the only thing left to worry about is whether or not that baseball is headed for a window.

About the author: Ken Vallens is a product development engineer and consultant to the plastering industry_ Equally at home on the job site or in the laboratory, he holds degrees in chemistry and materials science/engineering from the University of California. Los Angeles. He has written for several scientific journals, including Cement and Concrete Research.

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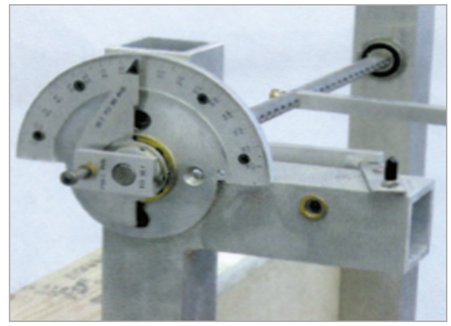

Fig 3 - Testing equipment.

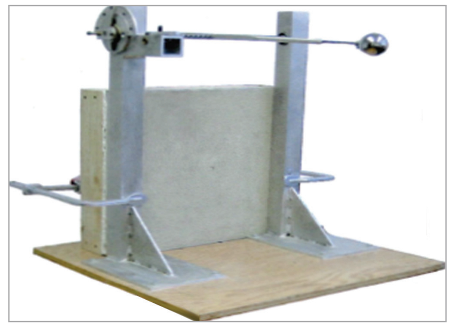

Fig 4 - Testing equipment