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# POST-FRAME SUCCESS

## Post-Frame 3-hour fire wall surpasses three-hour test

An hourly rated wall — rated as high as 3 hours — may be required to separate building areas or occupancy types to meet the International Building Code requirement for life safety. For architects, builders and engineers, this usually means using a rated 8-inch or 10-inch concrete block wall on a concrete foundation. But what about using a wood-constructed fire wall?

In this interview, Leo F. Shirek, co-chair of the Technical and Research Committee of the National Frame Building Association, member of its 3-Hour Post-Frame Fire Wall Subcommittee, and winner of NFBA's 2011 Perkins Award (**see page XX**), describes why and how NFBA successfully developed a post-frame fire wall.

He and other NFBA leaders predict that a wood-constructed wall will prove an extremely competitive and cost-effective alternative to a traditional block wall system.

**Q: Please describe the recent 3-hour fire-wall test and explain its significance.**

A: The post-frame building system is categorized as a Type 5 structure under the IBC. Under certain conditions in which occupancy separations are required — as with a high-hazard manufacturing occupancy — a 3-hour fire wall is required, often using a concrete block wall.

Current 3-hour wall assemblies using a noncombustible framing system (for example, light-gauge steel stud walls that have three or four layers of drywall on both sides) are also employed. In all these cases, a foundation wall is required, which is more expensive than using the post-frame system commonly used in the rest of the building.

We began testing work for this project in early 2011, knowing that, from an industry standpoint, we could create a wall that was much more cost-effective than a typical block wall, which costs $12–$15 per square foot. We felt that a post-frame fire wall with drywall could potentially halve that cost.

With a post-frame fire wall, we eliminate a tremendous amount of inconvenience in terms of scheduling other work trades like the block or foundation work.

Generally, work on the concrete block wall would be scheduled before the rest of the structure was built, whereas a post-frame wall can be built and incorporated into the natural flow of the building process, possibly saving as much as a couple of weeks in completion time. Besides the scheduling convenience, it's cost-effective.

This wood-constructed fire wall is a unique product and quite a testimonial to our industry's achievement. Our subcommittee had numerous ideas that were incorporated into the final design, but we also turned to two industry experts to help us in our investigation to determine the final framing and sheathing design: Kuma Sumathipala, PhD, of the American Wood Council and Robert H. White, PhD, of Forest Products Laboratory, Madison, Wis., where we conducted six small-scale preliminary tests that helped with decision making on the final design.

NFBA has tested an efficient and economical post-frame 3-hour wall system that can now be incorporated into a post-frame building without having to go to more expensive non-wood framing systems.

**Q: How did the small-scale test assemblies differ?**

A: One area of difference was the framing systems. We tested a known UL [Underwriters Laboratories] 3-hour light-gauge steel assembly to represent our control assembly to gauge further testing results against. We tested a wood assembly with bookshelf girts. And we also tested assemblies with 2 x 4 girts on each side, 16 inches on center, typical for the final design. We tested the adequacy of the columns by experimenting with additional lumber plies as well as gypsum cover plates to provide additional fire protection. We ultimately used a 4-ply column with the fourth ply as a sacrificial member to the fire. We also tested the effects of insulation in the cavity. As to gypsum sheathing, we varied the number of layers per side at 3 and 4, along with testing two grade types, type C and type X. Type C drywall is a little bit more fire-resistant but did not present itself as such in our test, and that is one reason we settled on four layers of type X. Our final assembly then was a post-frame structure with four layers of 2 x 6 laminations in the columns, spaced 8 feet apart with 2 x 4 girts 16 inches on center applied horizontally on each side. This frame was then sheathed with four staggered layers of 5/8 type X drywall on both sides. All joints were untapped.

When a 3-hour wall is deemed necessary to meet the IBC, a post-frame fire wall provides an already economical building system with additional savings.

In the test, our assembly nearly made 4 hours (3 hours and 47 minutes), thus obtaining UL's 3.5-hour rating. The UL testing group nicknamed our assembly "the Fortress" because they normally test stud walls and the like. This test presented a different challenge for them, and you can see by the results that we earned the name. It's quite a testament to the quality of post-frame construction.

**Q: Are you planning further tests?**

A: Well, yes, in a way. We do have the opportunity to obtain other hourly ratings based on this test through a "UL engineering study" for lower-rated walls. Possibilities are a reduced layered 2-hour post-frame system. Many possibilities exist and our committee will be exploring these. We are optimistic that this test will be a building block for other approvals and possibly for other future tests that can benefit the industry. When you compare post-frame fire walls to other building systems, our structures provide a tremendous economic advantage. Post frame is much speedier to erect than a stud-wall system or a light-gauge steel-stud wall system, and especially speedier than block walls, which generally require an expensive foundation.

**Q. Do UL test assemblies need to be followed precisely?**

A: The UL-approved assembly came about by confirming the adequacy of a 10 x 10-foot tested sample of what will be built in the field. These tests follow the requirements of the UL 263 (ASTM E119) standard of ASTM International [formerly known as the American Society for Testing and Materials]. One must follow stringent requirements to pass this test. For this testing we went to UL, in Northbrook, Ill., in December 2011. To pass the test, two duplicate test assemblies were run. In the first fire test, the assembly's test-to-failure duration was 3 hours and 47 minutes. In the second test, the assembly was subjected to a fire test of one hour and then a stringent water-pressure test.

There were a few notable points about the fire test:

- When the assembly frame was tested, a load was added to the structure to simulate maximum roof loads that the columns on the building are capable of carrying. Hydraulic pressure rams were used to put a load on the assembly of about 42,000 pounds — a lot of weight.
- UL is very thorough. The testers weigh every piece of lumber that is part of that assembly for calculation of the tare weight of the sample. The spacing of screws was quite methodical to eliminate the possibility of over-populating fastener holes in the previous gypsum layers, thus possibly affecting assembly performance. That is good, prudent work.
- A blast of fire comes out of 20 holes during testing to bring the furnace to about 1,800 degrees F. Thermocouples within the furnace and at various locations on the assembly sense the temperature, which is sent to and recorded on computers in a nearby control room. This log of data helps in any later engineering study for other possible approvals based on this test.
- An hour into the test, the exposed gypsum drywall loses its moisture and starts to shrink up. Joints start to open up. At 2 hours, two layers of drywall had fallen off, and a half-hour later a flame began exposing the fourth layer. At nearly 3.5 hours, the last layer of drywall began breaking off, exposing the wood-frame cavity.

**Q. What is your final message concerning this test?**

A: NFBA has tested an efficient and economical post-frame 3-hour wall system that can now be incorporated into a post-frame building without having to go to more expensive non-wood framing systems. When a 3-hour wall is deemed necessary to meet the IBC, a post-frame fire wall provides an already economical building system with additional savings. ***FBN***