

WHOLE HOUSE DESIGN AND THE LOWLY NAIL POP

by Liza Bowles and David Dacquisto

An e-mail newsletter came the other day with a story on a new J.D. Powers survey about customer satisfaction among the buyers of new homes. The survey was regional, and within this particular region customer satisfaction was down. The story went on to say that at the top of the list of customer complaints were nail pops, cracks and other drywall problems. If the survey had been done 20 years ago, the same items would probably have been at the top of the list.

Why can't we solve such seemingly simple problems? Perhaps it is because there are so many variables in a house, so many styles, products and materials, that it is much more complicated to build a "problem free" house than it seems on the surface. Increasingly the response is to call for analyzing the house as a whole system, rather than looking at it as a collection of products and parts.

The idea of systems-oriented "whole house design" is appealing, especially insofar as it can improve the house delivered to the customer. A house is made up of an enormous number of parts and dozens of subsystems that interact with one another and with the environment over time to produce the finished product. As with most complex devices, a change in one design or material can sometimes have unintended consequences on performance if not carefully thought through. Yet changes in house designs or material specifications are usually made in isolation, with little or no consideration of how changes in one system can influence the performance of another system, or how the overall performance of the house may ultimately be affected.

In recognition of the negative and positive implications of systems interactions in a house, builders and manufacturers have been enthusiastic in supporting PATH research in the area of "Whole House and Building Process Redesign." The promise this research holds for a new level of customer satisfaction and building quality can be illustrated with a nail.

Consider that even the lowly nail pop can be viewed in a larger systems context. It seems to spring from nowhere, like a mushroom, well after the house is completed. It is usually not a defect with the fastener,

Suggestions from PATH Partners

Given the current lack of whole-house tools and optimized solutions, if you want to get nail pops and drywall cracks under control, you might want to consider these suggestions from PATH partners. Just beware of the unintended interactions!

- Always glue and screw
- Use dry lumber and dry gypsum
- Use steel for interior partitions
- Observe drywall installation requirements including installation temperature and control joints
- Consider resilient channels
- Make sure you have a tight connection between the drywall and the framing when using R-15 high-density insulation in a 2 x 4 wall

"Six or seven years ago, we switched to tape-on corner bead," notes Brad Olsen, VP Operations of Shea Homes. "Usually the wood moves, and the drywall cracks. All corner bead cracking has gone away. It's saved a lot of cost and frustration and heartache with customers."

There are several good resources such as the *Gypsum Construction Handbook* available from USG which addresses fastener techniques for both wood and steel, how to avoid cracking, including an excellent chapter on problems, remedies and preventive measures. There are also some new products as well as additional information listed on their web site at www.usg.com.

The Wood Truss Council offers installation details at www.woodtruss.com which are also very useful.

the drywall or even the stud, although if the building materials have a high moisture content when installed, the likelihood of trouble increases. But even with proper installation, as the moisture content of the framing throughout the house seeks an equilibrium with changing levels of outdoor and indoor temperature and humidity, and as different materials expand and contract with changes in moisture, differential movement will occur and stresses will develop. When the stresses become large enough, the fasteners can withdraw. Even a tiny amount of withdrawal can lead to a visible nail pop, especially on a surface like drywall that is smoothed and finished with great attention to detail. So in this way, the entire house can interact with the outdoor environment and the conditioned indoor spaces to cause a tiny but unsightly failure at a single point—or lots of tiny unsightly point failures. Drywall cracks can result from similar processes.

At this stage, although a few of the basics are reasonably well understood, "whole house" analysis is more of an art than a science. PATH-sponsored research is focused on developing tools such as a "whole house calculator" that will ultimately allow designers and builders to understand more and more about the implications of changes to house plans and product choices. They can use this understanding to avoid problems, take advantage of synergies, or just make trade-offs. But tools for mass audiences clearly are not just around the corner. They are years away. The issues are just too numerous and too complicated. Most whole-house interactions are probably of very little consequence, but there are some important exceptions. The key to progress is focusing attention on the interactions that really matter most.

Whole-House Thinking

- Better windows, better insulation, and a tighter house, can allow downsizing the HVAC system
- A tight house can be susceptible to mold unless a positive ventilation system and/or dehumidifier is added.
- Skylights improve day lighting, but have energy impacts such as: larger demand on AC to counteract additional solar heat gain; and, added heat loss through the roof due to glass and shaft walls replacing an insulated ceiling.
- Changing wall stud spacing has implications for insulation as well as choice of siding products.