RAISING the bar with CONCRETE

By Carole McMichael

Photograph by James F. Wilson

When homebuilders talk "wish lists" with potential clients, they often expect to discuss architectural styles, such as Prairie, Tuscan, Mediterranean and ultra-modern, and popular amenities, such as spa baths, hearth rooms, hi-tech media wiring, and maybe even an indoor lap pool or a basketball court. However, since these clients are likely among the millions who watch shows on HGTV, they are increasingly aware of more important choices concerning building materials and the quality of life their new home will provide. They now come to builders with a different kind of wish list—one ideally suited to the benefits offered by concrete building systems.

Concrete benefits for residential

With the exception of masonry, which has a fairly long-standing acceptance by builders and homebuyers in the South, builders didn't begin to take concrete systems seriously until they became more widely available in the 1990s. Since then, they have continued to gain market share. These systems include insulated concrete forms (ICFs), concrete masonry, cast-in-place/removable forms, tilt-up, autoclaved aerated concrete forms and, recently, precast systems. These concrete methods now constitute more than 16 percent of new residential building projects.

Today, reduced energy costs are at the top of every client's wish list. Regardless of the price tag on the house, the utility bill keeps coming every month—and it keeps going up. Concrete is a step in the right direction. One of the top benefits of building with concrete is increased energy efficiency, which translates into reduced energy costs for both heating and cooling. Homeowners even save money before they move in because concrete homes require less HVAC tonnage than similar stick-built residences. Units are often one-half to two-thirds the size of standard-sized units for wood-frame homes.

Concrete itself is a naturally efficient heat sink, especially when positioned for solar advantage. Concrete walls help to maintain the desired inside temperature; the reduction of frequent fluctuation in temperature eliminates short cycling, preventing the waste of energy. Adding the correct amount of insulation to the concrete systems mentioned above will achieve an R-value of 40 to 50. Not surprisingly, concrete homeowners often experience a 30 to 60 percent decrease in energy bills. Word of mouth on such savings has proved to be a great marketing tool; one Michigan builder who combined concrete ICFs with solar roof panels reported that his entire electric bill for the winter was $45.

The proven energy efficiency of concrete has convinced some state governments to require insurance breaks for concrete houses that meet LEED (Leadership in Energy and Environmental Design) standards. The mortgage industry is beginning to get on board, too, offering Energy Efficient Mortgages (EEMs) that reflect a concrete home's ability to maximize the buyer's financial investment. See the sidebar on EEMs in this issue to learn more about these mortgages.

Energy savings are bound closely with home maintenance savings. Unlike wood, correctly installed concrete systems are not vulnerable to termites and rot. If the HVAC is the proper size, they are also free of toxic mold.

Many concrete homebuyers are retirees on a fixed budget, looking for a home that costs little to live in and requires little effort to maintain. Building with concrete produces a solid, sound structure that will last 100 years—all the while building equity instead of draining assets. If a concrete-built home is not their final home, the owners will find they have greater resale value than with a comparable wood-frame house.

Another benefit offered by concrete building systems is keyed to environmentalists' concerns about the waste of resources. The burgeoning interest in green building has created a growing market niche for builders who use concrete, which is in greater supply than wood. It also provides them with a very powerful argument for why clients should choose an alternative to stick-built housing.

Besides a healthier environment outdoors, buyers are also concerned about having a home with a healthy indoor environment. Once again, concrete fills the bill. Concrete building systems give off almost no fumes; the extremely tight construction, in conjunction with air exchangers, produces noticeably cleaner air. Clients who could not go near a stick-built construction site have tested concrete sites and come out believers in the air quality. With concrete's high level of noise reduction added, the buyer discovers what comfortable living is meant to be. As one builder put it, "What really sells the townhouse is what the clients feel when they are inside."

Next to energy efficiency, perhaps the most sought-after item on the buyer's wish list is safety, which happens to be one of the more spectacular benefits of building with concrete. The nearly annual wildfires in California and the West make buyers aware of the frequent threat to life and property from natural disasters. With close to a four-hour firewall, concrete homes are an incredible investment. Once buyers look at a picture of row after row of homes burnt to the ground, except for a beautiful concrete home that is left untouched, they will begin to consider concrete seriously.

The same could be said for many people on the "hurricane coasts." One concrete homebuilder reported that while Isabel's terrible storm winds were whipping the trees nearly flat outside, he couldn't hear a sound inside and the house weathered the storm without damage. In other parts of the country, tornados and floods wreak severe damage on wood-frame homes; concrete stands up to these disasters as well. Buyers can also take advantage of protection against man-made threats—terrorism and crime—by having a safe room, essentially a concrete envelope with steel doors.

Builder benefits

Although concrete systems provide potential buyers with the many benefits they seek, they have one more wish on their lists—to find a builder experienced with concrete. The good news is that every year, builder interest and numbers are increasing. The impetus for this trend is partly better informed clients, partly improved cost differential with wood-frame (sometimes no more than $1 per month in mortgage costs), partly updated codes that accommodate the needs of concrete construction, and partly the support of the associations dedicated to the different concrete building methods. The latter and the Portland Cement Association continue to pursue studies in conjunction with national housing groups to uncover even more advantages of concrete homes.

Photograph by James F. Wilson


Photograph courtesy of Rufty Homes, Inc.

Choosing a system

Whether you are a buyer or a builder, choosing the right concrete system involves doing your homework. The Internet is the ideal place to start. The sites for Portland Cement and other specialized concrete systems generally offer background on the building method, reports on studies, training sources, technical guidance, directories and literature. Association members have access to even more benefits. The following overview provides information on of the most commonly used concrete building methods and useful web sites on the topic.

Insulated concrete forms

Insulated concrete forms, or ICFs, are lightweight forms available in a variety of interlocking block or panel shapes. The forms are held together with fasteners and strengthened with rebar before ready-mix concrete is poured to create a wall. The rigid ICFs are made of expanded polystyrene (EPS), extruded polystyrene (XPS) or a cement-foam composite. They are a permanent part of the wall, providing an insulation sandwich when added to the concrete. Typically, there are 4 inches total of foam around 5 inches of concrete, but combinations vary.

The foam can be cut easily with a hot knife or router to create a conduit channel for utilities. Covering cuts with tape or spray-on foam will restore the integrity of the wall surface. When bigger channels are required, the recesses need to be set in the block before the pour. Preplanning is the key to the entire design process.

The flat wall surface serves as a backing for exterior material such as brick, lap siding or stucco. Some ICFs include studs that can be used to attach drywall for the interior finish. Although most builders do not use ICFs for interior room walls, narrower forms are available for such use.

There are a number of ICF designs, but most use blocks. They vary in size, thickness, fastening methods and specialties, like corners and curves. Panels offer a continuous expanse of concrete, which minimizes air leakage, but both systems eliminate convection currents within walls. Some ICFs use a waffle or grid pattern, where concrete is thicker in certain places. Builders can also go with a post-and-beam system, where the vertical columns are encapsulated with foam insulation. Whichever system a builder chooses, he can be confident that it has appropriate engineering for residential building and that it has been proved in the field and has met code requirements.

For more information, contact the Insulating Concrete Form Association (ICFA) at forms.org.

Concrete masonry

Concrete masonry blocks maintain their popularity for residential building because of the versatility in block style that takes advantage of insulation materials. Common systems include: interior insulated block, exterior insulated block, in-block insulation and mortarless insulated block. Generally, the least expensive interior insulated block is the favorite choice. The blocks offer excellent moisture protection because water repellant can be added to the concrete mix when the block is manufactured, and sealer and flashing can be applied on-site.

Exterior insulated block can easily increase the R-value of the masonry wall by increasing the thickness of the insulation. The exterior finish material can be placed directly over the foam. The concrete mass on the inside helps to reduce interior temperature fluctuation. Wiring and plumbing run through the block cavity or in a furred area prepared for drywall installation.

In-block or in-cavity insulation can be rigid foam pieces inserted in the cavity, loose polystyrene fill that is poured in, or expanding foam sprayed under pressure. Frequently, cavities with the greatest loads will be filled concrete, leaving the remaining cavities to be filled with insulation. This system achieves a moderate R-value that functions well in the South. Northern builders may choose pre-insulated block to reduce the size of the webs and add insulation beads into the concrete mix at the plant. These blocks meet high

R-value requirements and produce a lighter block that can be cut and nailed much like a wood product.

Mortarless insulated blocks are dry-stacked, with foam inserts placed in the cavities. A coat of bonding cement inside and out holds the blocks together, creating a continuous surface that acts as a barrier to moisture. The surface is ideal for plastering or stucco or, indoors, glued-on sheetrock.

To the buyer, variations in surface appearance, identified as architectural unit types, add textural interest. These types include: split-faced, scored, ribbed, burnished, glazed and offset units. Glazed masonry units offer a wide range of vibrant color options. Permanent colored facing, composed of polyester resins, silica sand and other chemicals, is bonded to the unit. The result is a smooth, impervious surface that is waterproof, resistant to staining and to many chemicals and bacteria. Natural color variations are achieved by varying the color of sand and aggregates as well as adding stains to the concrete mix.

Current masonry units are about 25 percent lighter than earlier traditional concrete blocks. They are also more cost-effective for homes and builders because masons can lay more units per hour. Standard block size (8 inches by 16 inches by a choice of 4, 6, 8, 10 and 12 inches) allows efficient modular layout of doors and windows. Additional size options expand designers' choices in custom home building.

For more information, contact the National Concrete Masonry Association (NCMA) at ncma.org.

Removable forms

The use of poured concrete removable forms in cast-in-place construction foundations, light commercial buildings, schools, clinics and multifamily dwellings is not a new practice. Now, thanks in part to the efforts of the Concrete Homes Council (CHC) under the Concrete Foundations Association (CFA), commercial builders are being encouraged to apply their considerable expertise to residential single-family homes.

The big advantage of removable forms is the time saved by working with lightweight forms that can be reused as many as 3,000 times. Builders do not need to invest in bracing or deal with the mess and unreliability of wood bracing. The smooth, flat exterior surface

Show Me the Mortgage

By Carole McMichael

If there is a sure sign that the growing popularity of concrete in the home construction industry is more than just a trend, it is the response of a centuries-old financial instrument: the mortgage. The response is a recognition of the value of energy efficient building strategies, and it is called the EEM, or the Energy Efficient Mortgage.

The energy efficient benefits provided by the various concrete building systems should make owners of these homes primary candidates for this type of mortgage. Concrete systems combine high R-value from polystyrene, the thermal mass of concrete and the enormous reduction of air leakage, meaning there is little infiltration of cold or heat to keep the HVAC from running up utility bills. A survey by Dr. Pieter VanderWerf at Boston University found that heating costs were reduced by 44 percent and cooling costs by 32 percent when using Insulated Concrete Forms for building.

In many cases, however, homeowners are not aware of EEMs or of where and how to apply for them. The EEM is available through government-based lenders, such as Fannie Mae, the Federal Housing Administration (FHA), the Veterans Administration (VA) and a number of private lenders. One lender that not only recognizes the importance of this new market, but also actively promotes reaching out to the public, is Lansing, Mich.-based, Indigo Financial Group (energyefficientmortgages.com). Indigo, a registered partner with the Energy Star program, offers the EEM in 37 states for remodeling a home for energy retrofits and for building a new home. For new homes, the mortgage covers the value of the home and property, not the cost of construction. In some cases, there may be a 5 percent equity credit, which could eliminate the need for private mortgage insurance.

After pre-qualifying for the mortgage, the next step in getting an EEM is having an energy audit (a Home Energy Rating System or HERS) performed on the remodel or on the blueprints of the new home. The audit covers things like placement of the house for solar advantage, number and placement of windows and doors, tightness of openings, E-value of glazing, type of insulation, type of lighting and HVAC, and use of power by appliances. Once the audit is complete, the builder or owner gets a list of energy-efficient choices, installation costs, the projected savings and payback. Then, they make their choices and determine the potential savings.

A study by the Environmental Protection Agency concluded that energy-efficient-built homes increase in value about $20 for every $1 decrease in the annual utility costs. The mortgage amount a lender will allow a homeowner depends on the debt-to-income ratio and reduced energy expenses; therefore, increased efficiency can make a large difference in how much he will lend. This means the homeowner can borrow more money to build a concrete home than to build a traditional stick-built house.

Depending on the area and the type of project, concrete houses generally cost a little more up front to build and require a higher mortgage. An EEM can make the difference when the homeowner decides whether or not he can build with concrete. He may not be able to afford more house in the sense of a larger residence, but in the sense of a better, safer, healthier and more risk-resistant home, it is definitely more house. From the lender's point of view, the benefits of concrete also mean the homeowner is more able to affordably maintain the house and be a stable customer for the lenders—everybody wins.

offers builders the option to cut finishing costs as well. The sandwich wall system, tunnel wall system and solid wall system are three common approaches to this kind of construction.

The sandwich wall system places rigid insulation between the forms and secures it with a system of non-conductive ties, strengthening the wall with rebar. Then, concrete is poured on either side of the insulation; when the walls are cured, the forms are removed. The tunnel forming system, which does the whole system (walls and floor or ceiling) in a single pour, is best suited to the multifamily dwelling designs that repeat floor plans.

Single-pouring a much larger area makes the curing process critical. To speed up the process, special heaters are suspended inside the forms. When heaters are used, the forms can usually be removed and set up for the next pour by the next day, increasing the cost-effectiveness of the operation. The solid wall system places the insulation on either side of the interior wall. The concrete, also strengthened with rebar, produces a solid concrete wall that is bonded to the insulation. The CHC and CFA have indicated goals to increase the number homes that use the removable form concrete system by 1,000,000 over the next three to five years.

For more information, contact the CFA at cfawalls.org and the CHC at concretehomescouncil.org.

Precast concrete panels

The precast panel system, like cast-in-place, comes to the residential industry from the commercial side of building. The system uses a concrete product that is manufactured and cured at a plant and then shipped to the home site. The builder takes the house plans to the plant that produces the exterior walls. Steel reinforcing, insulation and electrical wiring are added and rough openings are cut. The advantage of plant production lies in the opportunity for close control of mix design and curing temperature, and for custom design cuts for windows, doors and room size.

Once the trucks arrive at the home site with the precast walls, cranes lift them into place so the crew can attach them to the foundation and to each other. The ability to erect the perimeter walls in a few hours, in any weather, cuts construction time by about 30 percent, allowing interior work to proceed quickly.

A more common use of precast panels in residential buildings is precast, prestressed hollowcore floors and ceilings or roofs. These are manufactured with voids, making the units lighter and less expensive. Hollowcore technology is also applied to wall panels, spandrel members and bridge deck units. Frequently, custom homes will need to span a wide distance (as much as 600 feet) or provide the extra load-bearing strength to support floors for unusual design features, such as a swimming pool on a roof deck.

Recently, new carbon fiber grid technology that replaces rebar has made the precast panels much lighter and more cost-competitive with other concrete systems and even wood-frame housing.

For more information, contact the National Precast Concrete Association (NPCA) at precast.org and the Precast/Prestressed Concrete Institute (PCI) at pci.org.

Tilt-up

Tilt-up commercial construction has a long history, which means there are a number of builders and contractors with the expertise to apply their skills easily to building homes. The two-step process involves laying a concrete slab on which the crew will cast horizontal wall sections. Once they reach the proper strength after a week to 10 days, the sections are tilted using a mobile truck crane and set upright on the foundation.

The sections can also be produced in separate casting slabs. A ceiling or floor slab can be lifted into place for homes of more than one story. If the roof is not a concrete slab or hollowcore, the traditional roofing methods can be used.

One advantage of this system is that removable forms are not required. However, builders will need some form of temporary bracing to keep the walls in place while they are being connected and while joints are caulked. The walls are usually 6 1/2 inches thick, weighing about 40 tons. If the builder makes plans in the initial design, the panels can be detached and relocated to accommodate remodeling. As with most concrete building methods, there are several options for adding color and texture, which involve changes in the mix and surface-molding of the casting forms. The homeowner can select the tilt-up wall patterns that appear to be stone, wood grain, brick or striated concrete.

Tilt-up has been used in every state, but it is most popular in the sun-belt states and in California.

For more information, contact the Tilt-up Concrete Association (TCA) at tilt-up.org.

Autoclaved aerated concrete

The autoclaved aerated concrete industry has been growing at a rapid pace for the past decade. The AAC blocks, panels, lintels and cladding panels are made from a combination of cement, lime, an expansion agent, gypsum and a siliceous material. Although the product is comparable to concrete in strength, it weighs only 20 percent as much and can be worked like wood—drilled, cored, chased and cut to block tolerances within 1 millimeter. This characteristic makes it a comfortable cement system for crews used to wood-frame techniques.

AAC contains millions of tiny air cells that provide outstanding thermal insulation, so it requires no additional insulating material. These cells give the homeowner reduced noise transfer as well. AAC is also used along high-traffic highways near housing developments specifically to cut down on highway noise. This material does not decay, mold or require pesticides to protect against insect infestation. In a recent test for fire resistance, it showed signs of weakening only after eight hours. Besides being noncombustible, AAC provides a slow heat transfer that results in excellent energy efficiency.

Builders have a wonderful selection of products and finishes to choose from: standard, large and jumbo or panels blocks, 3-inch cladding, a variety of floor and roof panels, and specialty U-blocks and O-blocks. Finishes include a full range of textures and colors.

Financial advantages of building with autoclaved aerated concrete include the competitive installation cost, reduced operating costs, reduced insurance premium, shorter construction time and extremely low maintenance requirements.

For more information, contact the Autoclaved Aerated Concrete Products Association (AACPA) at aacpa.org.

Information on these systems was supplied by the Portland Cement Association and other concrete associations. CH

Photograph by Errol Russell