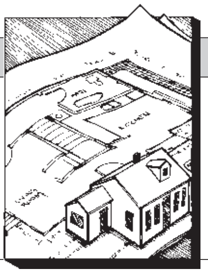

Building on Stilts: Seaside Solutions

by Gordon Tully

Houses built directly on the seashore are subject to periodic damage from large storms. To prevent large claims under the National Flood Insurance Program, the Feds (through local zoning regulations) have mandated special regulations for construction along the seashore.

If a home is entirely or partly within the "velocity zone" as shown on a special map (known as the FIRM, for Federal Insurance Rate Map), it must be built on sturdy piers so that the underside of the support structure is above sea level by an amount shown on the map. Everything built below this safety level must either be strong enough to resist the force of the waves, or weak enough to safely "break away" and disintegrate under wave action.

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I recently designed a home within the velocity zone, and want to pass on some observations concerning the special problems encountered with this type of construction.

Structure

While it is possible to drive pilings to support the elevated structure, in this case both aesthetics and security indicated a poured-in-place concrete structure. Our engineer used a clever scheme using 16-inch square concrete flue blocks as piers, filled with concrete and rebar, topped with a grid of concrete beams.

Conceptually, the structure resembles a table, except that the pier foundation is tied together with grade beams to avoid movement caused by the scouring action of the waves. You'll need a good engineer to work out the reinforcement and forming for this structure. But it is not particularly expensive for someone who is familiar with the work.

Why not build such a table-like structure out of wood? Beside the issue of durability and resistance to the impact of floating debris, wood has a problem at joints. Wood joints that resist tensile and compressive forces tend to loosen up when left exposed to the weather, especially at the seashore. The wood can split, holes can enlarge, and water can get into bolt holes and soften the wood.

Atop the "table," one can erect ordinary framing. But it is important to tie the structure down to the concrete support grid. Our engineer uses wood plates anchored into both the top and bottom of the concrete beam. The plywood wall sheathing then runs past the side of the beam and is nailed to both plates (see beam detail, next page).

Design

It would be simple to merely set an ordinary house on top of this raised concrete foundation. One can very easily cantilever the concrete beams out beyond the house to support a deck. Elegant, no?

Unfortunately for such simplicity, an ordinary house sitting on a bunch of stilts looks as uncomfortable as it sounds. Our standard house designs are proportioned to look good on the ground, and not a full story up in the air. A cantilevered porch adds visual insult to injury.

Precedents

Rather than try to invent the wheel, we looked to history to help us produce a satisfying building form while working around the engineering requirements. There are very few historic precedents for buildings on stilts, and even fewer for those of a modest, residential scale. Probably the most useful are certain French colonial homes, which have large porches surrounding the living spaces, with sheltering hip roofs extending out to the edge of the porch, supported by a two-story arcade (see illustration of the Fortier House, Figure 1).

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There are two important visual lessons to be learned from such houses:

- Bring the eaves down to the ceiling level of the main (now second) floor, so the house will not look tall and uncomfortable.
- Make the structure extend to the outermost part of the house—no cantilevered porches.

These houses were not exact prototypes for our project. For example, the lower floors were closed in and occupied, whereas there can be no usable space on the lower floor of a house in the velocity zone. The deeply shaded porches and recessed walls are a response to the hot, humid climate.

In our northern region, it makes visual sense to move the roof back from the edge of the porch, and to add a screen wall in the spaces between the porch posts. Nevertheless, the overall visual effect of the southern prototype was an excellent guide.

Another more monumental approach is to create an arcaded base, as in the example shown, a wing of a Virginia mansion known as Bremo (see Figure 2). The key design guideline here is to cut the arcade out of the building facade, so that the main floor is set back from the support structure—no cantilevers. We have added gussets at the top of the porch posts to suggest an arched opening. Note that a full arch would effectively increase the area of the porch posts and increase the resistance to wave action.

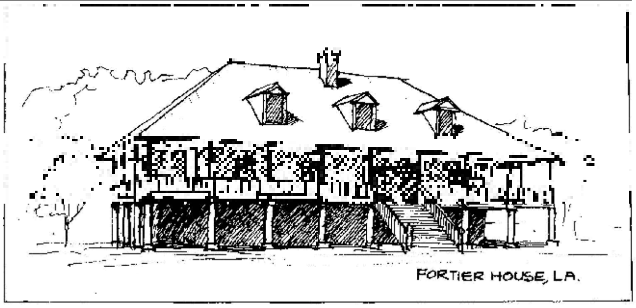


Figure 1. *The wide eaves carried down to the ceiling level make this French colonial look well-proportioned*

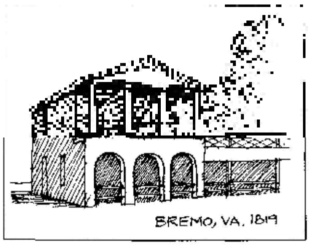


Figure 2. *The arcaded base of the Bremo house suggested a treatment for the substructure.*

Our design (see Figure 3) extends a porch around two sides of the small house, with an arcade of wooden posts supporting the outer edge of the porch. The wide eaves of the gable roof come down as low as possible, imitating the horizontal lines of the porch. The effect is an extended base topped by a massive, floating roof. Thus the height of the house extending right up to the 35-foot height limit) is disguised: It looks like an ordinary two-story house sitting on the ground.

Details

The porch posts needed to be smaller than the massive piers supporting the main house, so they were made of wood 6x6s. While not as strong as the main house piers, they rely on the house structure for their lateral stability and so do not have to stand alone.

At the line of the house, the basement level needed to be enclosed for equipment storage and security. After considering various kinds of panels, we ended up with the enclosure recommended by the Feds and by our engineer: a wall of unreinforced (but mortared) concrete-blocks masonry units (CMUs).

It is worthwhile discussing the problems with wall panels—to make clear the severe problems associated with break-away construction. Suppose that the wall panels do not break away from the structure when hit by a wave. The pier suddenly "looks" to the wave as if it were a full bay wide, perhaps 12 feet, instead of its real width of 16 inches: It must resist eight times the load from wave action.

If, however, the wall breaks away at the usually required 20 psf, the column experiences only a little more than the design wind load before the panel falls away (20 psf corresponds approximately to a 75 mph wind).

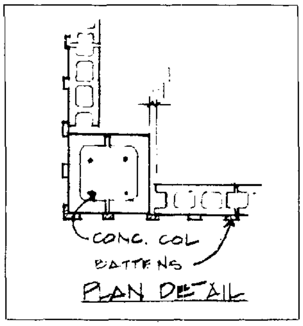
To achieve this result, the wall panel must not catch itself on, or jam itself within, the structure. To this end, a 2-inch gap is necessary between the panel and the columns at each side. One can cover the gap, as long as the covering will let go and get out of the way (see plan detail).

How can a panel be designed to break away at a particular loading? One way is to stiffen the top edge of the panel, and attach it to the structure only by a few carefully designed break-away pins. For example, a CMU wall is topped with a continuous bond beam held in place by one pin at either end designed to break at the required loading (see beam detail).

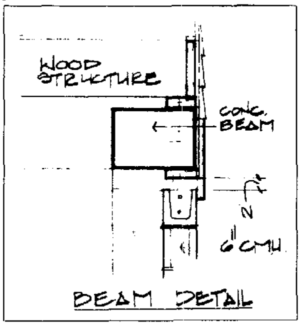
Once a panel falls away, it should break up into small pieces. CMUs are ideal: They simply fall down and stay more or less put. (A government expert cautioned that the waves would throw the CMUs around, scouring and damaging the structure; our engineer disagreed with this).

Wood panels are much harder to design, as a typical stud wall with

Figure 3. *The low, wide eaves—reminiscent of the Fortier house—work with the extended porch to disguise the true height of the building.*



Wood battens were added to the block walls to close the gaps at the columns and create an attractive pattern.



A grid of reinforced concrete beams creates a "table" to hold the wood frame structure. The concrete block walls underneath are designed to break away if battered by storm surf.

plywood skin will stay intact if waves break it away, and wreak havoc among the structural supports. Designing a wood panel to come apart is clearly at odds with designing it to resist wind loads and vandalism, and so the CMU solution seems at once more secure and easier to detail.

Given CMU construction, how could we make the base of our otherwise elegant, shingle-style house look better than a truck garage? We chose to disguise the block by attaching wood battens to the CMU wall at 8 inches on-center. These battens also close the gaps at the ends of the infill panels. We expect the shadows from the raked horizontal block joints to combine with the strong shadows of the battens to create a nice grid pattern.

Some code officials might allow a permanent full enclosure for the stair, but that's asking for trouble.

Some Other Considerations

How do you enter such a house? Well, the break-away concept simply has to be compromised by the introduction of a permanent stairway. In our case, we left the risers open, surrounded the stair with a break-away wall that must fall outward (it luckily points away from the water), and, put the front door at the top of the stairs.

Some code officials might allow a permanent full enclosure for the stair, but it seems to me such a structure is asking to be battered to pieces in a severe storm.

The second stair is off the deck, and is heaved up out of harm's way like a gangplank whenever the house is not occupied (the stringers are spindled on a pipe at the top).

Insulation can be a problem. The underside of the main floor must be heavily insulated, like a roof, by upsizing the joists (2x10s or 2x12s). Keep any horizontal plumbing at the top of the insulation: It is probably okay in most cases to cut the tub drain into the top of the (oversized) joists.

I ran all the house ductwork in the ceiling of the main level to avoid heating ducts in the floor, knowing that no matter how hard one tries, the ducts will not be properly protected if placed in the insulated floor.

Other Sources of Information

For more examples of historic precedents, consult the indispensable *A Field Guide to American Houses,* by Virginia and Lee McAlester, published by Alfred A. Knopf and available in paperback for about $20.

The "bible" on this subject is the *Coastal Construction Manual* published by the Federal Emergency Management Agency (FEMA), Document FEMA-55/February 1986, and available from the U.S. Government Printing Office.■

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