Making Space for a Barrel Vault

Modifying the existing trusses from below saved the cost of rebuilding the roof

by David Hanson

The owners of the 1970s home shown here liked to cook and entertain, but they were continually frustrated by a cramped floor plan. The original kitchen was tucked into a niche at the back of the house and felt cut off from other rooms. When they contacted our design-build remodeling company, the owners had no specific ideas in mind; they just knew they wanted a larger kitchen that connected with the spaces around it and included design features that would draw guests into the room — a "wow" factor, as they called it.

In response, our in-house architect came up with a plan that involved building an addition off the back of the house and relocating the laundry room to another area. The existing kitchen was around 200 square feet; we would be adding another 360 square feet and wanted to do something to make the area special. In many kitchens, the island is the centerpiece of the room, so we decided

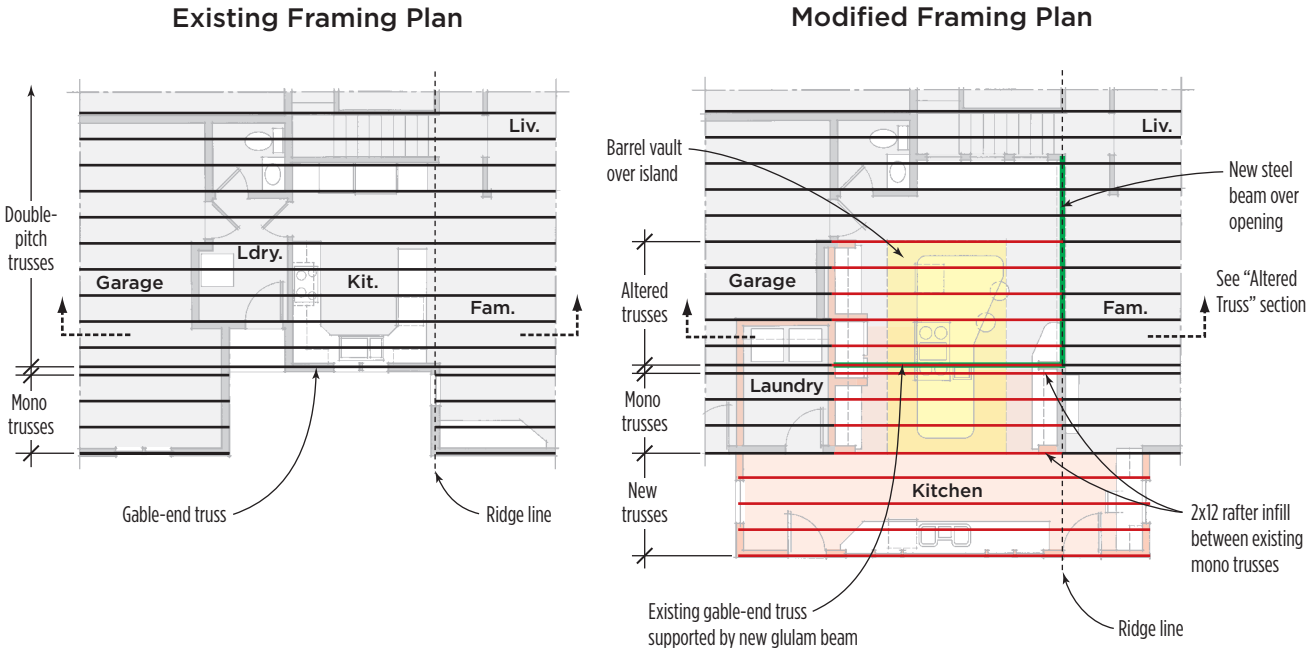


Figure 1. The existing common trusses spanned 64 feet and bore on the outer walls of the building. Space was created for a vaulted ceiling by reframing the sections of the bottom chords over the existing kitchen and carrying the vault into the new roof framing above the addition (illustration, above and next page). The engineered plan called for creating new bearing points at the existing garage wall and at a new steel beam installed over the opening to the family room (detail photo, next page).

to create a complementary focal point on the ceiling above. Since we had been in the attic and knew there was space to expand vertically, we suggested building an uplit barrel vault centered over the island. The owners liked the idea because it took what would have been a large, low ceiling and turned it into a conversation piece.

One end of the vault would be in the roof of the addition; that was new construction, so we were confident it would be easy to frame. The tricky part would be framing the section of the vault within the existing footprint, because the roof above was framed with trusses.

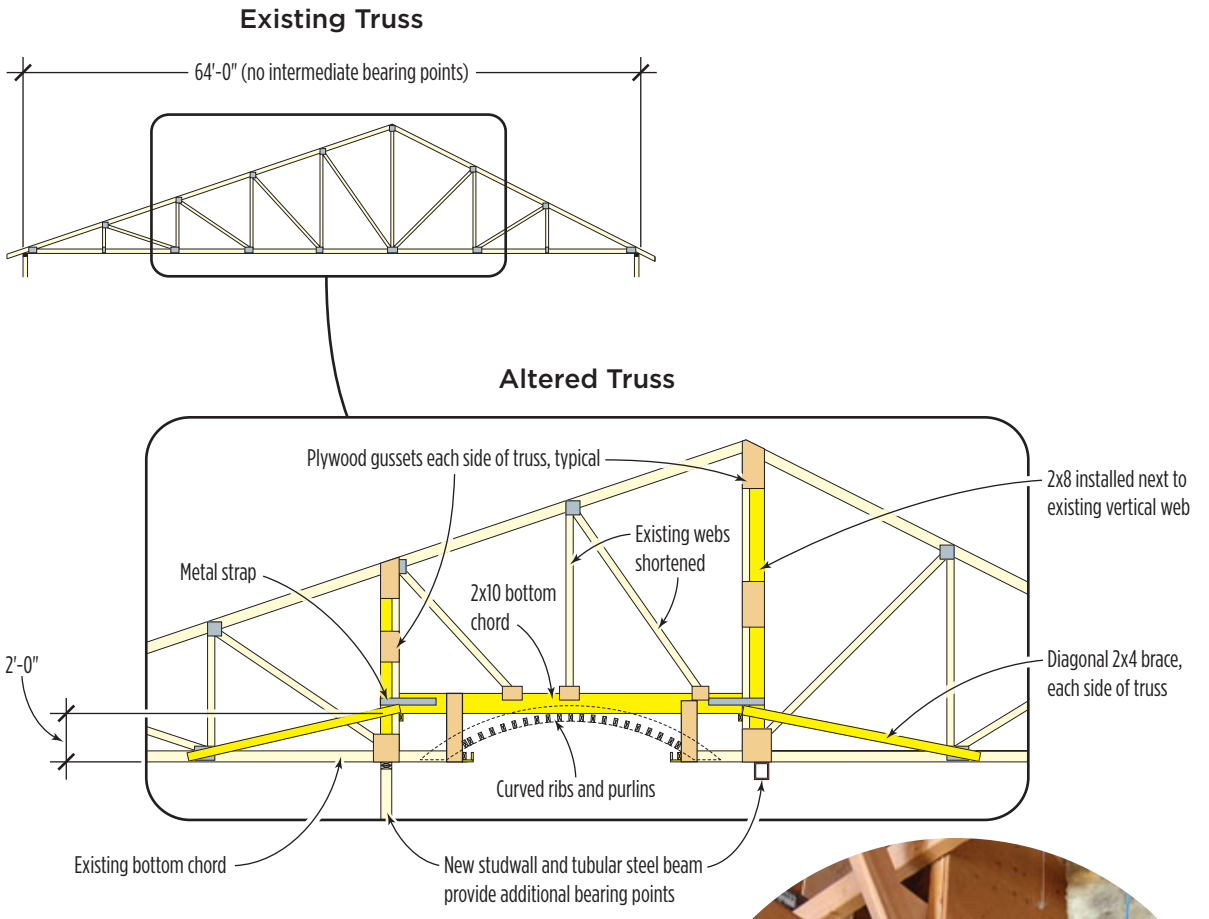
We asked the manufacturers supplying trusses for the addition what they would do to create space for a vault within the existing roof. They suggested replacing the existing trusses with new ones that were raised in the middle. We rejected this idea because it would have required that we remove a large area of clay tile roof and demolish the ceilings in adjacent rooms — work that would have added about $25,000 to the cost of the job. It would be less expensive for the clients and less destructive to their home if we could create the necessary space within the existing trusses.

An Engineered Solution

A truss roof is an engineered system, so we knew we'd need an engineered design before cutting or altering these trusses. We hired structural engineer Dan Jordan, who came up with a plan that would allow us to remove a section of the bottom chord from the common trusses above the kitchen, then reframe a cavity large enough for the vault (**see Figure 1**).

The trusses were 64 feet long; they extended from exterior wall to exterior wall, with no bearing points in between. Jordan's plan added two intermediate bearing points to the truss configuration — one directly above the back wall of the garage and the other at the line between the kitchen and family room, directly under the ridge.

Demolition came first. To avoid having the blown cellulose insulation fall down on us, we hired an insulation company to vacuum out the old insulation using the same equipment they would use to blow it in. We then removed the ceiling drywall



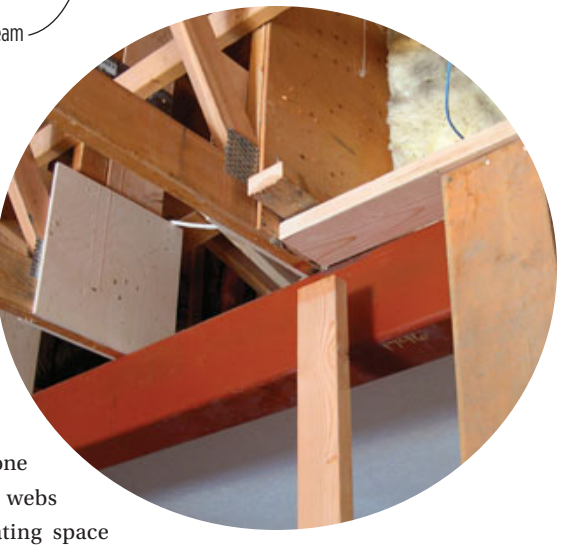
and began the structural work.

Our first step was to install an 8x6 tubular steel beam against the bottom of the trusses at the opening between the kitchen and family room. We supported the beam on a pair of 5 1/8-inch glulam posts that ran to the foundation below, bolting it in place. This beam would support one of the new bearing points in the altered trusses; the other support, the garage wall, was already in place.

Altering the Trusses

To avoid damaging the structure, we altered the trusses one at a time, shoring against the top chord with 2x6 braces that ran to the floor. Following the design, we attached 2x8s to the edges of the vertical webs above the new bearing points, fitting them tightly between the angled top chord and the diagonal web at the bottom. We secured the 2x8s to the truss with 1/2-inch plywood gusset plates on both sides, using medium crown staples instead of nails to reduce the risk of splitting.

Next, we shortened the one vertical and two diagonal webs above the vaulted area, creating space for a new 2x10 bottom chord, which we installed 2 feet above the existing bottom chord. Again, we made the attachments with plywood gussets and staples, and also added metal tension straps at each end of the 2x10s, per the engineer's design (**Figure 2, page 4**).



We were required to run diagonal 2x4 braces between the vertical web at the edge of the kitchen and the bottom chord in the adjacent room. As with the gussets and straps, the engineer specified the type and number of fasteners to be used for these connections.

Figure 2. After stripping off the ceiling to expose the existing trusses (above), the crew shortened vertical and diagonal webs to install a new 2x10 bottom chord, reinforcing the connections with plywood gussets and staples (right).

Figure 3. When the truss modifications were complete, the crew cut out the original bottom chords to leave a recessed space for the barrel vault (top). A 2x4 around the perimeter (above), positioned 3/4 inch above the surrounding soffit, would accommodate a shelf for LED uplighting.

Expanding Outward

Where the addition starts, we had to remove the exterior wall, which carried a gable truss above. To restore the support, we installed a 3 1/8-inch-by-12-inch glulam beam across the opening, supporting it on new posts that we framed in the flanking walls. We had to trim about 3 feet off the vertical members of the gable truss so that we could place the glulam high enough for the barrel vault to pass underneath.

The new roof was simple to frame; we used trusses over most of the addition and filled in with stick framing where we needed to.

Framing the Barrel

With the structural work out of the way, we could tackle the fun part of the job — framing the barrel **(Figure 3)**. Our first task was to create the opening in the ceiling, which we did by drawing the perimeter of the barrel on the floor, plumbing the location onto the framing above, and then cutting through the bottom chords of the trusses. To complete the opening

Figure 4. Working on the deck, a carpenter routs arcs in a sheet of plywood, but without cutting through to the subfloor (above). The arcs are completed on the bench with a pilot bit (above right), then laminated with glue and staples to form ribs long enough to span the vault (right).

we nailed a 2x4 around its inner edge.

Curved ribs. The barrel itself consisted of 2x4 purlins nailed between 6-inch-wide curved ribs cut from 3/4-inch plywood with a router and trammel **(Figure 4)**. To avoid damaging the subfloor, we cut partway through with a 3/4-inch straight bit, then finished on the bench with a flush trimming bit that ran against the edge of the partially completed cut.

Figure 5. The vault framing was too heavy to install as a prebuilt unit, so it was assembled in place (left). Ductwork for a commercial range hood will run through the opening between the two center ribs (above).

Valance Detail

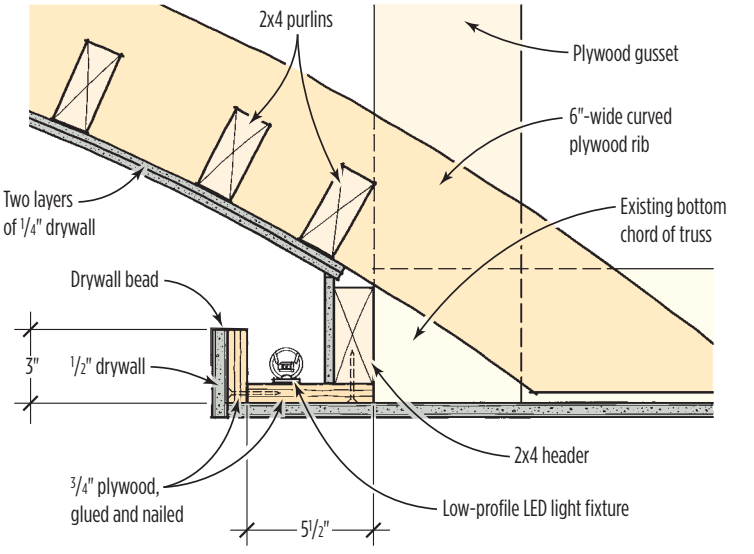


Figure 6. A simple plywood box, glued and nailed together (top and above), provides a tray for a strip of LED lights that lends a dramatic effect to the ceiling (right).

The ribs were too long to get from 8-foot sheets of plywood, so we laminated them from two layers, staggering the joints and fastening the pieces with glue and staples. There were four ribs in all, one at each end of the vault and two near the middle. To ease the installation of the ductwork for a commercial range hood, we spaced the center ribs one truss bay apart.

Since the barrel was too large to assemble on the ground and lift into place, we nailed the ribs to trusses and installed the purlins afterward (**Figure 5, page 5**). We spaced the purlins 4 inches on-center to ensure that the drywall bent in an even curve. The final bit of framing was to build a shallow plywood trough around the edge of the barrel to house the LED uplighting (**Figure 6**).

When the job was complete, the owners had what they were looking for: a modern kitchen suitable for entertaining a large number of guests — with a stunning conversation piece overhead.

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