Moving a Carriage House

How to resite a 15-ton historic structure

BY ELIOT LOTHROP

Photos by Eliot Lothrop and Tim Healey

My company, Building Heritage, specializes in the preservation and restoration of timber-frame structures in Vermont. In addition to timber-frame repair, we perform all aspects of restoration work—everything from house-jacking and foundation replacement to slate-roof repair and window restoration. Our projects include houses, barns, churches, covered bridges, as well as all types of outbuildings.

Last spring, we began work on restoring a carriage house built in the 1880s in Montpelier. The owner wanted to renovate the slowly collapsing building into rental space, but because of its proximity to the property's main house, he needed to relocate the 26-by-35-foot structure to 60 feet away. This would increase parking on the site and improve the curbside visibility.

In this article, I'll focus on how we relocated this 15-ton building—a two-step process, requiring us to first lift the building and brace it for the move and then roll the structure (cribbing and all) along an I-beam track to its new foundation.

EXISTING CONDITIONS

When we arrived on site, we discovered the worst damage to the structure was to its west-facing front façade **(1)**. One side of the large gambrel dormer had collapsed. This failure had been caused by rot from a reverse-flashed valley and by an undersized beam rolling (it had been used to replace a bearing wall in an earlier remodel).

The rolled beam had contributed to sagging of the second-level hayloft floor, as well. The ground-level stable's original wood floor was long gone, and what remained was a thin layer of asphalt over dirt. Finally, the building itself had severely racked and was out of square 6 to 8 inches. Clearly, in order to safely move the structure, we first had to jack it up and straighten it out.

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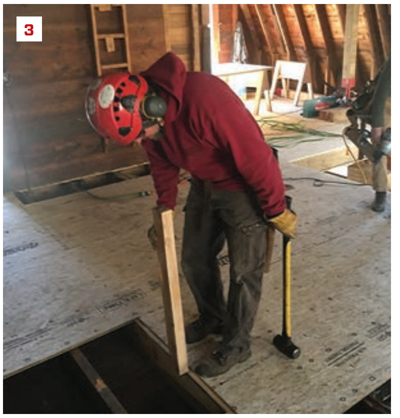

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The worst damage centered around a transverse dormer **(1)**. I-beams were inserted longitudinally to help level the second floor **(2)**. Sheathing the second floor helped square up the building **(3)**, and adding Zip System sheathing to the upper roof slope helped prevent racking **(4)**. The lower I-beams were inserted with the help of an excavator **(5)**. Cribbing supports a main beam (running right to left), which supports the needle beams (red). Running parallel to the needle beams was the I-beam track **(6)**.

SUPPORTING STRUCTURE

We removed the few remaining interior partitions in order to place our cribbing towers. Cribbing location is dictated by the steel-beam insertion points, with each tower centered on the steel. Fortunately, we were able to pass the two upper beams through a pair of south window openings and out through the lower portion of the exterior north wall, which also had been removed.

Next, we dug down about a foot to good bearing and carefully leveled four bases built from 6-inch-by-6-inch-by-4-foot lengths of cribbing (normally, we dig down all the way to the footing, but in this case, we didn't have to). As we assembled the cribbing towers, we checked for level at every layer. When we arrived at the desired height, we inserted the upper, 40-foot-long W10x45 main I-beams through the length of the building with the help of an excavator, placing them on beam rollers secured to the cribbing **(2)**.

We then inserted three smaller (W8x31) needle I-beams, running perpendicular to the main beams. The first two were placed on either end of the sagging gambrel dormer and ran on top of the main beams to take the sag out of the second-floor framing and to support the valleys. The third needle beam supported the chimney. We suspended the needle beams from the main beams with four heavy-duty, 12,500-pound-capacity Crosby clamps, then lifted the building approximately 2 feet off the ground.

STRUCTURAL REPAIRS

With the building in the air, we began our repairs. First, we removed the existing granite block foundation. This was a historic building, so we were preserving all of it. We marked each block's location to be reinstalled on a new foundation.

Moving on to the structure, the second floor had racked, so we

While the author's crew restored the structure's framing, the excavation sub broke ground on a new foundation **(7)**. A freestanding retaining wall was part of the foundation design **(8)**, which was built in line with the existing house **(9)**. A granite capstone, reclaimed from the existing foundation, lined the remaining foundation perimeter; here, the masonry sub maps out the rebar locations and angles to accurately line up boring holes **(10)**. Some capstone was installed prior to the move **(11)**.

squared it up by pulling it diagonally with come-alongs. We then installed new LVL support beams, floor joists, and a 3/4-inch-thick AdvanTech deck. The AdvanTech would make a diaphragm and help keep the second floor square **(3)**.

We reframed the sagging dormer and large sections of the west façade's roof. On the upper roof slope, we added a layer of Zip System sheathing over new 1-inch-thick rough-sawn decking to help prevent the roof from racking **(4)**. We then secured the chimney with 2-by bracing above the roof and added diagonal bracing where needed throughout the interior of building.

Once we had completed these repairs, we installed a pair of lower, 40-foot-long W10x45 main I-beams, which would pick up both the building and the upper portion of the cribbing towers during the move **(5)**. We didn't insert these as far into the building as the upper W10x45s.

Finally, in order for the bottom of the main I-beams to clear the top of the new retaining wall by 6 or so inches, we lifted the building up a second time, about 2 feet higher.

CRIBBING TOWERS

When we assembled the cribbing towers, we stacked the tiers with four to six 6x6s going each way. The more cribbing you have per tier, the more surface contact you have, layer to layer, and the less likely the tower will shift (it will also hold more weight).

As we assembled the towers, we needed to build-in the support gridwork of beams, starting with the needle beams. For the final lift, the cribbing stack also needed to be slightly reconfigured to allow us to insert the track rail I-beams; a "pyramid" stack of cribbing was assembled perpendicular to the main beams **(6)**. We installed Crosby clamps at the beam intersections.

The crew installed the first I-beam track into the north gable-end cribbing **(12)**. An excavator and a beam roller placed on mid-span cribbing helped insert the south track **(13)**. Beam rollers were placed on a "pyramid" stack of cribbing; the pyramid stacking formation was used throughout the lifting process to transmit loads through cribbing towers **(14)**. The I-beam track needed to be ground smooth to eliminate imperfections **(15)**. Waste-blocks rolled into place served as anchors for moving the building **(16)**.

NEW FOUNDATION

While we restored the framing on the building, our excavation sub began work on the new foundation **(7)**. The basic plan was for the foundation to be built in line with the existing house, so the move would be in a straight shot. We knew ledge was located in the vicinity of the new foundation. So, last fall we dug out the site and mapped out the ledge locations, which our structural engineer was able to incorporate into the new foundation design; we pinned the foundation to the ledge in several places.

The new foundation was unique. A 10-foot-high freestanding retaining wall was required to support the gable-end wall on the north side. Because there were no return walls to stiffen this wall up, it needed to be heavily reinforced with a 12-inch-on-center #5 rebar grid **(8)**. The wall was 12 inches thick at the base with a 4-inch brick shelf a couple of feet from the bottom (the lower north wall would be brick veneer). #5 L-shaped dowels 12 inches on-center joined the wall to its 12-inch by 5-foot-wide oversized footing. Beam pockets for lowering the upper beams were cast into the top of the wall **(9)**.

The remainder of the new foundation consisted of 5-foot-deep frost walls capped with the reclaimed 8-inch-thick granite blocks, which would serve as a capstone. Our concrete sub left rebar sticking out of the top of the frost walls, which our mason cut to the same height and plumbed upright using a rubber mallet and level. The mason then mapped out the rebar locations and their angles to accurately lay-out holes into the block **(10)**.

Once the capstone blocks were ripped down for uniform height and bored, they were installed on top of the foundation and mortared in place **(11)**. We later pinned the blocks to the wall, as well, by drilling down through the granite (and new wood sills) into the concrete, and setting threaded rod in adhesive grout.

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With the I-beam track set and leveled, the building was pulled with come-alongs anchored to the concrete waste-blocks **(17)**. Four 10-ton-rated Hilman rollers, two per track, were used to roll the building in place **(18)**. A turntable on top of the roller allowed for tweaking the roller's direction to keep it aligned on track **(19)**. It took an hour and a half to move the 30,000-pound structure **(20)**. Here, a video still from the author's GoPro camera shows the building nearly placed on its new foundation **(21)**.

I-BEAM TRACK

The I-beam track was composed of four, 40-foot-long W10x45 I-beams (two per track, butted end to end and bolted together). We began with W10x45s inserted into the cribbing, starting with the north rail **(12)**.

We assembled shorter, mid-span cribbing towers to pick up the track "in space" to a height where the track would be dead level. The crew maneuvered the beams into place using beam rollers on each mid-span tower and used an excavator with a beam-clamp attachment to help position the beams **(13, 14)**. The I-beam track needed to be ground smooth **(15)**, particularly at the ends of the beams where burrs were likely to occur. "Jumping" from one track section to the next is tricky enough (transferring the weight of the building from one track section to another) without having to deal with any imperfections.

MOVING THE CARRIAGE HOUSE

We planned to pull the building into place with a couple of come-alongs, so we positioned a couple of three-ton concrete waste-blocks to serve as anchor points **(16)**. We chained the come-alongs to the blocks and the lower W8x31 needle beams and began pulling the building into position at rate of about a foot per minute. It didn't take much to move it because it was on "wheels" (building rollers).

Even though we had two come-along setups, one come-along did all the work **(17)**. We used four 10-ton-rated Hilman rollers, two per track, to roll the building in place **(18)**. The rollers come with a turntable on top, which allows for tweaking the roller's direction to keep it aligned with the track. We use a handle tool, which we hitch on the end of the roller to straighten them as needed (you have to keep an eye on them, as there are no guides to keep them

The building was lowered onto new 6x7 sills set on the granite **(22)**. The cribbing towers were lowered one tier at time, the steel rolled out with beam rollers **(23)**. Hydraulic jacks were used for all the lifting **(24)**. A steel plate was inserted during removal of the chimney support beam; a tube steel support was added later **(25)**. The retaining wall beam pockets were blocked in **(26)**. Here, the carriage house is in position, ready for complete restoration **(27)**.

from rolling off the track's top flange) **(19)**. It took an hour and a half to move the building, including time to "jump" the rollers over the track seams **(20, 21)**.

BRINGING THE BUILDING TO REST

In many ways, lowering the building was the easy part of the job. The squared-up structure lined up with the new foundation nearly perfectly. We lowered the building onto new 6x7 sills set on the granite and toe-screwed the wall studs to the sill with TimberLoks **(22)**.

The cribbing towers were lowered one tier at time and the steel was rolled back out (a reverse of their installation) **(23)**. We used eight 22-ton Simplex hydraulic jacks for all our lifting and lowering needs (placed on metal bearing plates and in-line stacked cribbing to transmit the load through the tower) **(24)**.

A 3/4-inch-thick steel plate was inserted during removal of the needle beam supporting the chimney; a tube steel support was later welded to the plate for support **(25)**. The retaining-wall beam pockets were blocked in prior to installing the brick veneer **(26)**. With the building in position, it was ready for complete restoration **(27)**.

Because the owner is receiving a federal rehabilitation tax credit (an RITC) for the restoration, all the work had to conform to strict preservation standards. We were required to restore the building's original form, using as many traditional materials as possible (slate roofing, plaster interior), while using modern materials and systems like foam insulation and a radiant slab to bring it up to current standards for comfort and energy efficiency.

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