Jack Hursh

California's Cowell Lime Works Barn

The Background

THE Cowell barn in Santa Cruz, California, part of the Cowell Lime Works Historic District, stands on what is now the campus of the University of California, Santa Cruz (UCSC), overlooking the Pacific Ocean. The barn's recent reconstruction followed a winding path to a winning conclusion.

California's built environment, compared with the rest of America, is comparatively new. The "Golden State" went from a sparsely populated frontier wilderness during the Spanish and Mexican *Rancho* period (1784-1846) to become the most populous state in the Union. With the discovery of Gold in 1848, and the subsequent admission of California to the Union in 1850, San Francisco's population, for example, increased 17-fold in four years, from 15,000 in 1848 to 260,000 in 1852.

Miners weren't the only adventurers to make the arduous journey out West during this period, and many stayed. The three initial players in the story of the Cowell barn were all from successful business families back East, in shipbuilding, mining, engineering and timber. Whether they were sent to seek new business or to make their own marks, they had in common access to funding and knowledge of business practices.

Henry Cowell arrived in San Francisco before 1850 and started a successful drayage and storage business. Albion Jordan and Isaac Davis initially worked on the waterfront with steamship operations. Jordan, an engineer, purchased the original land grant with Isaac Davis and began developing the lime works in 1853. In 1865, Cowell bought Jordan's half of the lime works and expanded the operation, and in 1889 became its sole proprietor. Limestone burned at the Cowell Lime Works came from quarries on the UCSC campus, which is underlain by karst formations.

When heated correctly, limestone (calcium carbonate) turns to quicklime (calcium oxide) and carbon dioxide. Quicklime may be stored dry and, when desired, added to water to produce slaked lime (calcium hydroxide). Slaked lime combines with carbon dioxide in the air to become limestone once again. Combined with sand, slaked lime hardens into the mortar that was used universally in masonry structures until displaced by Portland cement, a harder version with common origins.

1 Mid-raising of reconstructed Cowell Lime Works barn, 2015. New frame measures 40 ft. 8 in. by 116 ft. 11 in.

2 Historic American Building Survey 1860s photo of Cowell and Davis cooperage. Upper trestle brought limestone to top of continuous kiln just behind cooperage, quicklime chunks dropped out at bottom. Lower trestle supplied pot kilns, unseen.

3 Cowell Lime Works warehouse near Cowell Wharf. Lime was shipped out to ports along California coast.

4–6 Barn seen in 2006 (upper photo) and 2010; interior in 2011.

7 Barn revived and repurposed, opening celebration.

Historic American Buildings Survey

Santa Cruz Museum of Art & History

Adams Humanities

Lime played a vital role during the 19th century as the principal ingredient in mortar, plaster and stucco, and was in great demand during the building boom following the discovery of gold. According to Lime Works historian Frank Perry, Santa Cruz lime was shipped to towns along the coast from Oregon to San Diego, as well as to Hawaii (by way of San Francisco), and some was hauled inland to the San Joaquin Valley. The Cowell Lime Works at its height employed 175 workers, 75 horses and 50 yoke of oxen, operated a cooperage and produced up to 1000 barrels of lime per week. It was responsible for 80 percent of the lime used in California, supplying necessary material for the growth of the San Francisco and other regions from the 1850s into the 1920s.

The Cowell barn was probably built in support of the oxen as their teams were necessary to move the wood to fire the lime kilns, eight cords for each 24-hour cooking period, and to haul the barrels of quicklime. There are indications that the barn also may have been set up for heavy lifting operations in rolling equipment maintenance.

The roof has one unusual feature compared with other California barns, the 6x8 plumb ridge beam. Most historic California barn roofs lack a ridge beam of any kind. Also unusual, the common rafters are let in to the ridge to provide its only support. The barn's original framing material is primarily circular-sawn Douglas fir, with braces and sills of Coast redwood.

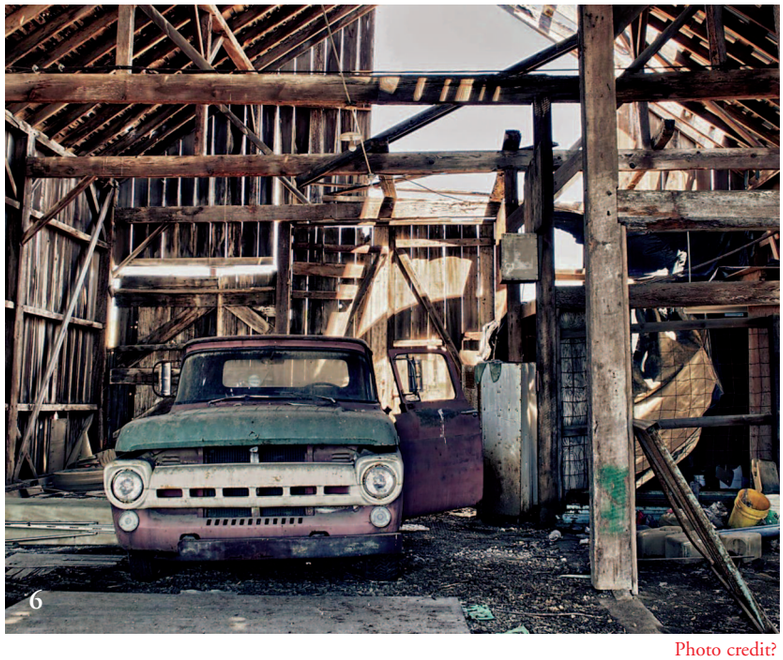


Photo credit?

Bill Hurley

8

Adams Humanities

Early in 2010, the Guild got a call from a member of UCSC's staff for assistance in the documentation of their timber-framed barn in danger of collapse. While documentation of the structure had been done previously, it did not fully detail nor address the specific joinery of the structure necessary for a possible reconstruction. Several Guild members responded and the Friends of the Cowell Lime Works, a volunteer nonprofit, hired our firm to produce a set of survey documents observing Historic American Building Survey standards (nps.gov/hdp/standards/index.htm), to assure that the building could be rebuilt as accurately as possible. These survey documents now belong to the University.

Around the time of the 2011 Guild Conference at Asilomar in Pacific Grove, a philanthropic proposal was presented to the University to explore the possibility of rebuilding the barn to serve as a center in UCSC's sustainable agricultural program. If this was to be done, it would kick in the formal process of a new building for a UC campus. Besides historic accuracy, salvage of original elements and seismic standards (Zone 4), the further requirement that all new State of California buildings be LEED certified would put this project into new territory for a ca.-1866 barn.

The architectural firm of Fernau & Hartman in Berkeley was chosen by UCSC after many interview rounds. Their multidisciplinary team included a historical architect, a structural engineer, a civil engineer, an electrical engineer, a soils engineer, mechanical engineers, a LEED consultant, a landscape architect, an archaeologist—and a cost-consulting firm! The resulting extensive plan set, to say the least, was pretty impressive. The rebuild requirements put unique constraints on the architects' design program. The finished product keeps the framing of a historic structure in a newly functional building. The contract to cut and raise the frame was awarded to Santa Cruz Timberframes, whose Karl and Ginger Bareis produced a technically and artistically proficient structure. Karl's account follows on page 12.

Barns are by their very nature adaptive. If a better mousetrap came along that helped the bottom line, farmers and ranchers utilized it. If it meant altering the barn, the alterations were done. In this case, the Cowell barn's new life as part of agricultural education is a leading adaptive use today.

Though there are numerous historic timber-framed barns in California (see TF 56, 81, 89, 102, 103 and 117), and probably more to be discovered, the state is not a hotbed of new timber framing, and all practitioners out here get used to explaining our work to building officials and engineers (and others). But nothing had prepared me for what the timber frame consultant's role turned out to be in advising and guiding the architect's team. From the scope and requirements of the careful dismantle, overseen and documented by Sherwood Forest Timberframes's Paul Oatman (see below), to the reuse of original frame members (78 in all), to the hugely successful raising in March of 2015 and the building's dedication last September, it was quite a ride.

—Bill Hurley

The Takedown

THE catalyst for the reconstruction and reproduction of the historic Cowell Lime Works barn was Sally Morgan of the University of California, the hero of the story, who contacted the Timber Framers Guild, which in turn contacted members of the Guild in California. Through Sally I met Bill Hurley of Dos Osos Timberworks, and we decided to team up. My work was to identify the layout system and the joinery, take the photographs and provide a description of the extant structure of the barn. Bill's firm would do the drawings. A local foundation, represented by Alec Webster, funded the project.

Paul Oatman, above and below

8 After stabilization, dismantling begins with roof covering.

9 Exceptional supporting housed rafter joint for ridge beam.

10 Modified step-lap joint at seat of rafter.

11 Top side of 6x8 ridge beam showing original U-bolt nuts.

12 Underside of ridge showing U-bolt and rafter joints.

Plainfield Construction of Santa Cruz dismantled the barn, while as field supervisor I recorded each member with shop drawings and photographs. To me this was the most interesting part of the project. After months of recording this barn, its true purpose remained something of a mystery to me. But the wedged half-dovetail tying joints at the walls, the modified-step-lap rafters at the plates and a fully supported ridge beam fitted with apparently original U-bolts, all pointed to hoisting of some nature.

The wall brace tenons were all wedged but the roof braces were not. I believe that the wedges were used to rack the frame into plumb. I would like to say the wedged braces, the strong tie beam joinery and the fully supported heavy ridge were in a one-of-a-kind barn, but the nearby theater barn on the UCSC campus, just below the lime works, was built the same way. So here we had two barns framed for hoisting heavy loads from the ridge, both near a lime works—but no certainty about what was hoisted.

The Cowell Lime Works barn appears to have been built before 1870, since all the scarf joints are pinned with wood, and bolts supplanted wood pins as fasteners in scarf joints about this time. Additional evidence of the construction date is that the straining beams between the purlin plates have been removed, almost certainly to accommodate installation of a hay track and trolley assemblage. This assemblage was invented in 1867 by William Louden and by 1880 had become a standard fixture in almost all California and Nevada barns.

In addition, the barn as it stood included an offset sill plate and a line of internal posts that ran the length, dividing off about 40 percent of the width from the eastern wall. The most unusual feature was the ridge beam with notched common rafter connections. The step-lapped rafter seat detail in the top plates I had not encountered in any of 200 California barns that I have inspected.

That the Cowell barn had a ridge beam was itself unusual, as most common rafters in California timber-framed barns butt together at the peak without a ridge, much less a 6x8 ridge. The U-bolts fastened to the ridge on 10-ft. centers were certainly original, as evidenced by the fact that their nuts were mortised into the top side of the beam. It's possible that these U-bolts could have been used for an early, innovative pulley system for hay forks, which preceded hay tracks, but more likely some heavier load justified the extra-sturdy framing.

13, 14 Half-dovetail tenons at tie beam ends were wedged down onto their sloped seats in wall posts, and pinned for good measure. Wedge, not shown, fitted mortise above housing.

Paul Oatman

The wedged half-dovetail tying joint, though found in historic barns in Eastern states, I had not encountered in any other California or Nevada barn. Considering the 40-ft. span of the tie beam, the builder made the right choice, as the wedged half-dovetail puts the forces on the sloped interfaces of the joint rather than on the fixing pins across the joint. —Paul Oatman

The Reconstruction

LOCAL Projects usually start with a conversation while standing around kicking dust and looking at what remains of a once proud barn. California barns have been discussed in some detail in this journal by Paul Oatman. Suffice it to say the University of California, Santa Cruz, let their heritage barns go for decades before the University architect called and suggested I take a look at their old "hay barn" (as they called it), originally built 1867-68 on the edge of coastal prairie and, more important, over one of the richest lime deposits in the state.

The barn was not actually built to store hay as the name implies. We believe the Cowell barn was used as a hoisting barn (Paul's term) to rig oxen wagons in the middle aisle and to lower yokes over the heads of ox teams as they were hitched. The large drayage wagons would carry quicklime in casks to the local wharf.

Our reconstruction of the barn included surveying what amounted to a pile of used timbers salvaged the year before during "deconstruction" of the original. Although we sit on the edge of the largest extant redwood forest, I noticed that most of the strength timbers were Douglas fir, all apparently cut within one mile of the barn and milled on-site using a 6 ft., 8-in. circular saw. By the time we got to it, the barn had deteriorated and there wasn't a lot of usable wood, so our first challenge after determining what was left was to find suitable replacement timbers.

We immediately thought of the campus itself, as its more than 2000 acres contained enough suitable timber to do the job. With the help of the project manager and the campus architect, we were given a list of 40 large Douglas firs that posed hazards or stood in areas slated for development. Our area has enough forest to keep several small mills in operation, and the University had milled most of the trees cut over the past several years. We surveyed the trees thinking in particular of the 40-ft. tie beams used in the original barn frame.

After compiling our lumber list from locally available stock, I was informed by the project manager that the project required "all prospective bids to be based on commonly available materials." The campus feared that if our bid included materials not known to the other four timber framers bidding, then we would have an unfair cost advantage. Needless to say, we were astounded by the logic, especially as the project had a LEEDS Platinum target for sustainability goal. After pointing out the advantages of remaining local, to no effect, we were forced to widen our search for materials and to source it at a Forest Stewardship Council–licensed facility. We were surprised how difficult it was to find sustainably harvested 40-ft. No. 1 Structural Doug fir beams. After searching all local sources we ended up in the Siskiyous at the very top of California, 500 miles north of the UCSC campus, where we met with and negotiated for salvaged timbers recently harvested after a major fire devastated an area of upland forest. Our team member Matt Lovemark, a native of southern Oregon and familiar with the area, personally inspected the logs in late August of 2014, so we were ready to submit our bid. As it turned out, ironically, the difficulty of sourcing materials limited the competition for this project!

By early January of 2015, we started getting shipments of the timbers, and we spent the next six weeks cutting out the new stock and fitting in the old pieces where they had been in the original building. Our small team of four was augmented along the way as we got closer to completing the layout and joinery. We were able to do most of the assembly in our timber yard in rural Bonny Doon, only four miles from the campus. The scale of the building was a challenge in every way. With eleven bents, we calculated 1460 elements to be replicated and stacked prior to raising. The University had asked for a date six months in advance. and As the time of the raising approached, we realized that we'd need help from the local community.

Santa Cruz City has a vibrant craftsman tradition, and over the past few years contractors have created a construction guild. Mostly the work of a single-minded local contractor who saw the need to separate quality from run-of-the-mill construction, his efforts have paid off in many ways for the community. (Local construction guilds are another story and deserve their own discussion.) Our local contractors had been following the stream of local media coverage on the Cowell barn project and jumped at the chance to volunteer for the raising.

In the run-up to the raising, we had to transfer 14 truckloads of finished timbers to the campus and catalog all the pieces in reverse order. The final week was a typical logistics and planning maneuver that our team divided between site prep and the yard. The last three days we met with officials from the University concerned about safety and liability, and the out-of-town professionals began to arrive from as far afield as the Sierra Nevada, with journeyman timber framers borrowed from throughout the region to help coordinate the one-day raising.

In the end, our timber-framing team ballooned to nine members, and we had 67 civilian volunteers plus the 40-ton crane! The actual raising scenario played out in several stages, starting with evening meetings at our place in Bonny Doon. I reviewed and assigned responsibilities to the 14 who would be responsible for volunteers, rigging, safety and communications. That strategy

session was critical because we had agreed to use sophisticated climbing gear, and two professional arborists had been added to the crew to ensure the rigging was handled—all to assuage the University's fears about having so many volunteers on-site. Strategy and logistics are critical, but in the end weather and simple physical constraints have more to do with final results than anything else.

Pre-dawn on the morning of the beam raising, our yard had mostly been converted into an encampment for the out-of-town gang, some having arrived just the night before. Traditional flapjacks, sausages, eggs and oatmeal were wolfed down as we checked our lists one last time before heading out to the campus. The last load of ridge beams was loaded on the crane truck and we headed down the winding mountain road just as the sunrise was peaking over the eastern horizon. By the time we were ready to hoist the first bent there was a crowd of locals spreading blankets on the hillside above the site, to watch. —Karl Bareis

Karl Bareis (karl@santacruztimberframes.com) is the proprietor of Santa Cruz Timberframes in Bonny Doon, Calif. Paul Oatman (paul.oatman@volcano.net) operates Sherwood Forest Timberframes in Pioneer (Amador County) and has written frequently on California barns. Bill Hurley (wlhurley@dososostimbverworks.com) is a principal at Dos Osos Timberworks in Los Osos. Dos Osos's work last appeared in TF 80.

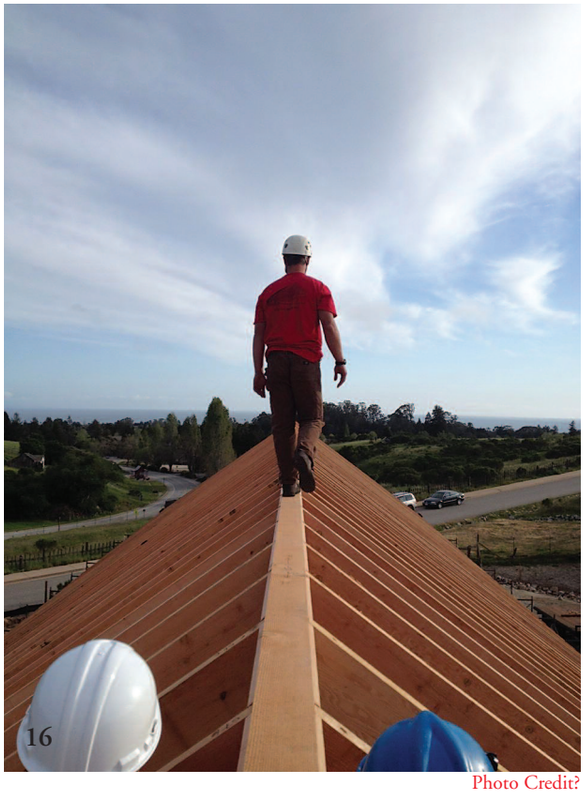

15

Jack Hursh

15 At mid-raising, red-shirted crew sets plate segment over waiting scarf-end and multiple braces. Drone observes.

16 Matt Lovemark, framer, surfer, smoke-jumper, back-country ranger and rock climber, walks ridge of completed frame.

17 Barn in service hosting history fair, October 2015. Note wood gutters with rain chains leading to flush drains at grade.


16

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17

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