Cupola Maintenance

by John Leeke

I was called to look at the cupola on the Memorial Building in Stowe, Vt. It is a finely detailed Colonial Revival building put up around 1900. Local officials have realized the importance and special character of the building,

Figure 1. *This composite photo shows the dome-roof structure on top of this cupola, which may have to be removed by crane to install new or reconditioned columns. Notice the Corinthian columns and the copper urns – just some of the fine detail.*

and restoration of the cupola is part of a general effort to save its distinctive details.

When I inspected the building, I used a ladder and safety harness to get up to and around the structure. Hiring a crane or setting up scaffolding would have been too costly. After the inspection, I wrote a "scope document," which describes both the condition of the cupola and the extent of the work to be done. The architect uses this document when he seeks contractors' bids.

The Cupola Design

The cupola is a dignified structure, and it has many interesting details, including Corinthian-column capitals, a roof-deck railing, and a cameo window in the vertical slate wall. Eight copper urns surround the bottom rim of the dome roof, and a tall flag pole sits atop the dome (see Figure 1).

The cupola is built with two decks, a roof deck and a lower deck, each framed with full-dimension 2x12s and 2x14s. The lower deck is framed inside the main-roof trusses. The roof deck supports eight wooden columns that act as spacers between the roof deck and the dome roof. Eight steel bolts run up through the hollow columns, and these bolts tie everything together (see Figure 2). As for roofing materials, the roof deck is covered with pan-type copper, and the dome roof is protected with form-fit copper.

Though the cupola needed attention, the structure was basically sound. There were, however, several parts of the exterior skin that were deteriorating rapidly. Without protection, the structure would soon be threatened because the rate of deteriorating was increasing.

It wasn't until the structure leaked that people in charge of maintaining the building began to notice of the roof problems. When you consider how many different parts of the cupola penetrate the cupola's 's roof, it's not surprising the roof leaked. Nearly twenty components of the structure penetrate the roof, including the columns, rail posts, ventilators, and a hatchway. Ideally these penetrations are flashed and sealed against leaks, but problems are prone to develop in these areas.

It was easy to pinpoint the leaks. It had rained during the first day of my inspection, so I could see the water coming in. I could tell which leaks were worst by how much they matted down the fluffy cellulose insulation below.

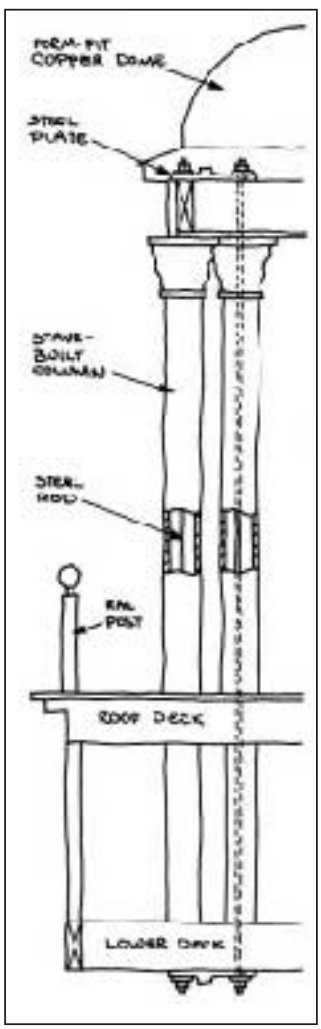

Figure 2. *The cupola has two decks: a roof deck and a lower deck. The roof deck supports eight wooden columns that act as spacers between it and the dome roof. Eight steel bolts run through the hollow columns and tie the structure together.*

If it had not rained, I'd have located the leaks by looking for water stains on the wood. After locating them, some moisture-meter readings could determine which leaks were old and which ones were new.

I found only one leak active long enough to have caused decay in the sheathing and roof, though decay hadn't penetrated to the framing yet.

Column Shafts

The column shafts are "stave-built," like a wooden barrel. Sometimes, moisture builds up within unvented columns like these and deteriorates the glue. Another source of moisture is through alligatored or peeling paint. In this case, both moisture and peeling paint were making the staves separate at the joints. When the columns are restored, they should be vented by drilling four 1-inch vent holes per column up through the roof-deck boards. Screening should cover the holes to keep insects out. With these columns, I was very concerned since they play a critical role in the structural system of the cupola.

On all the exterior wood, the paint had alligatored and peeled right down to bare wood because of heavy buildup. This old paint system no longer gave the decorative and structural woodwork the protection needed to stand up to the severe weather exposure. Often, a thick coat of pain doesn't flex with the wood beneath. It cracks, usually all the way through, letting moisture into the wood beneath. That causes peeling and allows in even more moisture (see Figure 3).

Figure 3. *A thick coat of paint doesn't flex with the wood beneath. In this case, 15 coats of paint cracked and let in moisture.*

Capital Details

Capitals are the ornamental uppermost part of a column. They are supported by a wood frame, over which gypsum plaster is molded. The casting plasters used in that era must be properly painted or they crumble when exposed to the weather. I was really disappointed when I saw the column capitals on this project. The plaster details of the composition casting were completely weathered away on the inside. Inside, however, the wood frames (called "structures") were intact.

Before I developed treatments for the cupola, I needed to address the root causes of the problems. I had to figure out why the cupola fell into such bad repair. I found the poor conditions were there for three reasons.

To care for a remote building element such as a cupola or tower, you must do more than wait until people complain because it looks bad.

Out of sight, out of mind. Remote parts of a building, like cupolas, towers, and spires, don't see much traffic. Their condition isn't noticed until a serious leak gets bad enough to damage plaster down below.

Lack of effective maintenance. This cupola received regular maintenance. Over 15 coats of paint attest to that fact. But "regular" may not mean "effective." You must consider specific needs and the results of the maintenance you do. Just going through the motions guarantees nothing. In this case, the column capitals didn't get enough paint, while the shafts got too much. Painting the capitals twice as often as the shafts would have been more effective and less costly.

Repair's future impact not considered. Some maintenance methods and materials limit future treatments. Once a copper roof is patched with tar, it is impossible to clean the copper well enough to effectively solder on a patch. Using an inexpensive "quick fix" like tar means the entire roof must be replaced, whereas an inexpensive soldered repair might have been possible.

Paint

The irregular and spotty condition of the existing paint means that the ordinary approach of spot scraping and full recoating will not work. All the old paint will have to be removed for a fresh start. In this case I have recommended the removal of all the paint, right down to bare wood, although traces of the original primer are acceptable. Next, they should sand all surfaces with 100-grit paper to clean and prep the surface. Finally, they should prime and recoat with two top coats of linseed-oil-based house paint, sanding between all

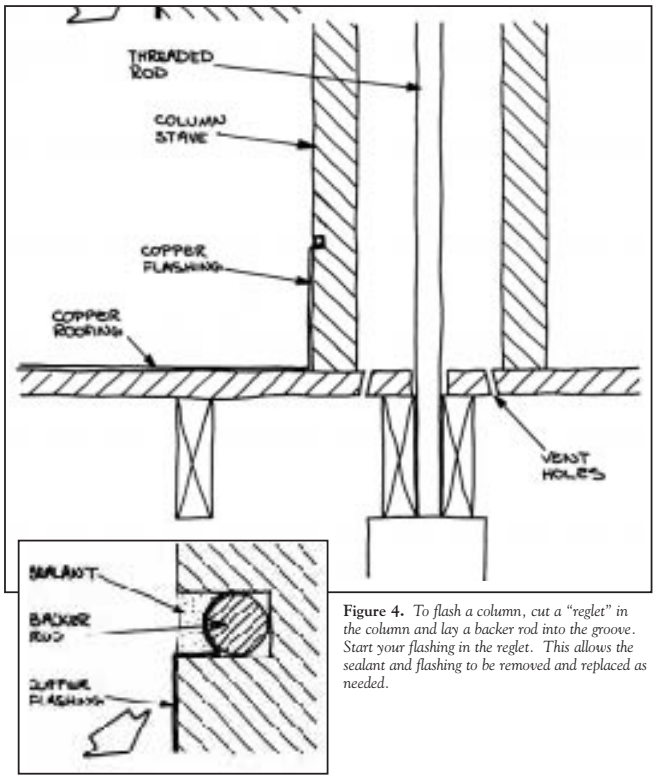

Figure 4. *To flash a column, cut a "reglet" in the column and lay a backer rod into the groove. Start your flashing in the reglet. This allows the sealant and flashing to be removed and replaced as needed.*

coats. (This assures the final result is a continuous coating, which protects better.)

Flashing

When flashing a column, design the sealant joint between the flashing and the wood column so the sealant can be easily removed and replaced. Cut a groove, called a "reglet," in the column 3/8-inch wide by 5/8-inch deep with clean-cut surfaces and edges. Lay a backer rod into the groove. This helps form the shape of sealant for maximum adhesion. The rod should have a release surface so caulk does not actually stick to it (see Figure 4). When the sealant wears out, you can replace it without damaging the wood or the copper flashing.

Cupola Maintenance

The root causes for deterioration had more to do with how maintenance was managed than the specific materials and methods used. To care for a remote building element such as a cupola or tower, you must do more than wait until people complain because it looks bad. Inspect a cupola at least every year or as often as after every storm. Where there is access, make the inspection close-up and first-hand. (you can inspect from a distance with binoculars or a telescope). Look for cracked paint at joints and deteriorating sealants. Make written notes of the conditions, and use the written notes to plan yearly maintenance. Except for materials like paint and sealants, we expect the repairs on this project to last from 30 to 40 years. ■

John Leeke, of Sanford, Maine, restores and maintains historic buildings. He also consults with contractors, architects and owners working on older buildings.