TETRA TECH

May 12, 2022

Mr. David Wilding
Louisville Metro Parks and Recreation
1297 Trevilian Way
Louisville, KY 40213

RE: Hogan's Fountain Teepee Pavilion, Cherokee Park

Dear Mr. Wilding;

In response to the request of Louisville Metro Parks and Recreation, on May 10, 2022, Tetra Tech performed a visual inspection of the structure of the Teepee Pavilion located adjacent to Hogan's Fountain in Cherokee Park. The pavilion was constructed in 1965 and consists of eight glued laminated wood (glulam) arched beams supporting the wood framed roof structure. Each glulam arch is anchored to individual concrete buttresses serving as the foundation of the structure. In the 1978-1979 timeframe, rotting was observed in the lower portion of two of the glulam arches near the buttress. At that time repairs were undertaken consisting of encasing the glulam arches with ½ inch thick steel side plates connected with two rows of ¾ inch diameter rods spaced at 12 inches on-center drilled thru the existing glulam arches. The steel casing extended from the base of the glulam arch up to the bottom of the wood roof framing, which was beyond the zone of wood rotting and allowed an adequate length of acceptable wood to transfer the forces from the glulam arch into the rods and steel side plates. Similar wood rotting problems eventually occurred in the remaining glulam arches. In circa 1989, the remaining glulam arches were repaired using the same strengthening repair technique as described above.

The current visual inspection was performed on the previously discussed eight glulam arches supporting the pavilion roof structure. Wood rot and severe deterioration of the wood was observed at the bases of the glulam arches at the concrete abutments (See Photo 1) as well as at the top of the steel casing near the connection of the horizontal roof framing members to the glulam arches (See Photo 2). Note that the condition of the glulam arch between the two ends of the steel casing could not be visually determined because of the steel casing itself. However, we suspect most of the glulam arch between the steel casing has similar wood deterioration.

At the top of the steel casing at one of the originally repaired glulam arches, a 4-inch gap was observed between the bottom of the glulam arch and the bottom plate of the steel casing, indicating significant movement in the glulam arch (See Photo 3). At this location the wood was severely deteriorated (See Photo 4), exposing the top ¾ inch diameter rod between the steel casing sides (See Photo 5). Wood deterioration and exposure of the ¾ inch diameter rod at the top of the steel casing is particularly concerning since it was the upper zone of the steel casing that served as the area for the transfer of the forces in the glulam arch to the steel casing.

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In the glulam arch opposite to the beam discussed in the paragraph above, evidence of frame movement was observed in the bulging gutter at the roof edge. Rotting of the wood above the steel casing was noted in several other glulam arches, with some limited glulam movement observed relative to the steel casing. Sounding and probing of the glulam arches was implemented directly above the steel casings. Many of the glulam arches had a hollow sound indicating internal decay of the wood members. Probing of the areas indicated excessive softness and lack of resistance to probe penetration into the wood members.

As a result of our visual inspection, we believe the pavilion structure is compromised and poses a safety concern to the public. The pavilion structure is almost certainly at the end of its service life. The pavilion structure is nearly 60 years old. The initial repair to the glulam arches supporting the pavilion structure occurred around 40 years ago and the follow-up repair occurred over 30 years ago, which in both cases is beyond the lifetime expected when the repairs to the glulam arches were made. The pavilion area should be fenced to approximately 80 feet beyond the footprint of the pavilion to prevent the public from accessing the area. This should occur as soon as possible.

After the area is fenced, if further exploration is desired to confirm the extent of wood damage between the steel casing, it could occur by utilizing specialized video cameras or drilling through the midzone of the steel casings to confirm the extent of wood rot in all glulam arches in areas under the steel casings. However, beyond any doubt, the glulam arch that displayed the 4-inch movement needs major repair work and likely total replacement. The cost of attempting to repair the pavilion structure would most likely exceed the cost of total demolition and reconstruction.

Please feel free to contact us at any time with questions regarding this letter.

Sincerely,

TETRA TECH, INC.

Scott Jenkins, P.E.
Structural Engineer

Michael I. Yost, P.E.
Structural Engineer

Photo 1 – Wood rot and decay at base of glulam arch.

Photo 2 – Glulam arch wood decay near the connection of the horizontal roof framing members.

Photo 3 – Separation of the steel casing from glulam arch.

Photo 4 – Glulam arch wood deterioration near the top of the steel casing.

Photo 5 – Exposed ¾” diameter rods between the steel casing sides thru the deteriorated glulam arch.

Memo

To: Mr. David Wilding
Louisville Metro Parks

From: Shea Carr
Wood Environment and Infrastructure Solutions, Inc.

Date: June 13, 2022

Project No.: 5-6607-1002

Re. Cherokee Park Hogan's Fountain Pavilion

The purpose of this memorandum is to provide a brief summary our site visit on Tuesday, June 7th at Hogan's Fountain Pavilion located in Cherokee Park, Louisville, KY. Based on our conversations with you and observed during a recent site visit, we understand the Hogan's Fountain Pavilion has experienced some movement in several of the wooden structural framing timbers. The structure is supported by eight structural timbers originally constructed in 1965. Due to deterioration of the wooden timbers at the base of the stone foundation, repairs were made to the structure in 1989 which including encasing the existing timbers with ½" thick steel with ¾" solid rods located

Photo 1: Hogan's Fountain- Eight timbered legs encased in ½" steel.

throughout. Due to the recent movement of the structural timbers, Wood was requested to evaluate the condition of the encased timbers and to determine if the timbers have experienced deterioration. Wood hired subcontractor, Concrete Coring & Cutting, to drill 2-inch diameter holes in the ½-inch steel casing to evaluate the wood condition. The following provides a brief overview of our results. For this evaluation, Wood used the same naming nomenclature used on the 1989 plans.

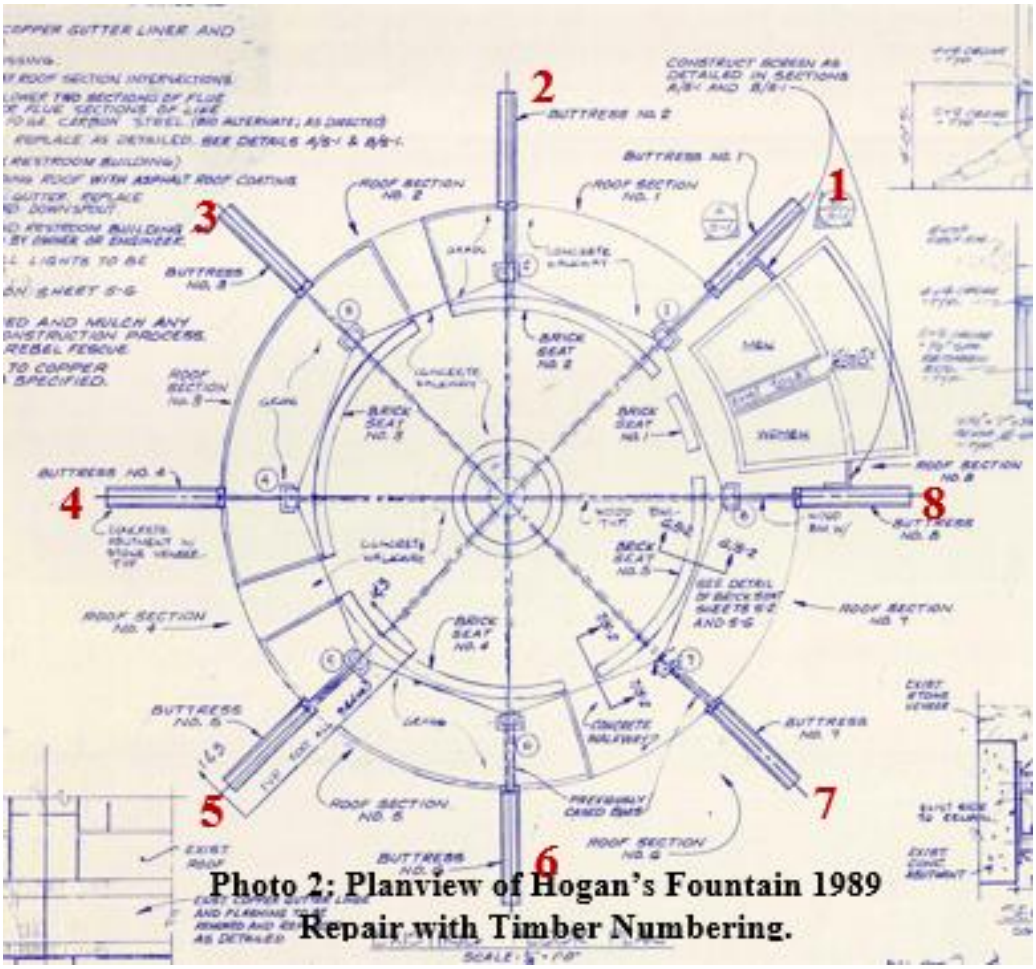

Photo 2: Planview of Hogan's Fountain 1989 Repair with Timber Numbering.

Table 1: Timber Evaluation Data Summary

Timber Number	Hole Location[1]	Timber Condition
1	a	Deteriorated; soft under mild pressure, wood appeared to be split/splintered
	b	Some deterioration
	c	
2	a	Deteriorated; soft under mild pressure
	b	
	c	
3	a	Deteriorated; soft under mild pressure
	b	
	c	
4	a	Deteriorated; soft under mild pressure
	b	
	c	
5	a	Deteriorated; soft under mild pressure
	b	
	c	
6	a	Deteriorated; soft under mild pressure
	b	
	c	
7	a	Deteriorated; soft to very soft under mild pressure
	b	
	c	
8	a	Deteriorated; soft under mild pressure
	b	
	c	

[1] a= 12" from bottom of steel, b= 6'6" from bottom of steel, and c= 12" from top of steel

Based on our evaluation, the wood encased in the steel has experienced severe deterioration and therefore is not structurally sound. Repair options should not utilize this section of wood as a structural component. In addition, in several areas, the wood above the steel is showing signs of distress (delamination, darkening of the wood from possible water damage, etc.).

This memorandum is for the exclusive use by the LMP only. We trust the information contained in this memo meets your current needs. If you have any questions, please do not hesitate to contact us at (502) 267-0700.

TETRA TECH

MEMO

To:	Dave Wilding
From:	Jason Burkett, P.E.; Scott Jenkins, P.E.
Date:	8-22-22
Subject:	Cherokee Park, Hogan's Fountain Teepee Pavilion Reassessment

In response to the request of Louisville Metro Parks, Tetra Tech has reviewed the memo provided by Wood Environment and Infrastructure Solutions, Inc. (Wood) and conducted a follow-up visual assessment of the teepee pavilion at Cherokee Park. The memo provided by Wood outlines their findings after drilling access holes into the steel casing around the base of the primary structural wood beams. Wood confirmed that the eight (8) glue-laminated wood beams are in advanced stages of deterioration within the steel casings and are not structurally sound.

On August 17, 2022, Scott Jenkins and Jason Burkett met with Dave Wilding at the pavilion to review the current condition, look inside the 2-inch diameter viewports on the steel casings, and compare these findings with our original assessment on May 10, 2022. Our previous letter, dated May 12, 2022, should be referenced for additional information and the history of the pavilion. The location of each glue laminated support beam has been identified in **Photo 1**, to correspond with the original repair drawings.

Summary of Findings:

1. Foundation Abutments
    - The concrete foundation abutments are clad with stone veneer, so an assessment of the structural concrete was not performed. However, the condition of the concrete abutments does not change the conclusions or recommendations provided herein.
    - Abutments 1, 4, 5, and 8 (**Photo 2**) have cracking in the stone veneer that could be an extension of cracking in the concrete abutment substrate. If this cracking is also in the concrete abutment, it may be caused by the change in load path from the steel casings. See discussion under glue-laminated wood beams about cantilever action for more on this.
    - Cracks in the abutments are not a new discovery but now have a logical explanation since the condition of the wood beams inside the steel casings has been deemed not structurally sound.

2. Glue Laminated Wood Beams
    - Wood beams within the mid-section of the steel casings at locations 1, 2, 3, 4, 6, 8 (**Photo 3**) have so deteriorated that there is either no wood evident, the member section is partially lost, or the wood is so soft that it does not resist probing with an ice pick.
    - Wood rot has been confirmed throughout most of the steel casing length on the majority of the beams.
    - The retrofitted steel dowels in the casings are no longer providing the axial, bending, and shear load transfer to the steel casing that was designed to simulate a beam extension.
    - The gap at beam #6 was measured and found to be about 4 ½" which is ½" more than previously documented in May (**Photo 4**). This side of the structure appears to be lifting.
    - Lifting movement from beam #6 is pulling on the exhaust hood and lifting one side as seen in **Photo 5**.

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- Wood beams at locations 1 and 2 appear to be supported by the ends of the steel casing as evidenced by the steel casing digging into the wood beam and facia boards (**Photo 6**). This side of the structure appears to be settling downward.
- The steel casings where the wood is mostly missing or rotten are likely acting as cantilever beams, fixed to the abutments, which was not how they or the foundation and connection were designed. This could be related to the stone veneer cracking, see the previous comment under foundation abutments (**Photo 2**).

3. Overall Stability and Movement
    - The fascia beam between steel casing 1 and 2 has a severe bow in it that appears to be from compression forces and/or rot (**Photo 7**). There are two steel angle connections to the adjacent roof purlin that have failed. If there is a compression force on this beam member, it is the result of the downward and inward movement of the glue laminated beams #1 and #2.
    - Most of the glue-laminated wood beams have lost their structural integrity within the steel casings, which has resulted in compromised stability and integrity of the overall structure. In other words, the load path of the structure has changed and what was originally designed and retrofitted by the steel repairs is no longer functioning as designed. It is unknown what the actual load path of the structure is, in its current state, due to the complexity of the structure and varying states and locations of deterioration within the glue-laminated beams.
    - The structure shows signs of downward and upward movement on opposite sides near locations #2 and #6, respectively (**Photo 4** and **Photo 6**).

Conclusions and Recommendation

The initial assessment and recommendations of our letter dated May 12, 2022, still stand. Additionally, the wood deterioration inside the steel casings is worse than originally assumed and the structure is continuing to move according to our measurements and observations. It is our opinion that the pavilion structure is at risk of collapse due to the evidence of movement and structural member deterioration. No one can predict when it will collapse, but it could happen in the near future. The most likely time that it would collapse is during severe weather (wind, rain, snow) or a seismic event when it sees significant live loads.

Because the wood is so deteriorated or non-existent within the steel casings our recommendation is that the pavilion needs to either be shored or demolished as soon as possible, to prevent an unexpected or uncontrolled collapse. Shoring a structure of this type is more complicated than a normal column supported structure due to the outward thrust forces of the curved beams and the necessity of circumferential or radial tension ties around the structure. Add to this, the deteriorated state of the glue laminated beams and instability issues, the condition of this structure makes shoring a very dangerous operation that should only be done by a reputable company under the direction of a structural engineer experienced in shoring design. Although shoring and repair is an option, it is our opinion that shoring and repairs to this structure would neither be economical nor preserve the architectural design of the pavilion.

Jason Burkett, PE
Structural Engineering Manager

Scott Jenkins, PE
Structural Engineer

Reference Photos

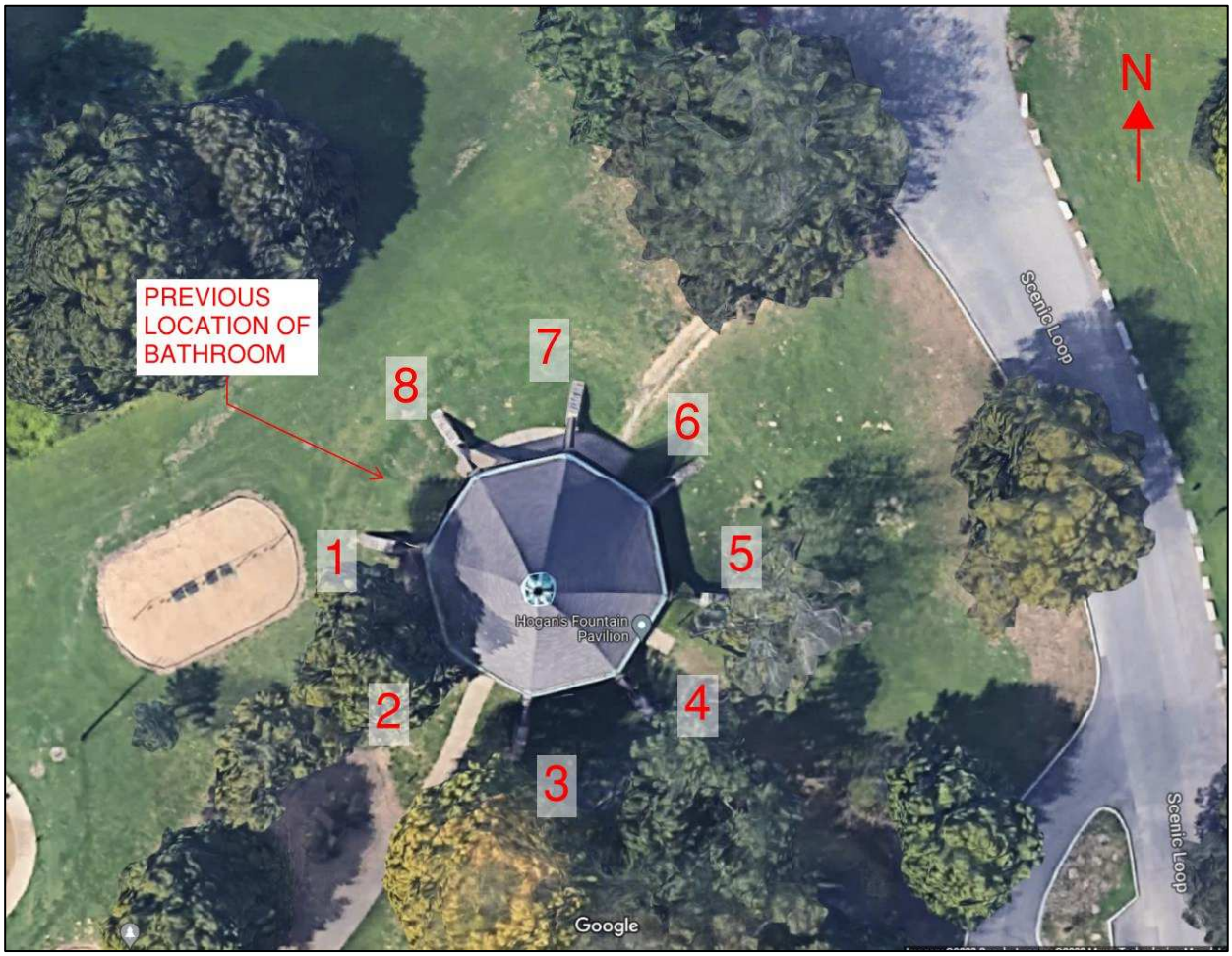

Photo 1: Pavilion and Beam Orientation

Photo 2: Abutment #8 Veneer Cracks

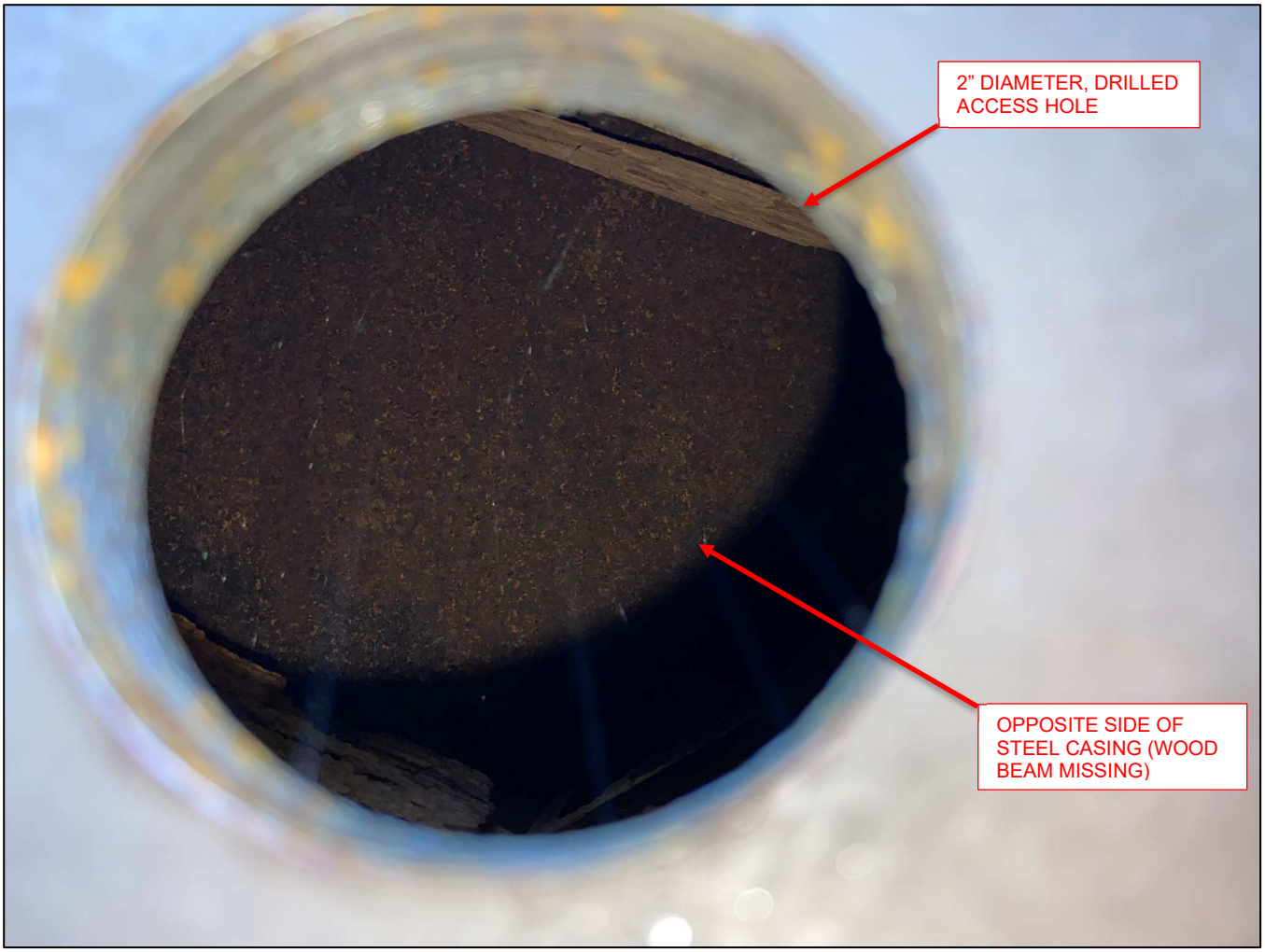

Photo 3: Steel Casing Access Hole at Location #1

Photo 4: Measured Gap at Beam #6

Photo 5: Hood Lifting from Beam #6 Movement

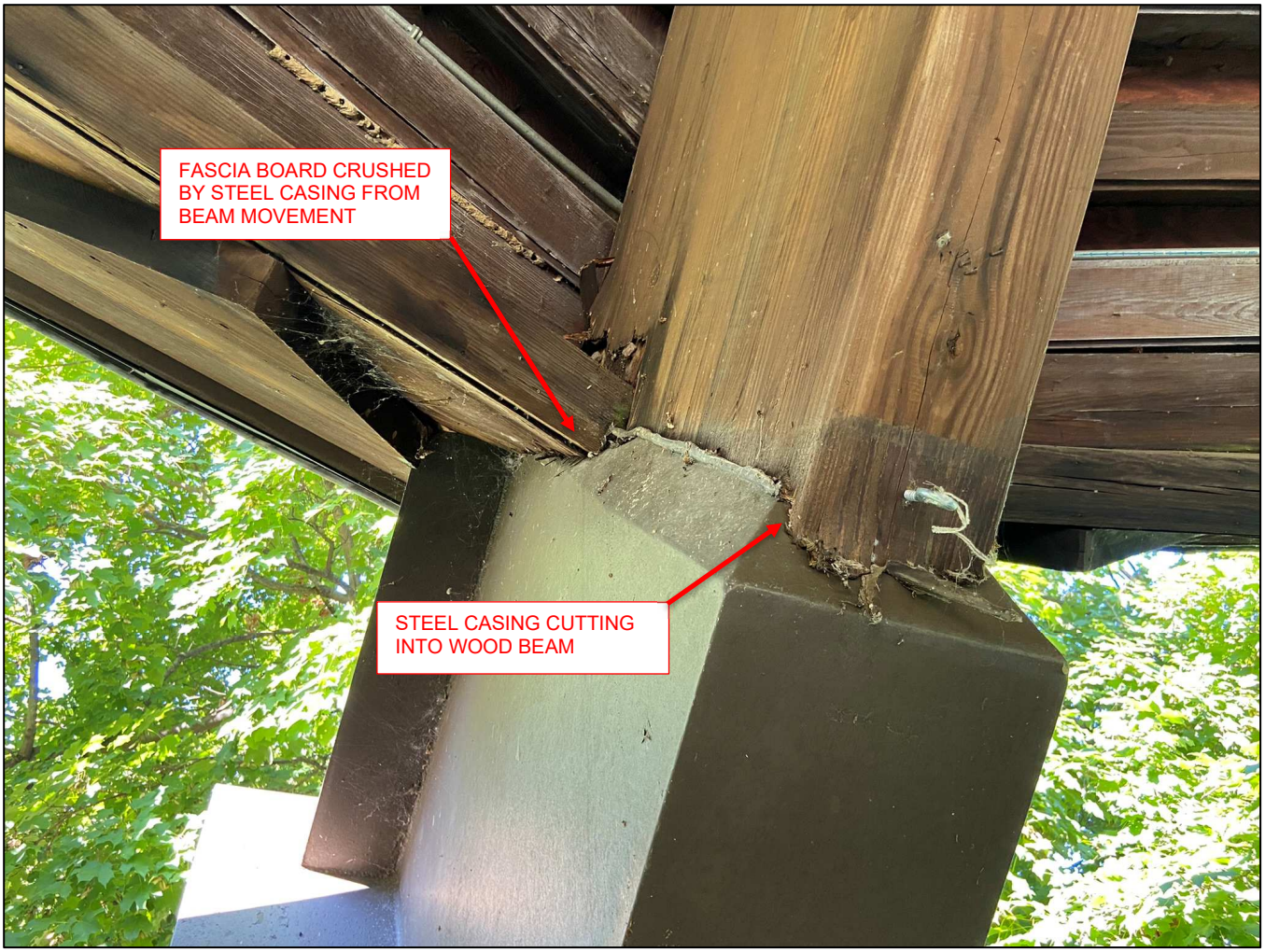

Photo 6: Steel Casing #2 Cutting into Wood Beam

Photo 7: Bowed Fascia Board