Fire Tower Engineered Timber, Inc.

PROVIDENCE, RI • KEWEENAW PENINSULA, MI • LARAMIE, WY

Albion River Bridge
Preliminary Condition Assessment

By:

Robert L. (Ben) Brungraber, P.E., Ph.D.
Richard J. (Dick) Schmidt, P.E., Ph.D.

24 August 2018

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Executive Summary

Over the two-day period from July 25-26, 2018, we (Dr. Ben Brungraber and Dr. Dick Schmidt of Fire Tower Engineered Timber, Inc.[1](FTET)) visited the Albion River Bridge located in Mendocino County, California, in order to conduct a visual examination of the bridge and evaluate its structural integrity, with a focus on its timber components. Prior to and following our visual examination we also reviewed multiple reports, including the most recent (January 5, 2018) Bridge Inspection Report from the California Department of Transportation (Caltrans) documenting its October 11, 2017 bridge inspection. Our examination was limited to portions of the bridge and the surrounding area that are openly accessible or visible to the general public.

The purpose of our examination was to make observations and collect information required to answer two questions:

1. Is the existing bridge in need of immediate or near-term replacement?
2. If the bridge does not require immediate or near-term replacement, what steps are necessary to keep the bridge in service?

Based upon our examination, experience, and qualifications, we offer the following responses to these questions:

1. No, the bridge is not in need of immediate or near-term replacement. The bridge is in remarkably good condition, thanks to its well-conceived structural design, high-quality timber materials, and effective connection detailing. While there certainly are locations on the bridge that require maintenance and repair, overall the bridge appears structurally sound and safe for continued use, as per the "Safe Load Capacity and Ratings" reflected in Caltrans' January 5, 2018 Bridge Inspection Report.

2. We recommend a multi-step program of inspection, maintenance, repair and monitoring to improve the condition of the bridge and to keep it in service indefinitely. Specifically:
    a. Perform a thorough inspection of the bridge to identify locations of decay, corrosion, or other distress points, so that those areas may be scheduled for maintenance and repair.
    b. Determine the remaining concentration and depth of penetration of the Wolman salts preservative treatment that was applied to the timbers prior to construction of

[1] Appendices B and C contain our professional vitae.

the bridge. If the preservative treatment is below the target concentration level, then plan and implement remedial treatment procedures to inhibit decay.

c. Rebuild the curbs and scuppers on the edges of the bridge deck to promote effective stormwater runoff, thus reducing the potential for deck-level and superstructure-level timber decay, and fastener hardware corrosion.
d. Develop and implement a regular maintenance, repair, and monitoring program for the bridge to keep it safe and operational.

Background

State Route 1 is a winding two-lane road through much of rural Mendocino County on California's north coast. The Albion River Bridge (Caltrans Bridge Number 10 0136), which was completed in 1944, connects two coastal headlands to carry State Route 1 across the Albion River near its mouth at Albion Cove, a semi-sheltered inlet of the Pacific Ocean between Salmon Creek to the south and Little River to the north. The small coastal community of Albion overlooks the 969 foot long bridge from the north and south; the Albion Flats marina and campground lie along the river and cove approximately 150 feet below the two-lane bridge.

The bridge consists of a steel truss main span supported on concrete towers, with timber side spans supported by a series of timber trestles, similar in form to many railroad bridges of the era.

In 2017, Albion River Bridge was placed on the National Register of Historic Places and the California Register of Historical Resources under two of the selection criteria:

- as an example of expedient planning and use of available materials during wartime shortage in facilitating commercial and industrial travel during the Second World War (Criterion A); and
- because of its distinctive characteristics of construction, designed to site-specific needs (Criterion C).

Caltrans has proposed to replace the Albion River Bridge with a more modern structure.

Albion River Bridge Preliminary Condition Assessment

We (Dr. Ben Brungraber and Dr. Dick Schmidt of FTET) have been retained to examine Albion River Bridge and offer our professional opinion regarding its condition, and the potential for its continued operation. In developing that opinion, we reviewed multiple documents, including available bridge inspection reports and related documents generated by Caltrans dating back to the bridge's construction (see List of Source Materials following this report). These documents provided the necessary background information for us to understand the fundamentals of the bridge's construction, Caltrans' stated concerns about the condition of the bridge, and the state of bridge maintenance. In addition, we examined the bridge itself over a two-day period (July 25-26, 2018) in order to evaluate the bridge firsthand, observe it from multiple angles, and document our findings to answer two questions:

1. Is the existing bridge in need of immediate or near-term replacement?

2. If the bridge does not require immediate or near-term replacement, what steps are necessary to keep the bridge in service?

This report documents our observations, outlines our recommendations, and presents our conclusions regarding the current condition and potential future of the bridge. Our examination of the bridge was limited to portions of the bridge and the surrounding area that are openly accessible or visible to the general public. We focused our examination on the timber components of the structure. We did not directly examine the steel truss and its concrete support towers, but did note that they appear to be in good repair.

Observations

From the vantage points available to us, we observed that the Albion River Bridge is in remarkably good condition, and is not posted with any load capacity/weight limits. The design of the bridge involves a highly redundant structural system with multiple load paths. Features of the design that lead to its robust and resilient character include the following:

- The timber members are of uniformly high-quality Douglas fir salt-treated by the Wolman method.
- The timber trusses of the superstructure and support trestles consist of members primarily subjected to axial compression forces, for which heavy timber members are well suited.
- The dimensional integrity of the bents in the trestles is impressive. Column lines are straight (to the eye) and the bents are planar. (Figure 1 below.)
- The battered columns provide a base that is wider than the bridge deck, thus enhancing the ability of the bridge to resist lateral loads, such as those from wind. (Figure 2 below.)
- In August 2002, a loaded logging truck plunged down the side of a trestle, destroying the cross-bracing members between bents. The fact that the trestle did not collapse due to the loss of bracing is an indication of the resilient and redundant nature of the trestles and demonstrates how the internal shear connectors might be revealed for inspection (as discussed later in this report) without endangering the structural integrity or safety of the bridge.
- There is little or no audible rattle below the bridge deck when traffic passes overhead. This observation suggests that connections are tight and members are sound.
- Generally, access to the connections within the trestles is good, which will enhance the efficiency of inspection, maintenance, and repair activities. Removing bracing members temporarily to inspect the inner connection hardware could be performed relatively easily without requiring closure of the bridge to traffic.

- Each of the outer-most columns of each bent is heavily bolstered at its base to help distribute compressive load into side-grain bearing on the lower sill plates. The next, inboard line of columns is lightly bolstered, because those columns carry less compression under lateral load. The bolsters appear to be effective in controlling overstress of the sill plates, as we observed no indications of localized crushing due to compression perpendicular to grain. (Figure 3 below.)
- Many of the large timber members have checks – radial cracks on the surface of the timber. The checks tend to be aligned with the longitudinal axes of the members, which suggests that the members have remarkably straight grain, another indication of high-quality material. Checks are not generally regarded as strength-reducing defects and do not require repair (see Appendix A). Checks on the sides or bottoms of horizontal members and on any face over vertical or diagonally oriented members are able to drain freely when subjected to rain water.
- The bridge deck consists of two crossing diagonal layers of timber planks. The upper layer uses tongue and groove planks that lock together and provide uniform support for the asphalt pavement. The lower layer has planks that are spaced to minimize trapping any water that might migrate through the asphalt wearing course and the upper layer. The two layers of planks, properly coupled to the longitudinal stringers along the edges of the deck, have the potential to form an effective diaphragm (a deep, flat beam) to resist out-of-plane loading. With proper drainage detailing, the bridge deck also acts as a roof to protect the superstructure and trestle towers from stormwater runoff.
- Concrete piers supporting the timber trestles are in good condition. We observed no spalling or cracking. The piers provide uniform bearing support for the sill beams of the trestles.

Figure 1: Battered columns provide wide base below roadway

Figure 2: Good dimensional integrity of trestles

Figure 3: Bolstered exterior columns

Although the overall condition of the bridge is good, it does have some areas that require maintenance and repair. The problem areas that we observed, with the exception of the scuppers on the deck, were isolated and repairable.

- Many of the deck scuppers were clogged with debris, preventing effective runoff of stormwater. In addition, there was no flashing that would direct runoff over the edge of the deck, allowing it to free-fall from the bridge or otherwise be redirected for collection. As a consequence, the edging board above the two layers of deck planks showed advanced decay. The edging boards are of little or no structural significance, but their decay opens the underlying deck planks to direct threat from decay.
- Some of the timber columns lack straps to hold them down to the concrete piers. Apparently, this situation has not yet caused a behavior problem, as the columns likely remain in compression under wind-loading events. Nevertheless, the possibility of uplift demands under a seismic event could lead to unacceptable structural behavior.
- We noted that one timber at the North end of the superstructure has a check in the top face, which was retaining water and debris, resulting in support of plant growth. Drainage of water from that check could be achieved by simply drilling a hole through

the timber, with little negative impact on the structural capacity of the member. An alternative to drilling drain holes is to apply tented flashing over the top of the check.

- Decay in several sill plates at the base of the trestles had been repaired with bulk epoxy, which is incompatible with timber in its elastic, hygroscopic, and thermal characteristics. Hence, cracks can develop around the epoxy patch, leading to water intrusion and entrapment. Repair of large zones of decay is best performed by scarfing in a wooden insert after the decayed zone is cut back to sound wood or by replacing the member entirely.
- The original drawings for the bridge, reproduced in the documents for Contract No. 0E2004, show use of split-ring connectors and toothed-ring connectors as internal fastener hardware between members at lap connections. These shear connectors can be effective in transferring load from one member to another, but assessment of their condition is a challenge because they are concealed within the joint. We observed occasional instances of staining from iron oxide. The source of the staining cannot be determined without disassembling the connection to examine the shear connectors, or possibly by using an indirect nondestructive evaluation (NDE) technique.
- Several areas of the bridge had a green or white crusty buildup on the faces of the timber members. This buildup could be leaching of the Wolman salt preservative treatment, lichen, or decay fungi. Sampling and analysis would be necessary to make a positive identification. Nevertheless, the timber members appear sound, suggesting that decay is not active at these locations.
- In several locations where two members crossed, but were not held in tight contact, debris had built up between the members. This debris could retain moisture, leading to wood decay or fastener corrosion. Occasional pressure washing of such areas could remove the debris and reduce the prospects for decay and corrosion. Debris buildup where two members crossed also promoted decay in a vertically oriented check, which would otherwise naturally drain.
- At the abutments, down the banks, and along the flats, vegetation has been allowed to grow. The vegetation inhibits access for observation and maintenance, and it also can promote decay when it is in contact with the bridge members.

Recommendations

Based on our observations of the bridge, we recommend a multi-step program of inspection, repair, maintenance, and monitoring as appropriate to improve and maintain the condition of the bridge, thereby keeping it in service indefinitely.

1. Perform a thorough inspection of the bridge to identify locations of decay, corrosion, or other distress. Any identified sites of wood decay, fastener corrosion, debris buildup, or similar issues should be documented (by location and type, with photographs) and scheduled for follow-up remediation.

   The inspection process should include a variety of nondestructive evaluation (NDE) techniques. The first and most obvious NDE technique is visual examination of all accessible locations of the bridge. Second, soundings (with a hammer) and probing (with an awl) can be effective to identify locations of advanced wood decay below the surface of the member. Based on these two techniques, locations that warrant additional examination can be identified. Where internal decay is suspected, more advanced NDE techniques, such as resistograph drilling, could be deployed to confirm and quantify the internal condition of the respective timber member.

   As part of the inspection process, selected members could be removed to facilitate condition assessment of the internal shear connectors. It is likely that individual bracing members could be temporarily removed and subsequently replaced without compromising the structural integrity or safety of the structure. In certain cases, supplementary members could be added to perform the function of the brace selected for removal.

   The inspection activity could serve as a means to learn and refine subsequent maintenance plans and procedures, including replacement of certain members as required.
2. Identify the nature of the crusty buildup on the surface of some members. In doing so, determine if remedial action is required.
3. Using core samples and lab tests, determine the concentration and depth of penetration of the Wolman salt preservative treatment that was applied to the timbers prior to construction of the bridge. If the preservative treatment is markedly below its minimum threshold level to control decay, then appropriate remedial action, such as inserting borate rods, can be planned and implemented.
4. Rebuild the curbs and scuppers on the edges of the bridge deck. It is critical to provide effective stormwater drainage or collection to reduce the potential for deck-level and

superstructure-level decay of the timbers and corrosion of the fastener hardware. The scuppers must be extended with flashing to allow pavement runoff to fall freely from the sides, rather than to run down the edges of the deck planking or to be redirected for collection.

5. Develop and implement a regular maintenance and monitoring program for the bridge that includes regularly scheduled maintenance and repair by qualified contractors.
6. Implement a retrofit to the structure to enhance its ability to resist the effects of the appropriate design-level seismic (earthquake) ground motions. In its October 2013 Final Value Analysis Study Report, Caltrans presents an alternative for the Albion River Bridge that involves seismic retrofit and rehabilitation of the existing bridge. Several retrofit methods are available, depending on the desired level of performance of the structure after the seismic event. Our recommendation does not identify the specific type of retrofit method, only that one be designed and deployed.

Conclusion

In conclusion, we offer our professional opinion, based upon our review of written materials, observations, experience, and qualifications, that the Albion River Bridge is in remarkably good condition, thanks to its well-conceived structural design, high-quality timber, and effective connection detailing. The bridge is not in immediate or near-term need of replacement. We recommend a multi-step program of inspection, maintenance, repair, and monitoring to improve the bridge's condition, keep it structurally sound, ensure the safety of its users, and keep it in service indefinitely.

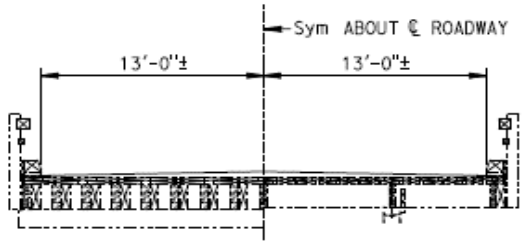
Robert L. (Ben) Brungraber, Ph.D., P.E. Richard J. (Dick) Schmidt, Ph.D., P.E.

List of Source Materials

1. "National Register of Historic Places Program: Weekly List," https://www.nps.gov/nr/listings/20170804.htm, 2018.08.14
2. "Albion River Bridge Rehabilitation/Replacement," California Department of Transportation (Caltrans) web site, 2018.04.12 http://www.dot.ca.gov/dist1/d1projects/albion/
3. "Bridge Inspection Report 2017," California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2018.01.05, 2018.01.05
4. "As-Built Spall Repair 2017," California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2017.03.01
5. "As-Built Bolt Replacement 2017," California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2017.03.27
6. "As-Built 2016 Epoxy Injection," California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2016.12.13
7. "As-Built 2016," California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, Sheets 11–19, 2013.07.19
8. Contract 01-0E2004, Albion River to Ten Mile River Bridge/Seismic Retrofit and resurfacing" California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2016.08.24
9. Document 01-0E2004IH Contract Handout/HazMat," California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2016.05.12
10. "As-Built Plan Sheets, Albion River to Ten Mile River Bridge/Seismic Retrofit and resurfacing," California Department of Transportation (Caltrans), Sheets 1–10, 2016.05.09
11. "Bridge Inspection Reports 2015–2009," California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2015.10.26 to 2009.10.21
12. "Bridge Inspection Report 2014 (excerpt)," California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2014.03.11

13. “Bridge Inspection Report 1-16-2014,” California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2014.01.16
14. “Final Value Analysis Study Report – D-1 Salmon Creek Bridge and Albion River Bridge Replacement Projects,” California Department of Transportation (Caltrans), 2013.10.30
15. “Albion Replacement APS Pricing Update,” Memo from Sims to Ashley, California Department of Transportation (Caltrans), 2013.05.21
16. “Bridge Inspection Report 051512,” California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2012.05.15
17. “Draft Bridge Inspection Report 10-2009,” California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2009.10.21
18. “Bridge Inspection Report 080307 (Supplement),” California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2007.08.03
19. “Bridge Inspection Report September 2007,” California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 2007.09.25
20. “Albion Bride collision sends Roach logging truck plunging,” The Mendocino Beacon, vol. 126, No. 3, pp. 1, 10, 2002.04.22
21. “Supplemental Bridge Inspection Report 02-20-1959,” California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 1959.02.20
22. “Bridge Inspection Report 1944–1960,” California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 1944.08.18–1960
23. “Bridge Inspection Report 1949–1958 Supplements,” California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 1949–1958 Supplements 1949.01.15, 1950.005.17, 1951.10.04, 1956.03.20, 1958.02.28
24. “Paint Metal Surfaces/Record,” California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 1949.12
25. Bridge Inspection Report 1944 (original),” California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, 1944.0818

26. “As-Built, 1942” California Department of Transportation (Caltrans), Bridge Number 10 0136, State Route 1, 01-MEN-001-43.74, Excerpt/As-built concrete towers and pedestal detail, 1942.06.01



TIMBER SPANS STEEL TRUSS

ALBION RIVER - TYPICAL SECTION

3/16" = 1'

ALBION RIVER BRIDGE BR NO 10-0136

QUANTITIES

EPOXY RESIN INJECTION	225	LF
REPAIR SPALLED SURFACE AREA	45	SQFT
CORE CONCRETE (1¼")	60	LF
BRIDGE REMOVAL (PORTION)	63	LF
STRUCTURAL CONCRETE, BRIDGE	LUMP	SUM
DRILL AND BOND DOWEL	23	CY
BAR REINFORCING STEEL (BRIDGE)	204	LF
TIMBER HARDWARE	353	LB
MISCELLANEOUS METAL (BRIDGE)	285	LB
	88	LB

See Attached Sheet for Epoxy
See Attached Sheet for Spall
See Attached Sheet for Bolts

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	1	43.7/69.7	13	19

4-20-16
REGISTERED CIVIL ENGINEER DATE

May 09, 2016
PLANS APPROVAL DATE

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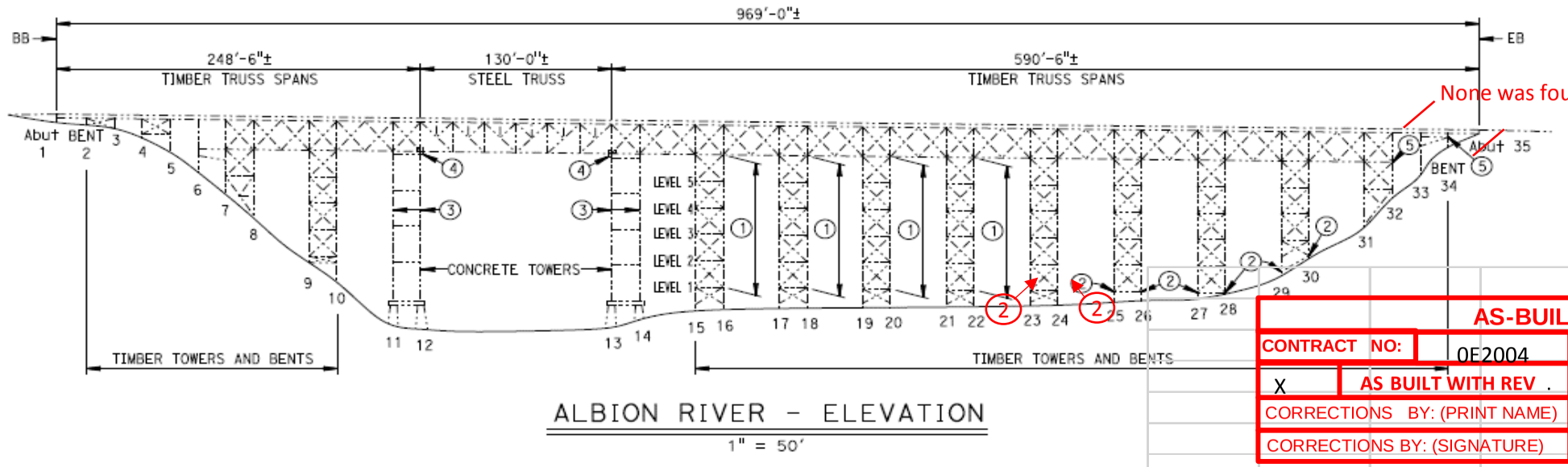
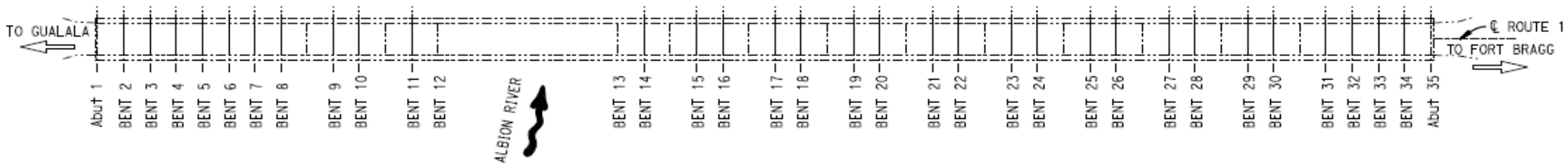
REGISTERED PROFESSIONAL ENGINEER TIMOTHY J. POWELL No. C 61037 Exp. 12-31-16 CIVIL STATE OF CALIFORNIA



ALBION RIVER - ELEVATION

1" = 50'



ALBION RIVER - PLAN

Br No. 10-0136, ROUTE 1, PM 43.74
1" = 50'

NOTE:
THE CONTRACTOR MUST VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

AS-BUILT

CONTRACT NO:	0E2004	Date :	3-6-2017
X	AS BUILT WITH REV .		NO CHANGES.
CORRECTIONS BY: (PRINT NAME)	MOUSSA JANDAL		
CORRECTIONS BY: (SIGNATURE)	Moussa H Jandal		

NOTES: (APPLY TO ALL SHEETS)
---------- Indicates existing.

NOTES: (APPLY TO THIS SHEET ONLY)

① Indicates limits of bridge removal, portion and place ¾" ø bolt and/or threaded rod connectors at timber Bents 15 through 22 at locations determined by the Engineer. For details see ALBION RIVER DETAILS No. 1" sheet.

② Repair checks, splits and rot in the bottom transverse horizontal timber tower members located on top of foundation pedestals with epoxy paste and epoxy resin injection at locations determined by the Engineer at Bents 25, 26, 27, 28, 29 and 30.

③ Indicates repair spalled surface area at locations determined by the Engineer at the concrete towers at Bents 11, 12, 13 and 14. See "ALBION RIVER DETAILS No. 2" sheet.

④ Widen steel truss bearing seat on concrete towers at Bents 12 and 13. See "ALBION RIVER DETAILS No. 3" sheet.

⑤ Repair checks, splits and rot in the top transverse horizontal timber tower members east of the catwalk with epoxy paste and epoxy resin injection at locations determined by the Engineer at Bents 32 and 34.

INDEX TO PLANS

STANDARD PLANS DATED 2010

SHEET No.	TITLE
A10A	ABBREVIATIONS (SHEET 1 OF 2)
RSP A10B	ABBREVIATIONS (SHEET 2 OF 2)
A10C	LINES AND SYMBOLS (SHEET 1 OF 3)

Michael J Lee 4-20-16
DESIGN ENGINEER

DESIGN	BY TIM POWELL	CHECKED KHANH TRUONG	LOAD FACTOR DESIGN	LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD	
DETAILS	BY GF BIDWELL	CHECKED KHANH TRUONG	LAYOUT	BY GF BIDWELL	CHECKED KHANH TRUONG
QUANTITIES	BY TIM POWELL	CHECKED KHANH TRUONG	SPECIFICATIONS	BY JENNIFER RAMIREZ	PLANS AND SPECS COMPARED JENNIFER RAMIREZ

STRUCTURES MAINTENANCE GENERAL PLAN SHEET (ENGLISH) (REV. 09-01-10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF MAINTENANCE
STRUCTURE MAINTENANCE DESIGN

UNIT: 3488
PROJECT NUMBER & PHASE: 0114000015 1
CONTRACT No.: 01-0E2001

BRIDGE No. VARIOUS
POST MILE VARIES

ROUTE 1 BRIDGES (REPAIR TIMBER, CONCRETE, STEEL RAILING & TREAT DECK)

GENERAL PLAN No. 1

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES			

SHEET 1 OF 7

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T J Powell 4-20-16
REGISTERED CIVIL ENGINEER DATE

May 09, 2016
PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

REGISTERED PROFESSIONAL ENGINEER — TIMOTHY J. POWELL — No. C 61037 — Exp. 12-31-16 — CIVIL — STATE OF CALIFORNIA

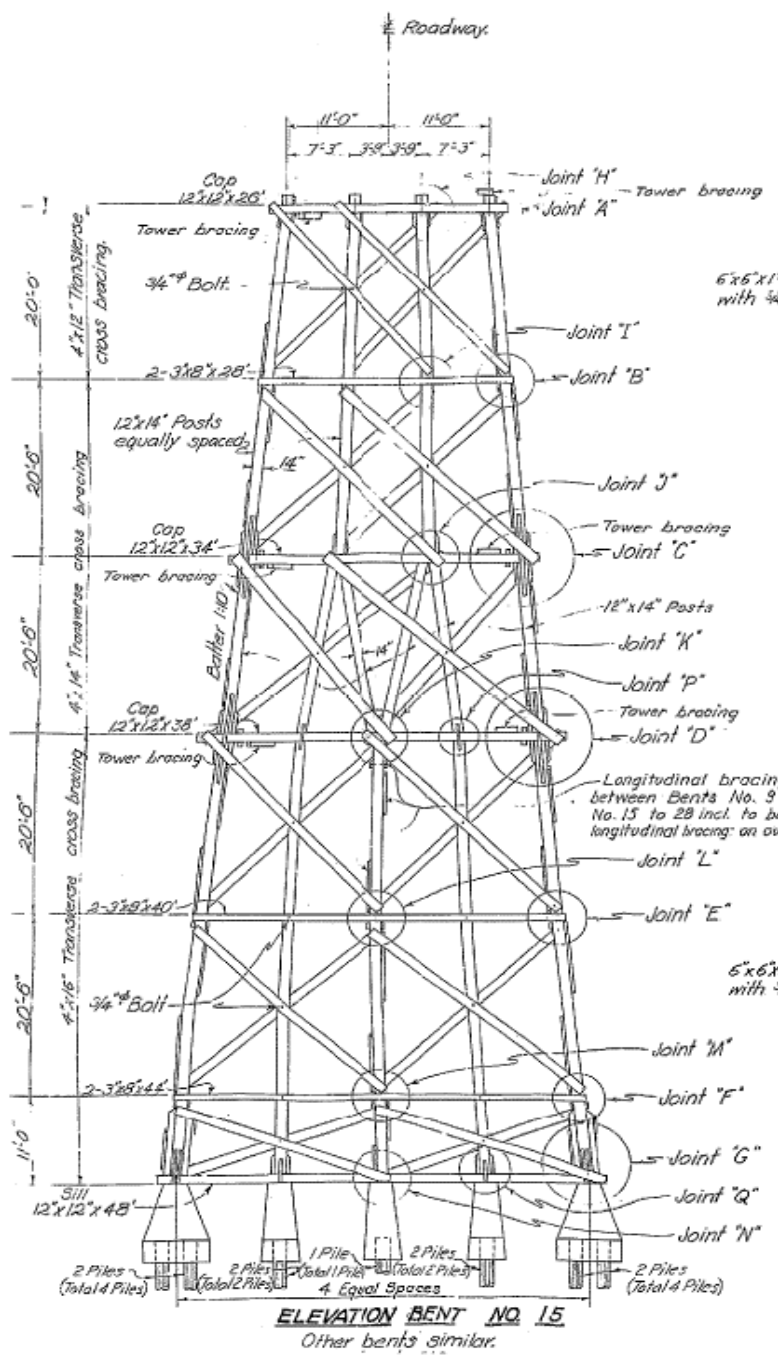
AS-BUILT

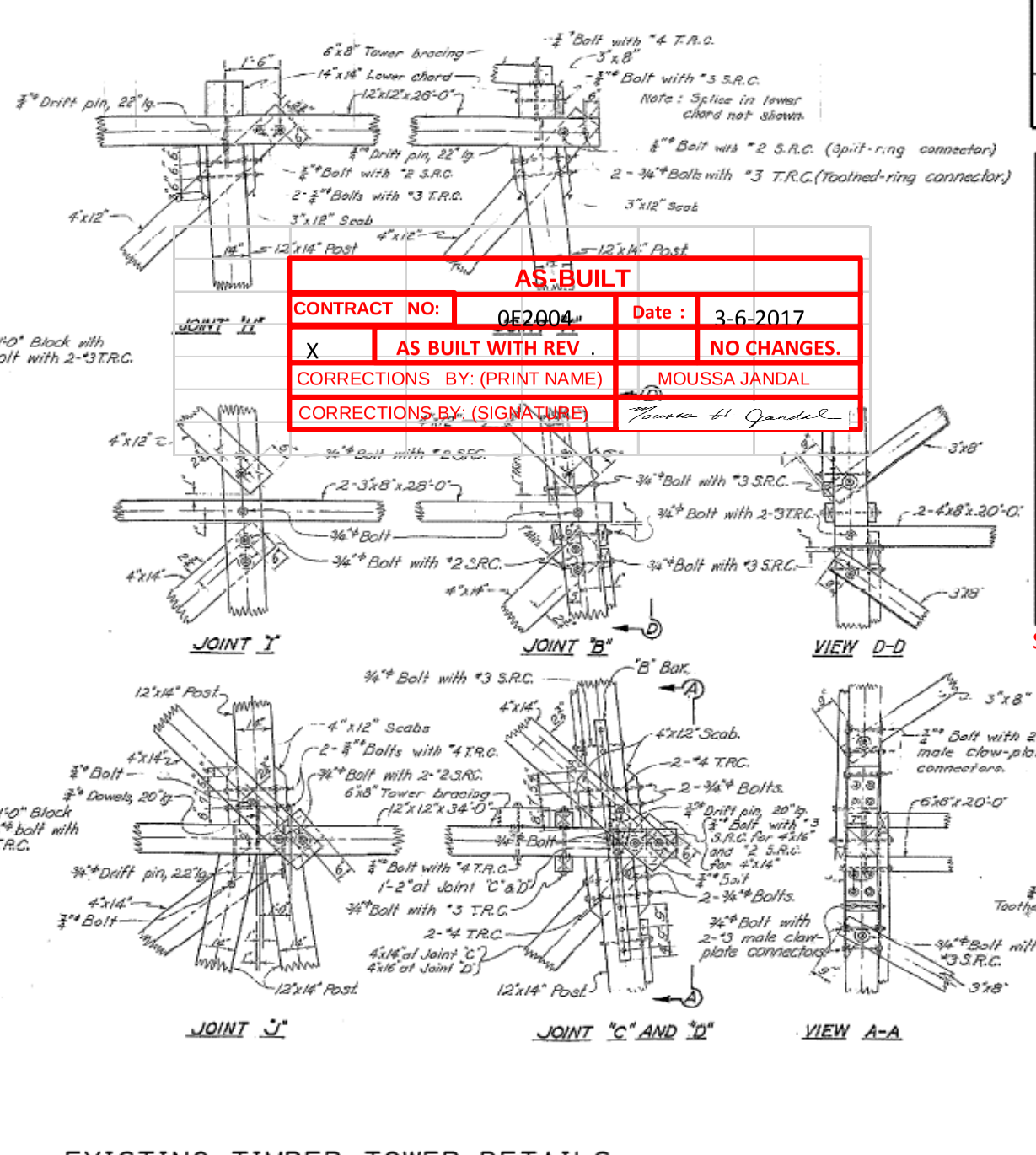
CONTRACT NO: 0E2004		Date : 3-6-2017	
X	AS BUILT WITH REV .		NO CHANGES.
CORRECTIONS BY: (PRINT NAME)		MOUSSA JANDAL	
CORRECTIONS BY: (SIGNATURE)		Mousa Al Jandal	

CONNECTOR REPLACEMENT TABLE

LOCATION (TIMBER BENT/ TOWER/TRUSS SECTION)		SUBSTRUCTURE MEMBERS NUMBER OF NUTS AND/OR ¾" BOLTS/¾" THREADED RODS TO BE REPLACED	
TOWER 15-16	BENT 15	31	20
	X-BRACES B15-B16		6
	BENT 16	73	60
TOWER 17-18	BENT 17	48	42
	X-BRACES B17-B18	5	4
	BENT 18	67	36
TOWER 19-20	BENT 19		110
	X-BRACES B19-B20	14	8
	BENT 20	141	110
TOWER 21 22	BENT 21	102	90
	X BRACES B21 B22	7	10
	BENT 22	101	74

See Attached Sheet for Bridge Removal





EXISTING TIMBER TOWER DETAILS

DETAILS SHOWN FOR ILLUSTRATIVE PURPOSES ONLY
NO SCALE

NOTE:
THE CONTRACTOR MUST VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

	BY	CHECKED
DESIGN	TIM POWELL	KHANH TRUONG
DETAILS	GF DIDWELL	KHANH TRUONG
QUANTITIES	TIM POWELL	KHANH TRUONG

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF MAINTENANCE
STRUCTURE MAINTENANCE DESIGN

BRIDGE No. VARIOUS
POST MILE VARIES

ROUTE 1 BRIDGES (REPAIR TIMBER, CONCRETE, STEEL RAILING & TREAT DECK)

ALBION RIVER DETAILS No. 1

STRUCTURES MAINTENANCE GENERAL PLAN SHEET (ENGLISH) (REV. 09-01-10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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PROJECT NUMBER & PHASE: 0114000015 1
CONTRACT No.: 01-0E2001

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES: 3-6-15 | 1-15-16 | 3-3-16 | 4-20-16

SHEET 4 OF 7

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APPENDIX A -- A Discussion of Checking in Timbers

The objective of this appendix is to outline some of the natural changes that occur in sawn timbers as they season from the green condition. Shrinkage and checking are normal responses in timber as they dry.

Wood shrinks in all three dimensions (radial, tangential, and longitudinal) as it loses moisture from its green (just harvested) condition. This shrinkage occurs as the moisture content decreases from the *fiber saturation point* (FSP) to the *equilibrium moisture content* (EMC) for the service environment. FSP averages around 30% for a broad range of wood species. Average EMC along coastal regions of northern California can be expected to be around 16%, with small seasonal variations as temperature and relative humidity change. Compared to other softwood species, coastal Douglas fir experiences average shrinkage rates. Average rates of shrinkage from FSP to oven dry (MC = 0%) are 4.8% in the radial direction and 7.6% in the tangential direction. Longitudinal shrinkage for all species of wood is very low, in the range of 0.1% - 0.2%. Since the rates of shrinkage vary roughly linearly with the change in MC, Douglas fir timbers can be expected to shrink approximately 2.2% radially and 3.5% tangentially from FSP to EMC in the Albion area. For example, a 12”-wide timber milled while green could be expected to have a final dimension between 11.6” – 11.7” (depending on grain orientation) at EMC.

Checking is a natural response to differential shrinkage. Since the tangential shrinkage rate is greater than the radial shrinkage rate, tension stress perpendicular to grain is developed and the timber develops checks (radial cracks) to relieve this stress. Note that checking is associated with separation of wood fibers, rather than fracture of the fibers themselves. Checking is generally small or nonexistent in free of heart center (FOHC) timbers (timbers that do not contain the pith of the log). In boxed heart timbers (timbers containing the pith), there is often one large check in addition to several small checks. The sizes of the checks are highly variable and depend on the species and particular genetics of the wood, the differential shrinkage rate, the location of the pith in the timber, the rate of drying and the timber sizes. The largest check generally occurs on the face of the timber that is closest to the pith.

While it might appear that shrinkage and checking are negative responses to loss of moisture in timbers, such is not necessarily the case. ASTM D245 states “*Outside the critical zone in bending members and in axially loaded members, shakes, checks, and splits have little or no effect on strength properties and are not restricted for that reason.*” There are also compensating beneficial effects to moisture change. In particular, both the strength and the

stiffness of wood increase with a decrease in MC. In fact, ASTM D245 quantifies this behavior and allows for adjustments to the design values of lumber based on in-service MC at or below 19%. No adjustment to design values for reduction in MC are quantified for timbers. Rather the increases in strength and stiffness are believed to be offset by the shrinkage and seasoning effects. Timbers are graded in the green condition, and the associated design values are used with the understanding that shrinkage and seasoning checks will occur as the timber dries.

APPENDIX B -- Curriculum Vitae, R. L. Brungraber

ROBERT LYMAN ("BEN") BRUNGRABER
Cape Cod and Providence, RI
cell: (603) 381-3810
e-mail: ben@ftet.com

EDUCATION

Stanford University, Stanford, CA Ph.D., Civil Engineering Traditional Timber Joinery: A Modern Analysis	1985
Stanford University, Stanford, CA M.S.C.E.., Construction Management	1984
Colorado State University, Fort Collins, CO M.S.C.E.., Timber Structures and Solar Energy	1978
Cornell University, Ithaca, NY B.S.C.E. (with distinction), Structures Major	1974

PROFESSIONAL EXPERIENCE

Principal/Owner Fire Tower Engineered Timber Providence, RI.	2006-Present
Sole Proprietor B&B Engineered Timber Started in PA, went with me	1978-2006
Operations Director/Owner Benson Woodworking Co., Inc., Walpole, NH.	1986-2006
Assistant Professor University of Connecticut Storrs, CT	1985-1986

Instructor Stanford University Stanford, CA	1982-1985
Visiting Instructor Bucknell University Lewisburg, PA	1980-1982
Senior Engineer Steven Winter Associates Empire State Building	1978-1980
Field Technician Colorado Sunworks Boulder, CO	Summer 1977
Field Engineer American Bridge, Division of US Steel Pittsburgh, PA	1974-1976
Concrete Inspector; DC Metro Rummel, Klepper & Kahl Baltimore, MD	1974
Engineering Technician ACF Manufacturing Milton, PA	Summer; 1973

FIELD EXPERIENCE

Benson Woodworking; 1986-2006
Played large management and small ownership roles in growing a 22 employee ($800,000 sales/year) company into an 80-member ($10,000,000/year)firm.
Designed and built some of the finest heavy timber framed structures in the US.
Most buildings were enclosed with Structural Insulated Panels.
Responsibilities included: engineering, designing, estimating, scheduling, writing contracts, new product development, site assistance, and sales.
Worked with a great many "outside architects," in design/build relationships

American Bridge; 1974-1976
Provided technical and site supervision in erecting structural steel for:

- 30-story Hilton in New Orleans
- Seating Expansion in Pittsburgh Civic Arena.
- Basic Oxygen Furnace replacement at Weirton Steel; Mingo Junction, Ohio
- US Steel mill expansion in Baytown, TX.

Rummel, Klepper & Kahl; 1974
Inspected and approved reinforcing steel and concrete on Farragut North Station; D.C. Metro

Colorado Sunworks; Summer of 1977
Designed, tested, fabricated, and installed solar heating systems and "Bead Walls"

ACF Manufacturing; Summer of 1974
Provided technical support; oldest RR tank car factory in USA. Helped to prepare annual budget.

CONSULTING EXPERIENCE

Fire Tower Engineered Timber; 2006-present
Started structural engineering consulting firm specializing in heavy timber structures.
Partner; Mack Magee, former graduate assistant at Stanford University.
Two other full-time, registered engineers.
Involved in projects that cover a wide range of new and old technologies.
Design/engineer new construction for companies providing the frames and panels
Work with architects in designing timber structures to be let out for bid
Work with owners/stewardsin maintaining their existing timbers structures.
These structures include: homes, barn, churches, bridges, tree houses, and mill buildings.

B&B Engineered Timber; 1978-2006
Provided engineering consulting services, specializing in traditional heavy timber framing.
Designed heavy timber superstructures for about 20 buildings/year.
Performed significant repair work on several covered bridges in Pennsylvania, including:
the longest (Wertz Mill-200') and the oldest (Rishel-1826).

BHB Energy Corp; 1986-1996
Partner and provided engineering consulting in revitalizing existing CT hydropower facilities
Prepared proposals for long-term sales contracts and testified in front of the CT DPUC
The firm built and brought on line a $4.5 M facility on the Quinnebaug River; Danielson, CT

Steven Winter Associates; 1978-80
Structural engineer for leading architectural/engineering firm serving the manufactured housing industry
Clients included many log home builders and timber framers.

Involved with value engineering, structural analysis, and building code approval projects.
Designed and tested new roof structural scheme for pre-cut home kit manufacturer.

PROFESSIONAL QUALIFICATIONS

Registered professional engineer in:
CA, CO, CT, DE, FL, ID, KY, LA, MA, MD, ME, MT, NH, NJ, NY, OH, OR, PA, RI, SC, TX, UT, VA, VT, WA, WY

NCEES Certificate holder *(# 31922)*

TEACHING EXPERIENCE

Norwich University; 2006-10
Co-taught on-line, graduate course in Timber Structures. Wrote/gave lectures and exams. Answered student questions on-line.

University of Connecticut; 1985-88
Established a Construction Management Program
Pursued timber structures research
Taught undergraduate courses in Statics and Dynamics (with Russ Johnson, of Beer and Johnson)
Taught graduate course in Timber Structures

Stanford University; 1982-85
Taught and administered the surveying course for three quarters
Gave the lectures and directed the field exercises with help of graduate assistant
Stanford Board of Trustees voted, each year, to authorize my issuing Stanford grades

Bucknell University; 1980-82
Taught undergraduate courses in:

- Structural Analysis
- Timber Design
- Surveying,
- Statics and Dynamics
- Mechanics of Materials.

Colorado State University; 1976-78
Taught undergraduate course in Material Science - lectured and led lab exercises
Led recitation sessions in:

- Steel Design & Dynamics

ADVISING EXPERIENCE

University of Connecticut; 1985-86
Enjoyed working with a full complement of undergraduates in Civil Engineering
UConn is an "open admission" school for in-state students, so some of this was akin to career counseling

Bucknell University; 1980-82
Advised undergraduates in civil engineering
Advised on two student projects:

- Stabilizing the 100' span Montandan covered bridge, until repair work could be done
- Designing, fabricating, and installing the 50' Town Lattice, Hufnagle Pedestrian Covered Bridge across the Bull Run in Lewisburg, PA. This span replaced a concrete bridge lost in the 1972 flood and is dedicated to the Police Chief who lost his life saving citizens in that flood. This project has been called the single best Bucknell PR effort, in town/gown relations.

Colorado State University; 1976-78
Tutored foreign undergraduate students in Steel Design

Texas A&M University - Architecture Program; 2011-12
Offered structural engineering input on Student Presentations; Graduate level at College Station and undergraduate at the Prairie View campus

Quasi-official Advising offered in engineering graduate degrees:

- Annette Keunecke - Equivalent of MS from RWTH Aachen University. She did her research in American Timber Frame Economics while I mentored her.
- Joe Miller - Acknowledgess my input in his 2004 MS Thesis from the Univesity of Wyoming and his 2009 PhD dissertation from Michigan Technological University. Both were in traditional timber joinery. Joe now works with us.
- Lance Shields acknowledges me in his 2011 MS Thesis on traditonal timber joinery from Virginia Polytechnic Institute.
- Rebecca Sangrey acknowledges me in her PhD dissertation on traditional joinery from Johns Hopkins.
- David T. Burnett acknowledges me in his 2000 MS Thesis on traditional joinery for the University of Massachusetts.
- Acknowledged in the 1992 Cal Poly, San Luis Obispo Senior Project done by Ket Le and Wesley Greaves, dealing with traditional timber joinery.

ACADEMIC-RELATED HONOR AND AWARDS

Tau Beta Pi; Cornell Chapter

Xi Epsilon; President, Cornell Chapter

EXXON Fellowship - Awarded by Stanford University, in support of my work there.

TESTING IN SUPPORT OF CONSULTING

Peg Testing; 1995
Tested large oak pegs in varied orientations, in order to help establish load-bearing capacity of Town Lattice covered bridges in Vermont. Tests done at MIT with Leonard Morse-Fortier, Ph.D., P.E.

Traditional Joinery and Timber Testing for TGF Members and Conferences; 1987-Present
Fire Tower Engineered Timber has carried on my long-standing practice of bringing a joint buster to Guild Conferences to break member-built joints. The original joint tester was the same one I built for my PhD research. We have since quadrupled the load capacity; reflecting the stronger connections being built in the industry - at least partly in response to our very public joint busting. We have also used various configurations to demonstrate shear failure and reinforcement in solid and composite beams.

PUBLICATIONS

"FHWA Manual on Covered Bridge Maintenance and Repair," under co-author FHWA contract with Phillip Pierce, lead author, 2003.

"Installing SIPs on Existing Buildings", article in WOOD DESIGN FOCUS -- A Newsletter of Contemporary Wood Engineering, published by The World Forestry Center, Portland, OR; V.22, N.1; Spring, 2012.

"Modern American Timber Framing: From the viewpoint of engineers working in the field," with C. Carbon, A. Dey, and D. McElroy; article in WOOD DESIGN FOCUS -- A Newsletter of Contemporary Wood Engineering, published by The World Forestry Center, Portland, OR; V.14, N.3; Fall, 2004.

"Traditional Joinery," Chapter 7 in: Timber Construction for Architects and Builders, McGraw-Hill, 1999, edited by Eliot W. Goldstein, AIA.

"Conditions and Capacities of Vermont's Covered Bridges" contributed to major investigation of all the authentic covered bridges in Vermont. Work performed for VT DOT. Sub-consultant to McFarland-Johnson, of Binghamton, NY. Inspected every bridge and established allowable load capacity.

"Assessing Capacities of Traditional Timber Connections", article in WOOD DESIGN FOCUS -- A Newsletter of Contemporary Wood Engineering, published by The World Forestry Center, Portland, OR; V.3, N.4; Winter, 1992.

"Engineered Tension Joinery", article in TIMBER FRAMING, the official publication of the Timber Framers' Guild of North America, Volume 23.

"Traditional Timber Joinery: A Modern Analysis," Ph.D. Dissertation, Stanford University, Palo Alto, CA, 1985. Unpublished, but Microfiche International sold nearly a hundred copies.

"Bridgeport Covered Bridge", an eight-page chapter in ASCE Publication (Classic Wood Structures, 1989).

Timber Design for the Civil Professional Engineering Examination, Professional Publications, San Carlos, CA, 1983 (1st, 2nd, & 3rd editions, 1990), 200+ pages.

"Evaluating and Reinforcing Covered Bridges", a twelve-page chapter in ASCE publication (Evaluation, Maintenance and Upgrading of Timber Structures, 1982).

"Wooden Peg Tests *Their Behavior and Capacities as Used in Town Lattice Trusses"*; Performed for VTDoT, under Contract TH 9290 - Long Term Covered Bridge Study. Prime Consultant; McFarland-Johnson, Binghamton, Tests performed at MIT in autumn of 1995, Co-authored with Leonard Morse-Fortier, Ph.D, P.E.

"Timber Bridges: Part of the Solution for Rural America" study based on existing FHA National Bridge Inventory. With: Richard Gutkowski, William Kindya, Ruth McWilliams; Transportation Research Record 1106, c. 1985

Standard for Design of Timber Frame Structures and Commentary (TFEC 1-07), Timber Frame Business Council, Timber Framers Guild of North America, and the Timber Frame Engineering Council, 2007. Contributed and helped to edit this Industry-Accepted Design Standard.

Timber Frame Joinery & Design Workbook, Timber Framers Guild of North American, 1996. Contributed Articles and provided technical editing.

"Architecturally Exposed Timber," with Jim DeStefano, PE, AIA, Structure Magazine, MAR05 edition

"Mechanically Laminated Timbers," with Joe Miller, Ph.D., P.E., Timber Framing; Journal of The Timber Framers Guild of North America, 93:14; September, 2009

"Good Vibrations, A Practioner's Guide to Sturdy Feeling Floors" Timber Framing; Journal of The Timber Framers Guild of North America, 96:20; June, 2010

"Voyages of Brungraber" Timber Framing; Journal of The Timber Framers Guild of North America, 42:10 & 41:12; September & December, 1996

"Pegging Design" Timber Framing; Journal of The Timber Framers Guild of North America, 28:15; June, 1993

"Visit to Germany" Timber Framing; Journal of The Timber Framers Guild of North America, 27:4; March, 1993

"On Dropping 115,000 Pounds (with lots of friends aboard)" Timber Framing; Journal of The Timber Framers Guild of North America, 25:16; September, 1992

"Engineered Tension Joinery" Timber Framing; Journal of The Timber Framers Guild of North America, 23:10; March, 1992

"Chisel Sharpness Assessment" Timber Framing; Journal of The Timber Framers Guild of North America, 20:5; June, 1991

"Tallest Timber Frame" Timber Framing; Journal of The Timber Framers Guild of North America, 9:12; August, 1988

"Log Building" Timber Framing; Journal of The Timber Framers Guild of North America, 7:6; February, 1988

"Allowable Stresses Proposed for Oak Timbers" Timber Framing; Journal of The Timber Framers Guild of North America, 6:5; November, 1987

"Dogleg Framing" Timber Framing; Journal of The Timber Framers Guild of North America, 120; June, 2016

BOOKS IN PROGRESS

Timber Connections
"Structures are connections, held together by members," and this even more true with timber structures than with either steel or concrete. The book is intended as a reference work, compiling all I have learned in decades spent designing, repairing, and selling, timber structures.

Screen Plays
Two, in particular, in low-key development

PRESENTATIONS

ACADEMIC

Dartmouth University

- Treehouse Talk - 11APR11 Advised subsequent student project building a treehouse on campus grounds. Vicki V. May, Ph.D., P.E. arranged events

San Luis Obispo University

- "Design - How I "Do It";" Day-long Architectural Engineering Lecture; 24APR04
- The Thrill of Celebrating Structural Timber Joinery;" 12th Annual Structrual Forum - The Art of Timber Design; SEAOC Student Chapter; San Luis Obispo, CA 2FEB02

The Catholic University of America

- Spoke to architecture students 2NOV11; taught by Rauzia Ruhana Ally.
- Featured lecturer to School of Architecture and Planning; 24APR09

University of New Haven

- "Structural Engineering Considerations," Seminar in: Physical Properties and Moisture Considerations in the Design of Wood Structures, 26SEP90; New Haven, CT

Norwich University

- "Timber Frame Construction," taught by Tom Descoteaux; Northfield, VT; 17APR03

Yale University

- "Building Bliss - Why would an Academic Run off to join a Circus?," with Duo Dickinson, AIA, New Haven, CT; 2MAY02

University of Massachusetts

- Spoke to students; taught by Paul R. Fisette; Building Materials; 28NOV01

University of Vermont
Spoke to CE 295 Structural Design - Wood; 15JAN12; taught by Dr. Priyantha Wijesinghe

Cornell University

- "The Engineering of Heavy Timber Structures Connected with Traditional Joinery" Repair and Design Considerations," Given at Architecture School; 26APR05

ARCHITECTURAL

Wood Solution Fairs; sponsored by the WoodWorks (American Wood Council and Canadian Wood Council), attended by architects, engineers, and building officials. Generally give the same one hour talk, morning and afternoon, to rooms with 50 to 200 attendees. Offered various talks about "Celebrated Heavy Timber Structures" at the following locations:

- Alexandria, VA; 11JAN13
- Boston, MA; 11SEP01 (yep) and 31MAR05
- Webinar; 18JUN09
- Miami, FL; 30NOV06
- Atlanta, GA; 16OCT08
- Charlotte, NC; 27MAR08
- Anaheim, CA;7NOV06
- Vancouver, BC; 27MAR03; 7MAR05, & 16MAR06
- Seattle, WA; 2MAR00
- Edmonton; 19APR06
- Pittsburgh, PA; 11MAY06
- Montreal, QC; 21OCT03 & 18OCT01
- Baltimore, MD; 7OCT03
- Ottawa, ON; 2NOV05
- Minneapolis, MN; 1DEC05
- Long Beach, CA; 29SEP05
- New York, NY 18OCT00
- Toronto, ON; 21SEP04

Others:

- "Mechanical and Structural Properties ,including fire safety," Wood in the 21st Century: Design and Preservation of Contemporary & Historic Architecture; Technology & Conservation, MIT Department of Architecture - Building Technology Department, Historic Resources Committee, Boston Society of Architects/AIA; MIT; Boston, MA; 24MAR12
- "Green Structures," New England Sustainable Energy Association; Providence, RI; 1JUL10
- "Timber Construction for Architects and Builders," Build Boston; 17NOV98; Boston, MA

- "Traditional Timber Joints, and Recycled Old Timbers: Insights into their use and capacities," The Delaware Valley Chapter of the Association for Preservation Techology; 21MAY94; Philadelphia, PA

ENGINEERING

Presentations to Professional Engineering Societies:

- "The Delights of Exposed Heavy Timber Framing," Delaware Valley Association of Structural Engineers; Breakfast Seminar, 12OCT11
- "Mistakes and Lessons Learned," NCSEA webinar; 18JAN11
- Keynote Speaker, CHBA, 400th Anniversary of Quebec, 26FEB09
- "Heavy Timber Connections," 2008 SEA NW Conference, 20JUN08; Sun Valley, ID
- "Mechanically Laminated Posts and Beams," ASCE/SEI Structures Congress; St. Louis, MO 19MAY06
- "Joint Design, Renovation of Historic Structures, & Fabrication and Construction of New Structures," Wood Design for Architects, Engineers and Contractors, sponsored by SEAoNY, NYC; 18MAY05
- "Timber Frame Engineering," SEAoW; Seattle, WA; 21APR04
- Keynote Speaker; ASTM Committee D07 on Wood; Centennial Anniversary Dinner; Madison, WI; 20OCT04
- SEAC; Denver, CO;7NOV02
- "Things to know about, and to look for, in Modern Timber Framed Buildings," Southeastern Massachusetts Building Officials Association; Brewster, MA 10APR02
- "Timber Frame Construction," 9th Annual NCSEA Convention, (with Les Robertson - his first public talk since 9-11); Manchester, NH; 5OCT01
- "The Painful Realities & Lovely Results of Using Rcycled Timbers," ASCE Structures Congress; New Orleans, LA 20APR99
- "Heavy Timber Construction in New England," ASCE Structures Congress; Boston, MA; 11APR94
- "History of Timber Bridges," ASCE Structures Congress; San Francisco, CA; 2OCT84
- "Restoring Covered Bridges," ASCE Conference; New Orleans, LA; 27OCT82
- "Revival of the Covered Bridge - Case Studies," ASCE Conference; Portland,OR; 14APR80

FOREIGN

Presentations to architects and engineers interested in Heavy Timber Structures in the USA:

Germany

- "Moderner amerikanischer Siedlungsbu," Internationales Holzbau-Forum; Garmisch Partenkirchen; 12DEC03

Japan

- "Using plywood to strengthen timber framed buildings against earthquakes," sponsored by APA; Tokyo; 25JUN96 and Osaka; 27JUN96

Mexico

- "Heavy Timber Construction in New England," Universidad Iberoamericana; 19FEB94

United Kingdom

- "Traditional Timber Construction,' Technical Performance of Traditional Construction Materials - Innovation in the use of building materials; University of Bath; 16SEP08
- "New Wood Construction Materials," RIBA Seminar; APA Sponsored; London, UK; 2JUN97 and Amsterdam, Netherlands; 3JUN97
- "Modern Heavy Timber Structures in the USA, Connected with Traditional Joinery;" The Carpenter's Fellowship Conference; Avoncroft Museum of Historic Buildings; Bromsgrove, Worcester; 9SEP06
- "Developments in Traditional Framing in North America;" Department of Architecture & Civil Engineering, University of Bath; 7SEP06

TIMBER FRAMING

Presentations made to professional timber framers over the years:

- "Shaken, not Stirred - Lateral Loads on Timber Frames," with Joe Miller, Ph.D., P.E.; TFG Conference; Leesburg, VA; 19OCT12 and Asilomar, CA; 29APR12
- "Timber Frame Preservation," Nantucket Historical Society, Nantucket, MA; 3MAY12
- "Beam Busting," TFG Western Conference; Port Townsend, WA 14MAY11 and "Treehouse Engineering," with Jake Jacob, 15MAY11
- "Truss Joinery and Cambering," TFEC Workshop; Roanoke, VA; 9NOV06
- "Keyed Beams," with Anders Frostrup; TFG Conference, Burlington, VT; 14OCT05 & Parksville, BC 23APR06
- "A Cautionary Tale," TFG Conference, Saratoga Springs, NY; 6NOV09 and Coeur D'Alene, ID; 24APR05
- "Engineering Day to Day," with Grigg Mullen; TFG Conference; Burlington,VT; 15NOV02
- "Codes: the Practical and the Possible," with Dick Schmidt; TFG Conference; Burlington,VT; 16NOV02
- "Principles of Truss Design," TFG Conference; Banff, AL; 8MAR02
- "Heavy Timber Trusses," TFG Conference; Davis, WV; 12OCT01

- "The Hundegger," TFG Conference; 10APR99; Whistler, BC
- "How I Relaxed and Learned to Love the Machine," TFG Conference; Westfield, MA; 25JUL98
- "The Portland Observatory: Addressing its Structural Problems," Greater Portland Landmarks Noon Lecture Series, Portland, ME; 11FEB98
- "Advanced Timber Frame Joints: An Engineering Perspective," with Ed Levin and Rick Sasala; TFG Conference; Bethlehem, PA; 12SEP94
- "Doing Timber Framing Outside the House - Commercial Work," TFG Conference; Nacogdoches, TX 20MAR94
- "Tension Joinery," TFG Conferences; Guelph, ON; 11JUN92 & Big Sky, MT; OCT91
- “The Good, the Bad, and the Ugly,” TFG Conferences; Couer d’Alene 15 & Saratoga, NY 18SEP16. With Mack Magee
- “Engineering for Preservation Joinery; When Bad Things Happen to Good Structures,” TFG Conference; Saratoga, NY; 16SEP16. With Michael Cuba

COVERED BRIDGES

Presentations to engineers and bridge stewards interested in Repairing and Maintaining Covered Bridges:

- "The New Covered Bridge Manual, a Comprehensive Resource and Guide," 2005 Western States Covered Bridge Seminar; 24-25AUG05, Eugene, OR. Sponsored by FHWA and OR-DoT
- "Presenting the New Covered Bridge Manual, a Comprehensive Resource and Guide," at the FHWA; Washington, DC; 21JUL04
- "The BEST Covered Bridges," Covered Wood Bridge Meeting; US Department Of the Interior; National Park Service; 7FEB02

TREEHOUSES & ZIPLINES

A recently developed interest/expertise has led to:

- "Trees as Structures and Structures in Trees," The Association for Challenge Course Technology (ACCT); 22nd Annual International Symposium and Conference, Boston, MA; 9-12FEB12
- Global Treehouse Symposium 2009; Engineering Roundtable; Fall City, WA 19-20SEP09
- Global Treehouse Symposium 2008; Treehouse Engineering; Fall City, WA 11-13OCT08

SERVICE

- Stonewall Farm; Served on Board of Directors for Public, Educational Farm, Keene, NH; 1994-98
- Timber Framers' Guild of North America; Technical Editor - quarterly journal: *Timber Framing*, 2010-present
- Timber Frame Engineering Council; Chairman since 2012
- Timber Framers' Guild of North America; Director 1988-1992;
- Timber Framers' Guild of North America; Treasurer, 1990-1992;
- ASCE Committee on Timber Bridges; Chairman; 1978-1982

PRO BONO ACTIVITIES

- Timber Framers' Guild of North America; Reduced Fee Engineering for Rebuild of Gwazdiec Synagogue Roof; on permanent display in new Museum of the Holocaust; Warsaw, Poland; built by American College students and installed by professional timber framers from the US; 2010- present
- Timber Framers' Guild of North America; Reduced Fee Engineering and site help for new 50' Covered Pedestrian Bridge - built during eight day TFG Workshop; Wason Pond; NH; 2010
- Timber Framers' Guild of North America; Free Engineering for new 144' Town Lattice Covered Pedestrian Bridge - during four day TFG Conference; 500 timber framers built this bridge - in another big show; Guelph, ON; June, 1994
- Timber Framers' Guild of North America; Free Engineering and Project Management for two Habitat for Humanity homes, built - in their entirety - during four day TFG Conference; the timbers and SIPs were crafted by donating firms from all over the world; this was a big show; Elizabethtown, PA; June, 1993
- New England Churches Roof/Steeple Inspections; feels like I have crawled around in 17% of them over past thirty years
- The Steelyard; Resident Engineer for the not-for-profit, entirely hip and admirable, rehabilitated brown field industrial facility housing our offices in Providence. The place houses artists, offers classes, and employs local, at-risk youths.

PROFESSIONAL AFFILIATIONS

- ASCE, Member since 1974
- Society of Wood Science and Technology
- Structural Engineering Institute
- Oughtred Society

- Timber Framers' Guild of North America; member since founding 1985; past Board Member and Treasurer
- Timber Frame Engineering Council; member since 2002

PERSONAL INTERESTS

- Bicycles; riding and maintaining, almost all sorts
- Vintage café racers
- Skiing and snow shoeing
- Sailing - especially in other people's boats
- Vintage Feathercraft
- Books and tools
- Miatae

APPENDIX C -- Curriculum Vitae, R. J. Schmidt

RICHARD J. SCHMIDT, Ph.D., P.E.

653 Roger Canyon Road • Laramie, WY 82072

307.460.4342 • dick@ftet.com

PROFESSIONAL EXPERIENCE

March 2015 – present:	Fire Tower Engineered Timber, Laramie, WY, Senior Engineer
Aug 2011 – June 2015:	University of Wyoming, Laramie, Wyoming, Professor and Head, Department of Civil and Architectural Engineering
July 2010 – July 2011:	Hochschule Pforzheim, Pforzheim, Germany, Visiting Faculty, Fakultät für Technik
Aug 2005 – June 2010:	University of Wyoming, Laramie, Wyoming, Associate Dean College of Engineering and Applied Science
Aug 1999 - Aug 2000:	Technische Universitaet Braunschweig, Germany Visiting Researcher, Institut fuer Baukonstruktion und Holzbau
July 1998 – July 2011:	University of Wyoming, Laramie, Wyoming, Professor Department of Civil and Architectural Engineering
July 1996 - June 2000:	Colorado State University, Ft. Collins, Colorado, Faculty Affiliate Department of Civil Engineering
Sept 1985 - June 1998:	University of Wyoming, Laramie, Wyoming, Professor, Associate Professor, Assistant Professor, Lecturer, Department of Civil and Architectural Engineering
June 1980 - Dec. 1984:	University of Kansas, Lawrence, Kansas, Research Assistant and Graduate Student, Department of Civil Engineering
June 1977 - May 1980:	Marley Cooling Tower Co., Mission, Kansas Project Engineer, Major Products Division

EDUCATIONAL BACKGROUND

Institution: University of Kansas, Lawrence, Kansas

Degrees:	Ph.D.	Civil Engineering	1986
	M.S.	Civil Engineering	1982
	B.S.	Civil Engineering	1977
	B.S.	Business Administration	1977

PROFESSIONAL REGISTRATION

Licensed Professional Engineer: Wyoming, Kansas, Colorado

PROFESSIONAL ORGANIZATIONS

Timber Framers Guild

Timber Frame Engineering Council

American Wood Council

American Society of Civil Engineers

Wyoming Engineering Society

TEXTBOOK AUTHORSHIP

Boresi, A. P. and Schmidt, R. J., *Advanced Mechanics of Materials,* Sixth Edition, John Wiley and Sons, 2003.

Boresi, A. P. and Schmidt, R. J., *Engineering Mechanics, Statics,* PWS Publishing Co., April 2000.

Boresi, A. P. and Schmidt, R. J., *Engineering Mechanics, Dynamics,* PWS Publishing Co., May 2000.

TEACHING RELATED TO TIMBER AND WOOD

CAE 4290 – Structural Timber Design, University of Wyoming, 1996 – 2015

CAE 5700 – Advanced Timber Design, University of Wyoming, 2003

An Engineering Primer for Timber Frame Apprentices, Timber Framers Guild – Apprentice Training Program, Fort Collins Colorado, February 2015

Why Wood Does What It Does, Timber Framers Guild – Midwest Regional Meeting, Grand Marais Minnesota, June 2015

Engineering Characteristics of Wood, Wyoming Engineering Society Annual Convention, Sheridan Wyoming, February 2016

LABORATORY TESTING EXPERIENCE RELATED TO TIMBER AND WOOD

CLT Rigging and Lift Qualification Testing for MyTiCon Timber Connectors, Vancouver BC, current.

Timberlinx Embedded Fastener Capacity Testing for Timberinx, Toronto Ontario, 2004-2016.

Withdrawal, lateral load, head-pull-through, installation torque testing for Trufast Corporation, Bryan, Ohio, 2001-2007

Wide range of wood member and timber frame joinery testing (bending, dowel bearing and shear capacity of wood dowels; mortise and tenon joints in tension, rolling shear, seasoning and long-term loading; joist housings in glulams; racking behavior of stand-along and SIP-sheathed frames; flexural capacity of glulams manufactured from cull lumber) while at the University of Wyoming, Laramie, WY, 1995-2015

CERTIFICATIONS RELATED TO TIMBER AND WOOD

Timber Grading Training Course 2015, Timber Frame Engineering Council, Heartwood School, Becket Massachusetts, April 2015.

SELECTED CONSULTATIONS

Schmidt, R. J. and Brungraber, R. L. (2016) Peer Review of the AMMC for Seismic Strengthening of Hangar H2 at Moffet Field, San Jose CA Using Fully Threaded Screws, with KPFF, San Francisco office.

Schmidt, R. J. and Brungraber, R. L. (2017) Peer Review of the Seismic Upgrade of the Spruce Goose Fabrication Hangar in Playa Vista, CA Using Fully Threaded Screws, with ARUP, Los Angeles office.

SELECTED PUBLICATIONS

Schmidt, R. J. Optimal Conversion of Logs to Timbers, *Timber Framing – Journal of the Timber Framers Guild*, No. 118, pp. 6-8, December 2015

Schmidt, R. J. and Miller, J. F., "Considerations for Design of Rafters in Timber Buildings," *Practice Periodical on Structural Design and Construction*, ASCE, 17(3): 127-132, August (2012)

Miller, J. F., Schmidt, R. J., and Bulleit, W., "New Yield Model for Wood Dowel Connections," *Journal of Structural Engineering*, ASCE, 136(10):1255-1261, October (2010)

Schmidt, R. J. and Moody, R. C., "Modeling Laterally Loaded Light-Frame Buildings," *Journal of Structural Engineering, ASCE*, Vol. 115, No. 1, pp. 201-216, (Jan. 1989).

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Erikson, R. and Schmidt, R., *Behavior of Traditional Timber Frame Structures Subjected to Lateral Load*, Contract Report to USDA NRI/CGP, Award No. 97–35103–5053, Timber Frame Business Council, Hanover, NH and Timber Framers Guild, Becket, MA, August 2003.

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Erikson, R. and Schmidt, R., "Laterally Loaded Timber Frames IV — SIP Connection Behavior," *Timber Framing, Journal of the Timber Framers Guild,* No. 65, pp. 24-26, September 2002

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Erikson, R. and Schmidt, R., "Laterally Loaded Timber Frames II — Two–Story Frame Behavior," *Timber Framing, Journal of the Timber Framers Guild,* No. 63, pp. 8-11, March 2002

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