



March 3, 2011

Directorate of Public Works, Engineering Division
Department of the Army
Installation Management Command
Headquarters, U.S. Army Garrison Fort Wainwright
1060 Gaffney Road, #4500
Fort Wainwright, Alaska 99703-4500

Attn: Tim Sponseller, P.E.
Chief, Engineering Division

Re: Building 3008 – Hanger 2 Structural Evaluation

At the direction of Mr. Tim Sponseller, Design Alaska, Inc. has provided professional engineering services as described below:

Perform structural evaluation and provide a complete report on areas of the hangar that were damaged by the fire that occurred on 17 February 2011.

- Review and physical examination of the portions of hangar that have been damaged by fire.
- Review and provide recommendations on potential for rehabilitation or replacement of building fire damaged areas.

A site inspection was conducted 28 February 2011. A boom mounted personnel basket was provided for inspection of the fire damaged areas from the outside of the structure. An inside catwalk was utilized for inspection of the fire damaged areas from the inside of the structure.

Please refer to the attached report as the deliverable for the project scope of work.

It is noted that the basis for rehabilitation was based on returning of the roof system (trusses, purlins, decking, etc.) to the condition of the structure as it existed prior to the occurrence of the fire. There have been numerous structural assessment reports that have evaluated the adequacy of the structure to current design load conditions, especially in regards to the wear and tear condition of the structure since its initial construction. The recommendations from these reports were not factored into the conclusions of the attached report.

Please contact the undersigned, or Mr. Bill Brookins, for any questions or comments regarding the evaluation report.

Sincerely,

Design Alaska, Inc.

Michael Dean, P.E.
Chief Structural Engineer

encl: Special Inspection Report, Hanger 2, Fort Wainwright, 28 February 2011
xc:

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Special Inspection



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To:	Fort Wainwright Directorate of Public Works (DPW), File	Field Visit Date:	February 28, 2011
Date:	March 3, 2011	Location:	Hanger 2, Fort Wainwright
Time:	1330-1630	Weather:	-10°F, light wind, clear skies
Project:	FTWW Bldg. 3008 – Hanger 2 Structural Evaluation	Present at Site:	Michael Dean, Billy Brookins, Janet Matheson – Design Alaska; Scott Smith – FTW DPW; Shaw Contracting Crew

On February 17, 2011 Hanger 2 experienced a fire in the truss space of the building. At the time of this report, the exact cause of the fire has yet to be determined by the Fort Wainwright Fire Department. A field visit was conducted on February 28, 2011 to review the structural damage to the Western most truss, hereby noted as Truss 1, and it was noted that the fire was concentrated along the building centerline on the exterior face of the facility. It is also noted that this structure has historical significance due to the age of the facility and the history of Fort Wainwright. The structural inspector for this project is also a certified firefighter, whom was trained in fire origin and damage assessment. Hand tools utilized during the inspection included a scratch awl, tape measure, flashlight and camera.

The purpose of this report is to describe the fire damage and repair options to the structure. Only those areas damaged by the fire have been investigated; the structure as a whole was not reviewed or inspected. Items that were previously recommended for repair were not checked to determine if repairs had been conducted or if additional repairs were necessary.

Background

Hanger 2 was built on Ladd Field, now known as Fort Wainwright, in 1943. Based on as-built documents available for the structure, the roof is supported by timber bowstring trusses spaced 25 feet on center and span 158 feet. Purlins are noted as 3x8 members, spaced at approximately 8 feet on center across the span, with one over every joint. Web members vary from 3x8 timbers or double 2x6. All bolts appear to be 3/4 inch diameter with oversized washers and square nuts.

Truss 1 - Exterior

Truss 1 was inspected on the exterior with the help of Shaw Contracting and an 80 foot boom mounted construction basket for access. The exterior sheathing of the facility was partially removed during the fire for appropriate firefighting access and clear

Visqueen sheeting had been partially attached to help seal the facility from the elements where appropriate (see photo 1). The Shaw crew stated that more Visqueen sheeting was going to be placed in the next 48 hours on this facility.

The first stop on the exterior inspection was made at the center of the truss along the bottom chord (see photo 2), noted as joint 21 in the attached as-built drawing. This drawing is from the repair hanger doors project, dated July 21, 1987 and was utilized during the course of the inspection. This joint was noted to have all of the original square nuts loose as the inspector was able to turn them all freely with his fingers. It was also noted that the visible burn patterns appeared to start in this area with charring extending to the roofline along member 39. The truss vertical timber (member 39) had 1/4" to 1/2" of burnt material on the exterior face along the accessible area (see photo 3). No exterior charring was noted on the bottom chord members 38 and 41, indicating that the fire started near the top of the bottom chord and moved upwards from there.

We next moved to joint 20, at the top of the truss along the building centerline. This joint has seen significant fire damage and is in dire need of immediate repair (see photo 4). Charred surface penetration values varied from 1-1/2" to 2" along the exterior face of top chord members 36 and 40 within 2 feet of the building centerline indicating that this was the hottest part of the fire (see photo 5). The roof deck was burned through at this location as well indicating extensive roof deck damage. The damage in this area indicates that this was the hottest part of the fire and it spread outwards from this location along the length of the truss (see photos 6 and 7). Exterior face damage to the top chord is noted at even numbered joints from 14 to 26; a distance of twenty-four (24) lineal feet, straight line; which can also be denoted as 3 panel points each side of centerline. It was also noted that the purlins above all of the above joints have fire damage to some degree, as further described during the interior inspection, below. The double purlin over joint 20 is severely damaged and needs replacement. The bolts that hold these purlins to truss member 39 is visible throughout the width of member 39 due to the fire damage; it was also noted to be visible deformed, indicating intense heat at this location (see photo 8). Web members 37 and 41 also showed signs of severe fire damage near the top; with member 41 having the most noted damage due to it being on the North side of the of the truss, where the majority of the fire damage is found. These members require replacement as well. Penetration tests on these members show that the thickness has been reduced up to one inch; which requires replacement.

The following members need to be replaced during the course of post fire repairs:

Top Chord members 28, 32, 36, 40, 44, 48, and 52
Web members 35, 37, 39, 41, 43

The following members should be further inspected with the top chord members removed and replaced as deemed necessary:

Web members 27, 29, 31, 33, 45, 47, 49, and 51

It was also noted that all of the square nuts tested on the truss were found to be finger tight, or extremely loose. This also includes nuts that were over non-burned material. All bolts and associated hardware in the area of fire damage should be replaced with new materials.

Interior

The interior inspection was conducted off of the catwalk system that runs along Truss 1. The catwalk itself was visually inspected for damage before attempting to utilize the system. Access is available from a ladder near the center of the South wall. Due to steel bracing and equipment, the lift could not be utilized to access the truss members, so the interior inspection was performed from the catwalk itself. Some charring was noted on the catwalk toe plate, towards the building exterior above the bottom chord (see photo 9).

Truss 1 has interior fire damage, but it appears that the majority of the damage is concentrated on the exterior face and exterior ply of the three ply truss. The center ply also shows fire damage; therefore the best recommendation is to replace all plies of the members damaged (see photo 10). The bottom chord of the truss has minor charring along the top edge, penetration depths of approximately 1/4 inch; characteristic of being below the fire origin (see photo 11).

The purlins supported by Truss 1, have fire damage as noted below, all measurements extend from the exterior of the facility towards the interior:

Above Joint 26, previously repaired with Glu-lam beams on each side – approximately 2 feet on South face, none noted on North face (see photo 12)

Above Joint 24 – approximately 3 feet on South face, 1 foot or less on North face (see photo 12)

Above Joint 22 – approximately 6 feet on South face, 4 feet or less on North face (see photo 13)

Above Joint 20 – approximately 10 feet, all visible faces (see photo 14)

Above Joint 18 – approximately 8 feet on North face, 4 feet or less on South face (see photo 15)

Above Joint 16 – approximately 6 feet on North face, 3 feet or less on South face (see photo 15)

Above Joint 14 – approximately 2 feet on North face, none noted on South face

Due to the previous recommendations for purlin repairs, it is recommended that all of these purlins be replaced in kind with new glu-lam material. This will require roof decking removal and replacement back to Truss 2. It is noted that the roof deck is damaged to approximately the same distance back from the exterior face as the purlins, shown above. The decking is braced mid-span by a flat laid 2x nailed in place. These members will also need replacement due to damage along the exterior edge of the facility (see photo 14).

Truss 1 has undergone significant fire damage along the center member 39 and the top chord. All members noted above need to be replaced with new material to ensure the truss remains capable of supporting the loads it was originally designed for. The original construction material was Douglas Fir #1 according to as-built documentations utilized during the inspection. All bolts not immediately affected by the fire, outside of joints listed or affected by repair work, need to be checked for proper tightening and thread exposure. All bolts affected by the above repair work should be replaced with new material and hardware due to adverse stresses imposed during the fire.

Truss 2 - Interior

Truss two has experienced slight water and smoke damage, which is considered primarily cosmetic. There are no visible signs of direct fire contact with this member. While this member was heated during the course of the fire, it does not appear to be visibly damaged. It was noted that the center joint on the top chord was blackened with smoke (see photo 16). It is marked as having water damage due to the firefighting efforts and lack of intact fire sprinkler heads in the area of the fire. It is believed that this truss is sufficient to continue service without any structural repairs from fire damage. Any repairs scheduled for this truss due to prior inspections and adequacy testing should be performed while work is ongoing with Truss 1.

Conclusion

Heavy timber construction is typically regarded as one of the best construction materials when considering post fire damage due to the usual lack of major damage. The timbers found in Truss 1 have seen significant damage requiring member replacement. While immediate collapse is not probable due to the lack of snow load or maintenance workers on the roof, this facility needs to have the first truss repaired and brought back as close to the original configuration as soon as possible, including any and all prior repair recommendations. The snow load is not present due to the lack of roof insulation, as heat from the facility tends to keep the snow melted; however, the heat in the facility needs to remain on until the repairs can be completed. It is not recommended to have any workers on the roof of the facility along this truss length or within 15 feet of the building face until repairs have been made to the damaged truss chords, web members, purlins and roof decking. Roof decking repairs will need to be conducted from bucket lifts until such a time that it is safe for personnel to be working in the area. All square truss nuts that were checked were finger tight on Truss 1, it is presumed that they loosened with the loss of member thickness behind, but all truss nuts should be checked throughout the facility.

It is also recommended to have the fire sprinkler system overhauled with new heads installed so that it can be put into operation again. This sprinkler system definitely helped prevent a structural collapse by preventing fire spread before the fire department arrived on scene.

Please feel free to contact the undersigned if there are any further questions or if clarifications are needed.

Photos



Photo 1: West Exterior Face



Photo 2: Above Joint 21



Photo 3: Member 39, above Joint 21



Photo 4: Joint 20



Photo 5: Joint 20, showing damage to each side



Photo 6: Top Chord, Looking North



Photo 7: Top Chord, Looking South



Photo 8: Interior shot of Joint 20, Damaged Hardware



Photo 9: Catwalk Charring



Photo 10: Top Chord Ply Damage @ Joint 22



Photo 11: Top of Bottom Chord (Member 42) Charring



Photo 12: Purlins above Joints 24 & 26



Photo 13: Purlins above Joints 22 & 24



Photo 14: Purlins above Joints 20 & 18



Photo 15: Purlins above Joints 18 & 16



Photo 16: Truss 2, West Face

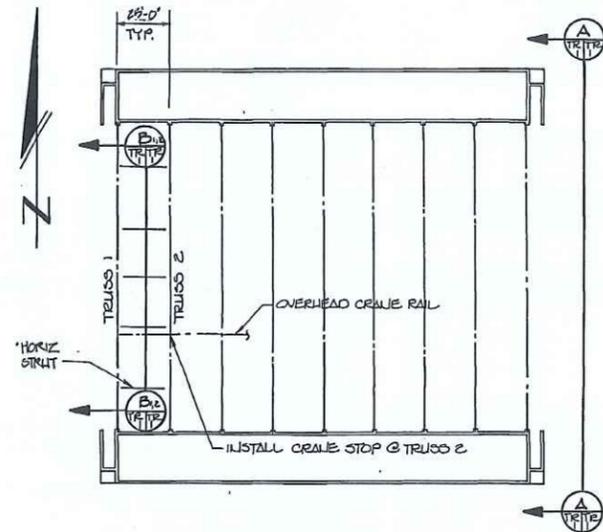


Signature: *Billy Brookins*
Billy Brookins, P.E.

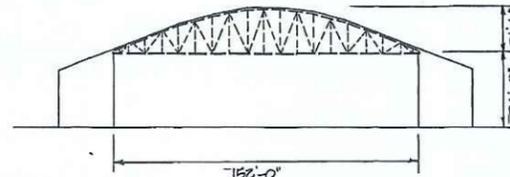
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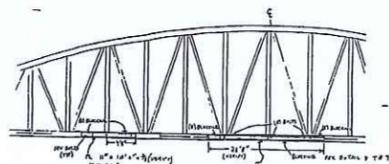




PLAN - HANGAR 2

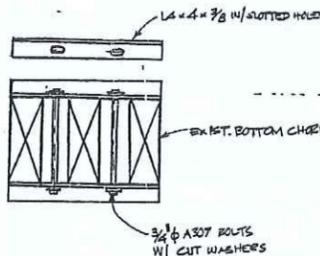


BUILDING ELEVATION



SCAR LOCATIONS
 1 NEW BLOCKING FOR DETAIL K, SHEET TR 7
 2 HOLES SHALL BE CUT TO FIT C10x20 CHS
 3 PL 1/2" x 4" x 3" SHALL BE PLACED BETWEEN LOWER CHORD AND EXISTING TRUSS MEMBER
 4 NEW BOLTS (4" #) THROUGH SCAR SHALL BE 2" LONG AT 9" INTERVALS

B1 BOTTOM CHORD REPAIR
 NTS



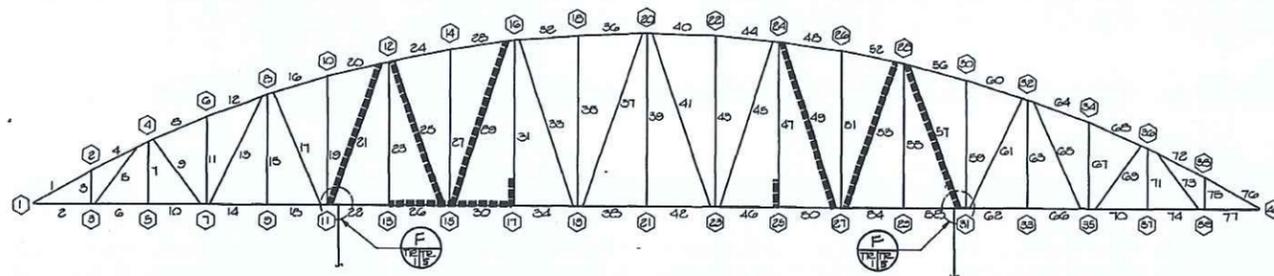
TYPICAL CLAMP DETAIL
 NTS
 NOTE: CLAMPS TO BE LOCATED AT CRACKS IN BOTTOM CHORD WHERE SPACE PERMITS

TABLE 2-1

REPAIR AND ADDITIONS		HANGAR 2 TRUSS 1	
LOCATION	TYPE OF DISTRESS	REPAIR / MODIFICATION-TYPE	LOCATION / DETAIL REFERENCES
J7	STRUT MODERATE CHECK	REPLACE	TRUSS 1 TO TRUSS 2
M21	COMPRESSIVE OVERSTRESS	TYPE 4	DETAIL I-TR 7
M25	TENSION OVERSTRESS	TYPE 3	DETAIL K-TR 6, DETAIL G-TR 8 (OPP.)
M28, M30 EAST	SEVERE SPLIT	TYPE 2	JT. 13 / DETAIL F-TR 7 TO JT. 17 / DETAIL G-TR 7
M29	COMPRESSIVE OVERSTRESS	TYPE 4	DETAIL I-TR 7
M31	TENSION OVERSTRESS	TYPE 3	DETAIL K-TR 8
J15	STRUT SEVERE SPLIT	REPLACE	TRUSS 1 TO TRUSS 2
M47	TENSION OVERSTRESS	TYPE 3	DETAIL K-TR 8
M49	COMPRESSIVE OVERSTRESS	TYPE 4	DETAIL I-TR 7 (OPP.)
M53 EAST	SEVERE SPLIT, TENSION OVERSTRESS	TYPE 3	DETAIL K-TR 6 (OPP.), DETAIL G-TR 8
M57	COMPRESSIVE OVERSTRESS	TYPE 4	DETAIL I-TR 7 (OPP.)

J = JOINT M = MEMBER

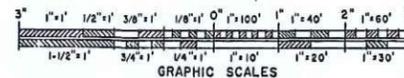
REPAIR/MODIFICATION DEFINITIONS
 TYPE 1 - TOP CHORD CONTAINMENT
 TYPE 2 - BOTTOM CHORD REINFORCEMENT
 TYPE 3 - TENSION WEB REINFORCEMENT
 TYPE 4 - COMPRESSIVE WEB REINFORCEMENT
 REPLACE - REPLACE ORIGINAL TIMBER MEMBER. SEE TR-9



B1 TRUSS KEY - TRUSS 1

LEGEND
 14 JOINT DESIGNATION
 14 MEMBER DESIGNATION
 ■■■■■ EXTENT NEW CONSTRUCTION. SEE TABLE

NOTES
 1. REFERENCE SHEET TR 9 FOR MEMBER SIZES AND EAST-WEST DESIGNATION.
 2. SEE SHEET TR-5 FOR GENERAL AND CONSTRUCTION NOTES.



REFERENCE NO. TR-1

KEY	DATE	CO	ACTION	DESCRIPTION	BY	APPD
CONTRACT NO. DACA85-87-C-0058 CONTRACTOR GASTON ASSOCIATES, INC. CITY ANCHORAGE STATE ALASKA RECOMMENDED <i>[Signature]</i> APPROVED <i>[Signature]</i> DATE 9 June 89 LOFTUS & DAILEY, INC. ALASKA DISTRICT Consulting Structural Engineers 1028 Aurora Dr. CORPS OF ENGINEERS FARMBANKS, ALASKA 99701 ANCHORAGE, ALASKA DESIGNED: J.P. DRAWN: K.L.K. TRACED: CHECKED: J.L.L. SUBMITTED: RECOMMENDED <i>[Signature]</i> APPROVED <i>[Signature]</i> DATE 87 Jul 31 CHIEF, DESIGN BRANCH CHIEF, PROJECT MGT BRANCH SCALE: REGULAR (HIND DIVISION) DRAWING NUMBER AS-BL/F30-01-138 SHEET 18 OF 30 SPEC. NO.						