

Hangar 2 (Building 3005)

Hangar 2 (Building 3005) After Fire Structural Inspection Report



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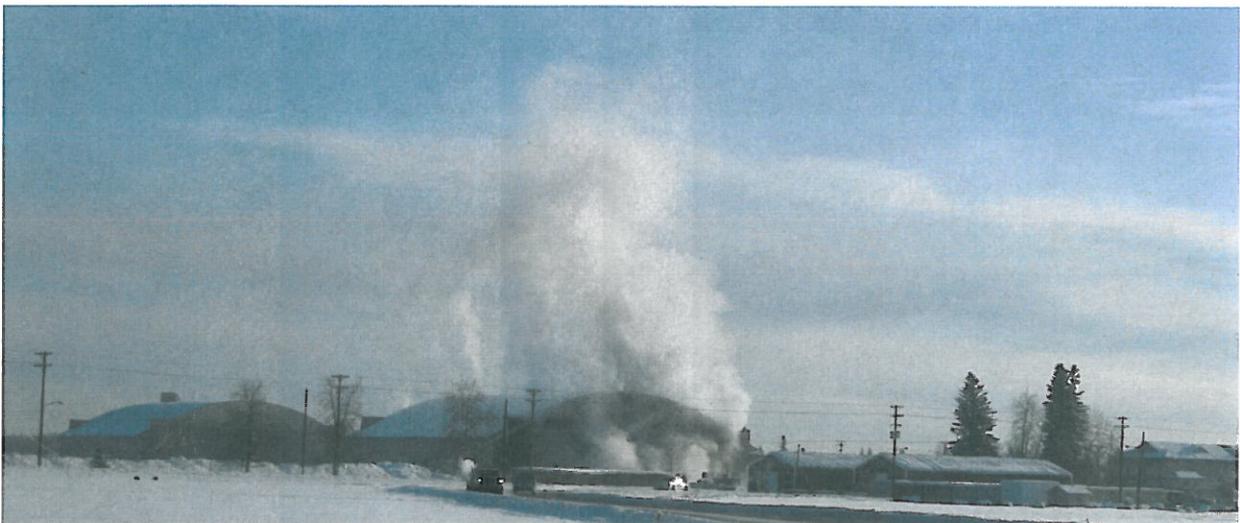
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The Event

At approximately 11:45 on Thursday February 17th a fire was reported by employees of Tatitlek Inc. who were working on removing the door overhangs. Due to deployments no soldiers or helicopters were present in Hangar 2(Building 3005). Firefighters from Fort Wainwright, Fairbanks and North Star departments worked to extinguish the blaze.



The fire was extinguished about 2 p.m. and the building was cleared for entry by the fire chief about 4 p.m.



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History

Hangar 2 was constructed in 1942 by the US Army Air Corps on what was Ladd Field. The National Registry of Historic Places first listed Hangar 2 as a contributor to the National Historic Landmark District in 1984 and was listed as a Cold War Historic District contributor but not individually eligible in 2007. The construction of this structure is Birchwood bowstring trusses and walls with a concrete foundation.

Damage Due to Fire**Hangar 2 siding and sheathing removed to ensure fire was fully extinguished**

The fire was concentrated in the west end of the hangar. Trusses in earlier reports (US Army Corps of Engineers-Truss Inspection Report 2007) were numbered 1-8 going from east to west. I will use the same notation system as the USACE report as it will be referenced again in this report. The easternmost truss (#8) sustained the most damage and is a total structural loss; many of the connections have up to 2" of charring. Damage to the webs is most critical at the connection to the top cord of the truss. The main ridgeline beam that spans from truss #7 to truss #8 was also heavily damaged at the connection and is no longer supported by truss #8 and is currently being carried by truss #7.

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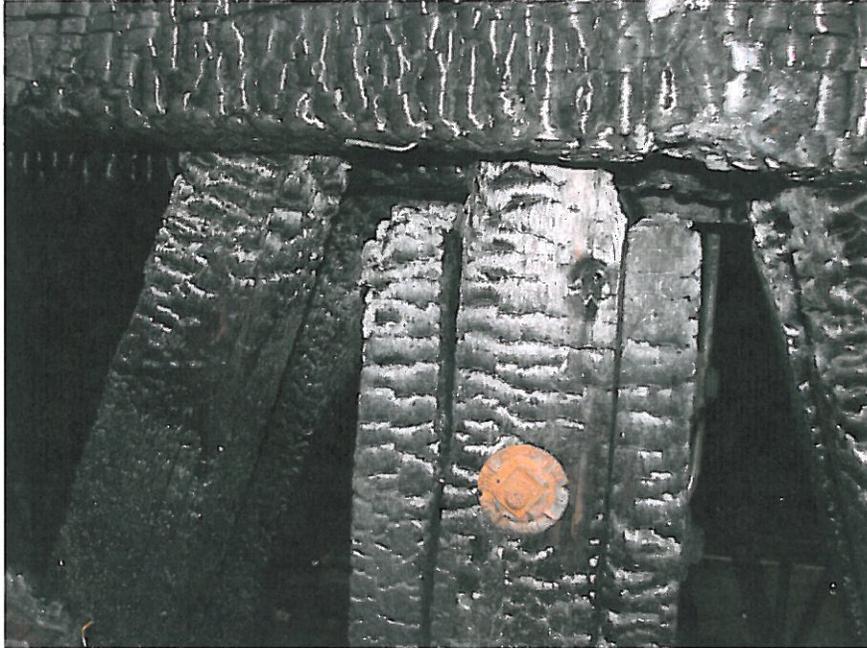
Ridge beam is no longer supported by truss #8



Fire damage on truss #8

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Truss #7 shows minor charring and the connections have no physically apparent damage. The roof deck shows significant fire damage eastward to truss #7 with minor charring to truss #6. Much of the exterior cladding on the west end of the hangar was damaged in the fighting of the fire.

**Damage to truss #8 shows loss of connectivity between members**

To this point only physical damage has been discussed. However the greater damage to the structure might not be visible. One contributing factor to the unseen damage is the high heat in the adjacent truss bays. Even when the surface of the wood doesn't reach the flash point, the heat can cause property changes in the wood. The same goes for the steel that holds the wood together; it could see even greater stresses due to its large capacity for thermal expansion coupled with the quenching from the fire hoses. Sudden changes in the temperature of the steel causes the steel to stress and become brittle. The thermal expansion of the steel is between 4 and 5 times that of wood, this additional expansion may have caused the holes the bolts go through to stretch beyond the cooled size of the steel bolts. This damage is difficult to assess as there was no baseline assessment for the connections before the fire.

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Ridge beam damage with truss #7 beyond and roof deck damage is visible

Pre-fire Building Condition

There was significant structural damage to the structure before the fire. A copy of the Hangar 2 portion of the Truss Inspection Report 2007 is included in Appendix A at the end of the report. The structural section of the Condition Assessment and Rehabilitation Plans, Hangars 2 and 3, Ladd Field National Historic Landmark Fort Wainwright, Alaska report is included as Appendix B. The key elements of the existing damage are covered in the two mentioned reports. Key items will be discussed in the repair sections. The pre-fire condition is best summed up in one sentence from the Truss Inspection Report 2007, "This Building has substantial structural deficiencies and needs replacing as soon as possible."

Repair

The entire west wall of the building will have to be replaced due to the fire damage, this includes truss #8, the roof beams, the interior cladding, exterior cladding, and the roof deck will need to be replaced for at least the last two truss bays between truss #6 and truss #7 and between truss #7 and truss #8. The ridge beam and all secondary beams that were damaged in the fire will need to

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be replaced to their nearest current splice location. This may necessitate the need for further roof decking removal.

Due to the fire and the pre-fire condition an evaluation must establish whether the damaged building if repaired to its predamaged state would comply with the provisions in the current building code, because we are in Seismic Design Category D. Gravity and snow loads must be brought current because there is substantial damage to the gravity load carrying components. Current material properties must be used and there has been a change in allowable design strength. For example until 1955 the allowable tensile strength of the Birchwood framing members would have been set equal to the allowable bending strength which would have been 1450 psi depending on what grade of timbers were used. The current design values for Birchwood timbers would be in the ranges of 1450 to 1000 psi for bending and 850 to 600 psi in tension. Truss analysis shows that the tensile value is the most critical in determining capacity of trusses.

Prior to this fire, Hangar 2's structural condition and ability to stand safely was assessed against historical criteria. The International Building Code 2009 (IBC 2009) and previous editions allowed this under Section 3409.1 entitled *Historic Buildings*. Section 3409.1 reads:

"Historic buildings. The provision of this code relating to the construction, repair, alteration, addition, restoration and movement of structures, and changes in occupancy shall not be mandatory for historic buildings where such buildings are judged by the building official to not constitute a distinct life safety hazard."

The fire, along with the substantial pre-fire structural deficiencies detailed in the 2007 truss inspection report, makes this building a ***distinct life safety hazard***. Construction to repair the fire damage will be considered significant and comprehensive enough to warrant applying current and more stringent modern codes to the entire building.

A building structural analysis and repair will be required for all structural elements in the building. All truss connections will have to be inspected to determine to what extent they will have to be rehabilitated. It is likely the entire roof would have to be removed to properly rehabilitate the structure.

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**Separated conduit with charred wires is the point of ignition**

The Ft. Wainwright Fire Department inspector determined that the fire was caused by separation of an electrical conduit. The inspectors report is included as Appendix C at the end of this report. This is a situation that could continue to happen again. If the building is to be rehabilitated the entire electrical system should be brought up to current code standards to reduce the risk of additional Fires.

Recommendation

Although the overall visual damage to the structure appears to be about 20% of the roof structure the damage may be the end of Hangar 2. Hangar 2 cannot be put back in use until the structure is brought up to current design standards. In the assessment by the Louis Berger Group Inc. entitled "Condition Assessment and Rehabilitation Plans, Hangars 2 and 3, Ladd Field National Historic Landmark Fort Wainwright, Alaska" the rehabilitation of each of the hangars was listed at more than \$24 million in 2006. Now the scope of this rehabilitation would be increased well beyond what was proposed in their assessment. The increased scope includes bringing the building up to current building code requirements. This will more than likely require complete roof structure replacement, and the addition of seismic bracing. Projecting to 2012 or 2013 construction costs will likely push the necessary budget in the \$30-\$40 million range.

Hangar 2 can be saved, however this would only replace the hangar to the current functional standard. As it stood before the fire the hangar no longer met the mission needs as an aircraft hangar. This amount of funding could provide a brand new state of the art hangar that will meet the mission needs now and for the foreseeable future.