National Park Service
U.S. Department of the Interior

Branch of Wildland Fire
Division of Fire and Aviation

The Fire at Sperry Chalet

Fire Investigation Report
April 2018

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Sperry Chalet
Glacier National Park
West Glacier, Montana 59936

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Produced by Division of Fire and Aviation
National Park Service
U.S. Department of the Interior
Washington, DC

Cover image: The Sperry Chalet at Glacier National Park burned on August 31, 2017. NPS

Contents

Background

On August 10, 2017, dry lightning storms ignited multiple fires across the northern Rocky Mountain region. One of these fires was the Sprague Fire that started within Glacier National Park, which was initially detected at 8:20 pm and located in terrain that was difficult to access.

On August 31, 2017, two structure fires occurred at the backcountry Sperry Chalet complex, which damaged the Dining/Kitchen building and consumed the majority of combustible materials in the Dormitory building.

On September 2, 2017, I was contacted via telephone by Brian Johnson, NPS Structural Fire Branch Chief (acting), who advised me that the Sperry Chalet had been involved in a fire. He also inquired as to my availability to visit the site and conduct investigations.

I was also contacted via telephone by Alan (Chad) Fisher, NPS Wildland Fire Operations Leader, on September 2, who provided background on the process of a Facilitated Learning Analysis (FLA). I was added to the FLA team and traveled to Whitefish, Montana on Sunday, September 17. As a member of the FLA, I attended briefings and participated in interviews with park personnel, incident managers, firefighters, maintenance personnel, and concessionaires. On Saturday, September 23, I visited the Sperry Chalet site for approximately two hours. During the site visit I completed a cursory walk around of the Dining/Kitchen building and the Dormitory building, taking photographs and evaluating the fire ignition and fire spread in both buildings.

My participation on the FLA team continued through Friday, September 29 and I returned to Atlanta, Georgia on Saturday, September 30.

Site Information

The Sperry Chalet complex is located in northwest Montana in the backcountry of Glacier National Park. The complex consists of six buildings, which include the dormitory (aka chalet), the Dining/Kitchen building (aka cookhouse, cook shack), a maintenance building, a trail crew cabin, a restroom building (aka comfort station), and a chlorination building/shed. Access to the complex is by backcountry hiking trails with trailheads located on the Going to the Sun Road at Lake McDonald (6.5 miles) or Saint Mary Lake (12+ miles). Sperry Chalet is operated by NPS concessionaire Belton, Inc., with a typical open season beginning in early July and closing mid-September each year.

Building Information

Dining/Kitchen (aka cookhouse, cook shack)

The Dining/Kitchen building was constructed in 1913. The building is a single-story structure approximately 1,450 square feet in area. The construction method consists of masonry stone exterior, timber and lumber interior, with a wood shake shingled roof, reported to be Class B. Exterior wooden decks are present on three sides (west, south, and east).

The building utilities consist of propane (kitchen appliances and lighting) and domestic water. There is no electrical service to the building. A wood-burning stove is used to heat the dining room.

Multiple entry doors provide access to the building, including two on the west side, one on the east side, and two on the south side. The south end entry door at the southwest corner accesses a sleeping room that is approximately 8′ x 8′ in size.

Dormitory (aka chalet)

The Dormitory building was constructed in 1913. The building is a two-story structure with a footprint of approximately 2,790 square feet and a total floor area of approximately 5,580 square feet. The construction method consisted of masonry stone exterior, timber and lumber interior, with a wood shake shingled roof, reported to be Class B. Exterior wooden decks included a full-length deck on the west side and second-story balconies on all sides. A single second-story balcony was located on the north, south, and west sides, with two second-story balconies located on the east side.

The interior of the building is accessed by two doorways located on the west side at the first floor deck. Each entry door opened into first floor lobbies (north and south). Stairways in each lobby provided access to the second level. A hallway on the second floor provided access to guest rooms as well as access between the north and south building areas, connecting both stairways. Two small storage rooms were located on the west side of the second story, located at the top of the interior stairs.

A one-hour fire-resistant wall was constructed in the mid 1990's, which separated the north and south building areas. The wall was constructed of 2" x 4" dimensional lumber with sheetrock and covered with wood siding to match the existing building interiors. A 90-minute fire-rated wooden door with self-closing device was installed in the fire-resistant wall on the second floor.

Doorways opened onto each exterior second-floor balcony from the adjacent guest room. There was no outside stairway access from the balconies to ground level.

The gable roof was reported to be a 6/12 pitch with dormers located on the west and east side. Roof covering consisted of fire-rated cedar shingles (Class B), installed in 2007. Interior walls were constructed of exposed timber framing, tongue and groove lumber, and wood panels. Floors were painted 1" x 6" tongue and groove lumber. The ceilings in the building consisted of wooden bead-board paneling on the first floor and 1" dimensional lumber with timber framing on the second floor. A wooden wall separated the east and west interior portions of the building. This wall was constructed from the first floor to the peak of the vaulted ceiling. The second floor hallway ceiling intersected this wall, which created a small loft area in rooms on the east side of the building.

A total of 22 sleeping rooms existed in the building, 10 on the first floor (even numbered 2 through 20) and 12 on the second floor (odd numbered 1 through 23). Each sleeping room was equipped with a side-hinged wooden door.

The dormitory has two masonry stone chimneys. The use of wood-burning stoves was discontinued many years ago and the stoves were removed. Water pipes in the building originally serviced each room, but were discontinued many years ago. The piping, faucets, and sinks remained in the building for historic purposes. There was no electrical service, fuel gas piping, or other utilities in the building. Hallway illumination was provided by battery-powered, motion-detection operated light packs. Lightning arrestor cables were installed on the building.

In 1996, a 48-volt fire alarm system was installed, powered by storage batteries that were supplied by a ground-mounted photovoltaic (solar) panel located south of the building. All components of that fire alarm system were removed in 2016, with the exception of one area of conduit that was imbedded in historic components of the structure. A wireless smoke detection system was installed in 2016. Smoke detection was provided throughout the building, with detectors interconnected to provide occupant notification. The alarm was local notification only, with no off-site transmission.

Sperry Chalet Operations

The Sperry Chalet is operated by the concessionaire, Belton, Inc.

Occupancy in the days preceding the fires included 41/42 guests, 9 staff, and 4 additional people that were part of a naturalist program. Guest evacuations began on August 11 and the staff of 9 concession employees remained until August 17.

During the timeframe between August 11 and August 17, concession staff members completed projects at the complex, including painting exterior decks. Water-based paint was used, along with disposable paint brushes. Debris was taken out with regular trash. The staff conducted the seasonal shutdown on August 15 and August 16, storing all furniture, mattresses, draperies, and bedding in the mouse-proof rooms (Rooms #8 and #14). Deck and balcony railings were removed and stored and the shutters were installed over the windows and doors.

NPS Concessions Coordination

NPS staff members indicated that operational evaluations were completed every year at the Sperry Chalet and strict fire prevention elements were incorporated into the operational plan of the concessionaire.

A fire alarm replacement program occurred in 2016 that utilized wireless smoke detectors installed in the dormitory. The system was divided into three zones and all devices were interconnected to provide occupant notification throughout the building. The 2016 project also included methods to reduce/limit fire ignition (fire-retardant treatments to draperies, smoking restrictions, mattress upgrades).

NPS staff provided detailed photographs of the dormitory interior and exterior from the operational files. Selected photographs, taken in 2013, 2016, and 2017, are included in the photo timeline of this report.

Events on August 31, 2017

On the day of the Sperry Chalet fires there were five personnel at the site, which consisted of an NPS maintenance person and four wildland firefighting personnel. The firefighting crew included a division supervisor and three firefighters. Fire protection at the site included exterior sprinklers that had been set on the ground as well as on the roofs of the Dining/Kitchen building and the dormitory.

Personnel at the site indicated that the weather conditions and fire behavior changed in the early afternoon of August 31, with winds increasing to approximately 25 miles per hour. A significant ember shower occurred between 2:00 p.m. and 3:00 p.m. with multiple spot

fires occurring throughout the Sperry Chalet complex. During this time period, personnel on site reported hearing the smoke alarms sounding in the buildings. One firefighter reported that smoke alarms were sounding in all buildings by 3:00 p.m.

Following the ember shower, at approximately 3:30 p.m., a firefighter observed smoke issuing from the southwest corner of the Dining/Kitchen building. Firefighters used a pulaski and forcefully opened the combustible soffit boards at the eave to find the fire. Firefighters reported that when they opened the eave a burning "nest" of material fell out. Flames were seen inside the soffit, reported by firefighters to be approximately 6"-12" in length. Water from lateral hose lines was used to suppress the fire.

Ember showers and winds continued across the site. Firefighters reported many spot fires occurring across the Sperry complex and extinguished them with water from hose lines. Firefighters reported that they continued to spray water on the roofs, walls, and eaves of the dormitory.

While suppression of spot fires occurred across the complex, a firefighter noticed smoke on the west side of the Dormitory building. This observation is estimated to be between 5:50 p.m. and 6:00 p.m., based upon interviews and activity reports of the personnel on site. The location of the smoke was at the second floor area of the south dormer and eaves, on the left side of an upstairs window. No flames were seen at that time and a firefighter continued to spray water in the area of the smoke.

Other firefighters and the NPS maintenance person made access into the first floor south lobby of the dormitory by removing the shutter and breaking the window in the entry door. The firefighters and maintenance person all reported heavy smoke conditions in the first floor lobby. They also indicated that they did not recall any noticeable increase in temperature inside the first floor lobby. Access to the north lobby was also gained by firefighters and the maintenance person. Firefighters reported similar smoke conditions in the north lobby.

Personnel on site reported that flames were first noticed at the second floor window (Room #15), visible between the spaces of the shutter boards. It was estimated that the time from smoke being visible in the dormer area until flames were seen was approximately 20 minutes.

Site Investigation (September 23, 2017)

I began my site investigation by conducting an exterior walk around of the Dining/Kitchen building. I observed snow covering the roof, decks, and ground surrounding the building. Photographs were taken of the building exterior, including multiple photographs of the southwest corner eave, soffit, and beam end (timber). The wooden soffit pieces that were broken during the fire had been reinstalled. Smoke staining was visible along the eave and charring was noted on the south fascia board and also on the upper portion of the timber beam end. A small hole was observed in the soffit board with smoke staining that appeared to be pushed outward through the hole on the underside of the painted soffit board. A splintered portion of the soffit board had been placed into the hole after the soffit was reinstalled, possibly to preserve the splintered piece or plug the hole.

The interior sleeping room was entered by removing the shutter and accessing the locked entry door with a key. I examined this room for smoke and fire indicators. Smoke staining and charring of combustible building materials was observed in the upper southwest corner of the room. Two smoke alarms were observed in the room. Photographs were taken of the smoke/char area.

After completing the interior examination, an area of potential fire damage along the southwest corner edge of shingles was noticed by the FLA team lead, Miranda Stuart. The area was approximately 1" deep by 12" wide. Dark areas resembling charring were observed, however I was unable to visualize the top of the shingled area due to the height above the deck. Suitable ground ladders were not readily available. Access to the roof was not possible due to safety concerns. Refer to photos on Slide #15 and #16 for detail.

I continued my investigation by conducting a walk around the Dormitory building. I observed snow covering the ground as well as snow covering the fire debris that was scattered outside and within the dormitory walls. Photographs were taken of the dormitory walls. The interior portion of the dormitory was not entered due to safety concerns related to the stability of the two interior chimneys and unsupported gable ends.

I continued my investigation by conducting a walk around of the maintenance cabin and restroom, taking cursory photos. I did not observe any indication of structural fires at either building. I observed the trail cabin from

a distance of 100 feet or more, but did not approach. The chlorination building/shed was not observed.

The site investigation was completed in approximately two hours.

Follow-up Interview Questions

In reviewing the photographs of the dormitory fire (Slide #55 and #56) I observed the first floor door shutter was back in place over the front of the entry door. This shutter was reported to have been removed by personnel on site during the fire to investigate smoke in the dormitory. I contacted personnel that were on site during the fire and asked about this shutter being reinstalled.

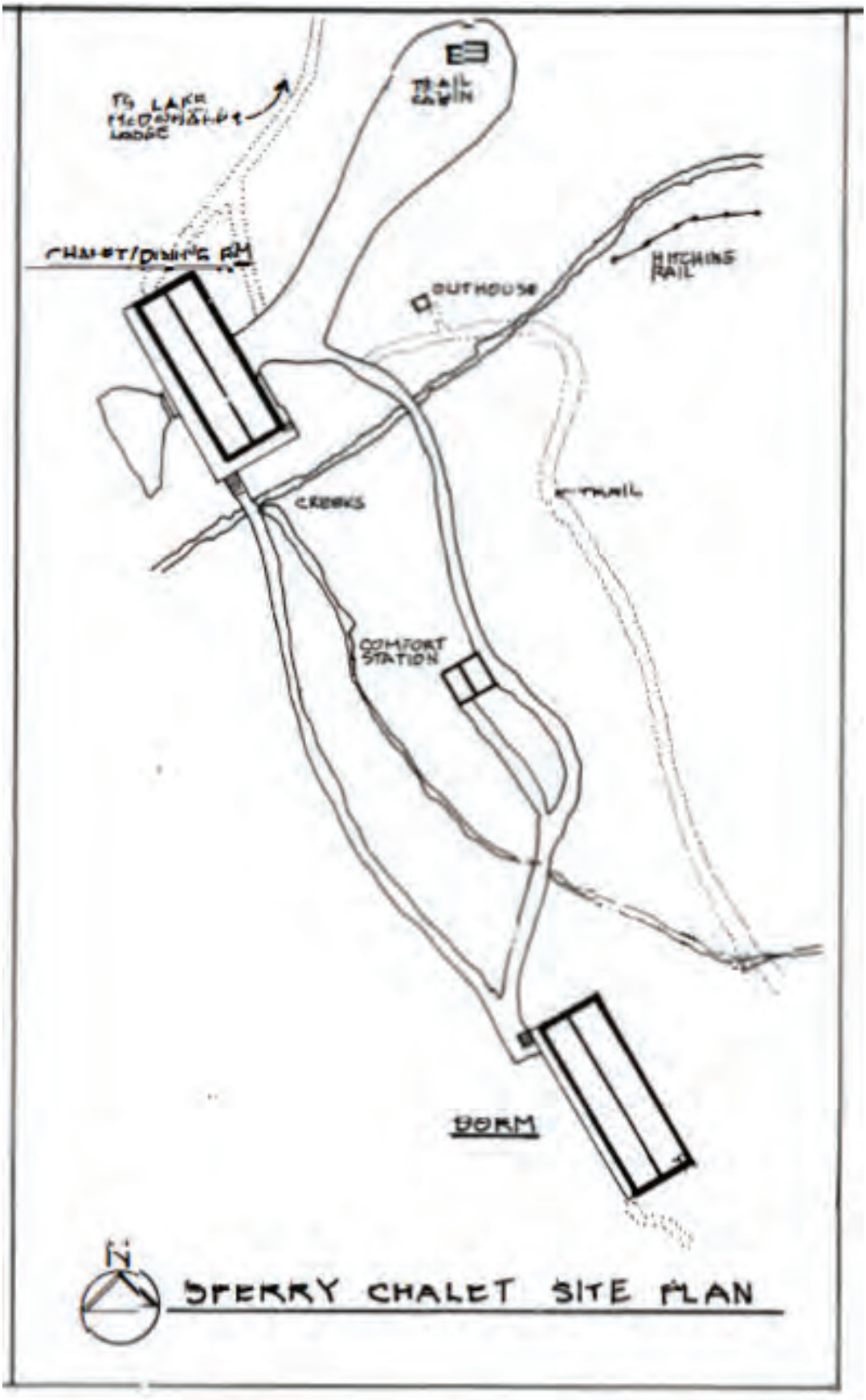
The division supervisor indicated that he thought the maintenance person had put the shutter back over the doorway on the dormitory. He also remembers finding the five woodscrews in his pocket after the fire. The maintenance person did not remember putting shutter back on the door. One of the firefighters indicated that he did not put the shutter back, but thought it may have been reinstalled by the maintenance person.

Additionally, I asked the personnel on site if the shingle damage on the southwest corner of the Dining/Kitchen building (Slide #15) was preexisting, caused by a spot fire, or damaged during suppression. The division supervisor was not sure if it was there before the fire, part of the fire damage, or if a firefighter might have hit it during suppression. The maintenance person indicated the shingle damage was not there prior to the fire, but was not sure if it was fire damage or suppression damage. The firefighter indicated that he was pretty confident the shingles came off when they were removing boards at the eave during fire suppression.

Consolidated Photos

Sperry Site Plan - excerpt from fire alarm project as-built drawings

July 2016



Area photograph

September 15, 2017

Area photograph

September 15, 2017

Dining/Kitchen building

West side – north end - September 23, 2017

Dining/Kitchen building

West side - September 23, 2017

Dining/Kitchen building

West side – south end

September 23, 2017

Dining/Kitchen building

Taken from southwest corner of exterior dining/kitchen deck. Shows fire damage at eave/ soffit/timber.

September 23, 2017

Dining/Kitchen building

Taken from southwest corner of exterior dining/kitchen deck. Shows fire damage at eave/ soffit/timber.

September 23, 2017

Dining/Kitchen building

Taken from southwest corner of exterior dining/kitchen deck. Shows fire damage at eave/ soffit/timber.

September 23, 2017

Dining/Kitchen building

Taken from southwest corner of exterior dining/kitchen deck. Shows fire damage at eave/ soffit/timber.

September 23, 2017

Dining/Kitchen building

Taken from southwest corner of exterior dining/kitchen deck. Shows fire damage at eave/ soffit/timber.

September 23, 2017

Dining/Kitchen building

Taken from southwest corner of exterior dining/kitchen deck. Shows soffit board that was reinstalled by firefighters after the fire.

September 23, 2017

Dining/Kitchen building

Taken by personnel on site after the fire. Shows internal charring of the soffit. Also shows damage to shingle area.

September 23, 2017

Dining/Kitchen building

Taken by personnel on site after the fire. Shows internal charring of the soffit. Also shows damage to shingle area.

September 23, 2017

Dining/Kitchen building

Taken by personnel on site after the fire. Shows spot fire on deck.

September 12, 2017

Dining/Kitchen building

Taken in the interior of the southwest sleeping room. Shows fire progression into the building.

September 23, 2017

Dining/Kitchen building

Taken from the southeast exterior deck of the dining/ kitchen building. Shows comparison eave on east side of building.

September 23, 2017

Dining/Kitchen building

Taken from the southeast exterior deck of the dining/ kitchen building. Shows comparison eave on east side of building.

September 23, 2017

Dining/Kitchen building

Taken from the southeast exterior deck of the dining/ kitchen building. Shows comparison eave on east side of building.

September 23, 2017

Dining/Kitchen building

Taken from the southwest exterior deck of the dining/ kitchen building. Shows nesting material that dropped from the soffit onto the deck during fire suppression.

September 23, 2017

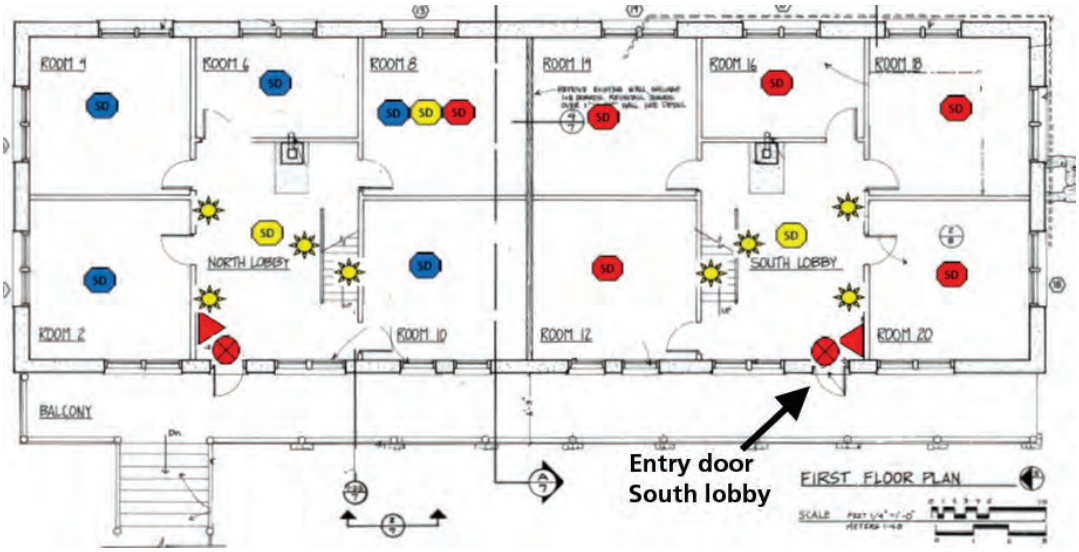
Dining/Kitchen building

Taken from the southwest exterior deck of the dining/ kitchen building. Shows nesting material that dropped from the soffit onto the deck during fire suppression.

September 23, 2017

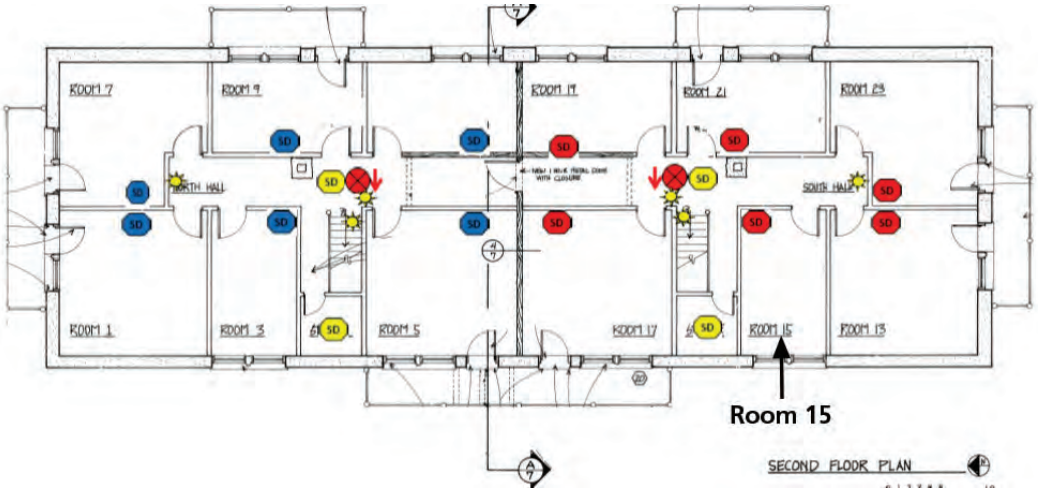
Dormitory building

First floor as-built fire alarm drawings.



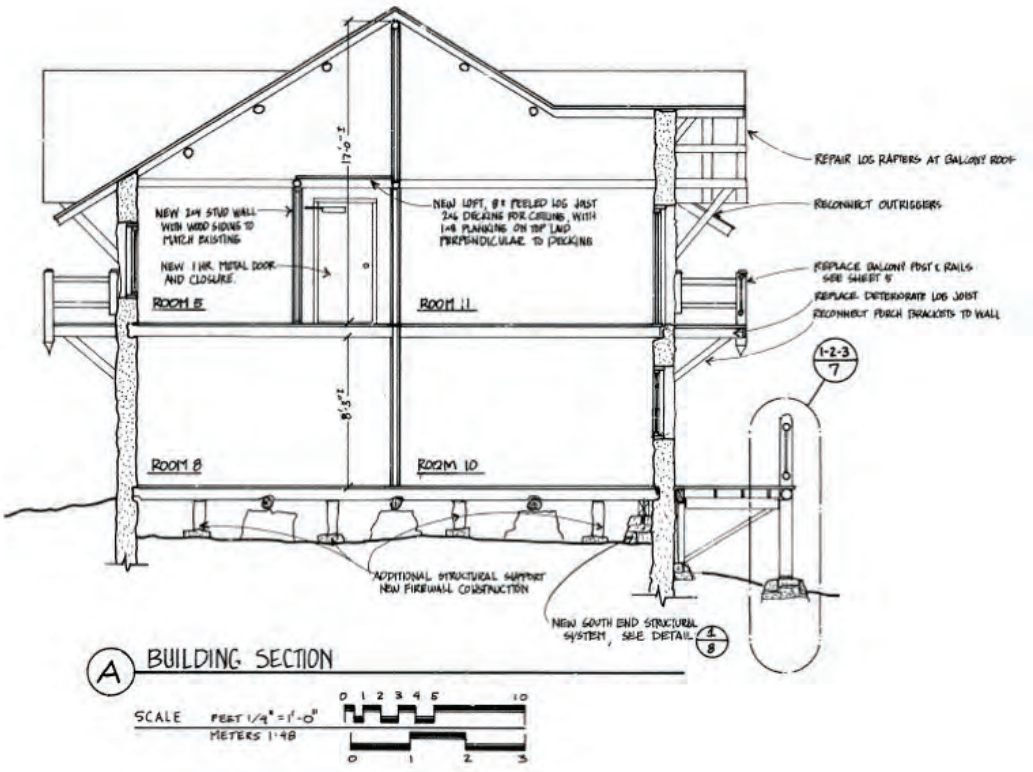
Dormitory building

Second floor as-built fire alarm drawings.



Dormitory building

From the north side showing elevation.



Dormitory building

Taken from the southwest corner of the dormitory.

August 23, 2016

Dormitory building

Taken from the southeast corner of the dormitory.

August 23, 2016

Dormitory building

Taken from the southwest corner. Close up photo [below] shows the second floor dormer over Room #15.

Note: To identify beam and rafter locations, I assigned a letter designation to the individual timbers. That letter designation system is continued on additional pertinent photos to provide clarity related to construction elements.

August 23, 2016

Dormitory building west exterior

Exterior second floor window of Room #15, dormer, and eaves. Letter designations added.

August 6, 2013

Dormitory building west exterior

Exterior second floor window of Room #15, dormer, and eaves. Letter designations added.

August 6, 2013

Dormitory building eaves north of Room 15

Exterior second floor window of Room #15, dormer, and eaves. Letter designations added.

August 6, 2013

Dormitory building eaves south of Room 15

Exterior second floor window of Room #15, dormer, and eaves. Letter designations added.

August 6, 2013

Dormitory building

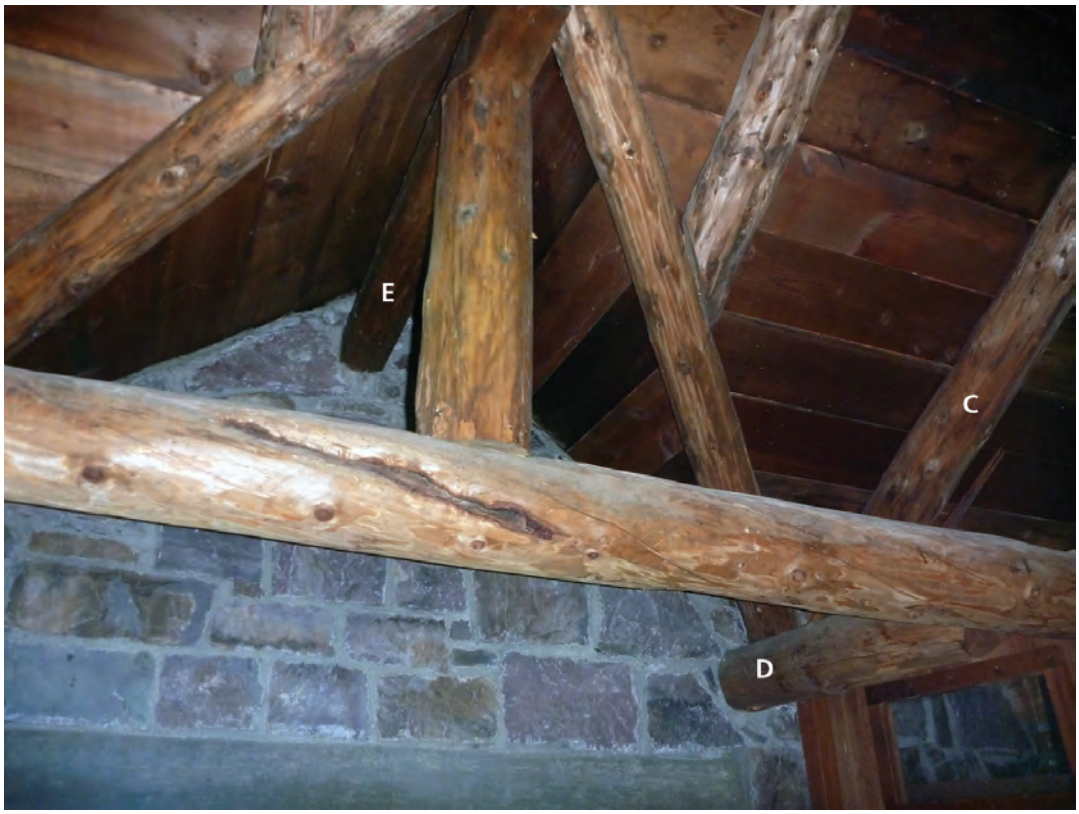
Interior of Room #15, peak above windows. Letter designation for beam added.

August 6, 2013

Dormitory building

Interior of Room #15, ceiling peak above windows. Letter designations for beams and rafter added.

August 6, 2013



Dormitory building

Interior of Room #15, floor below windows.

August 6, 2013

Dormitory building

Interior of Room #15, window latches.

August 23, 2016

Dormitory building

Interior of Room #15, north wall. Identifies area of adjacent storage room and interior stairway. Letter designation for beam and rafter added.

August 23, 2016

Dormitory building

Interior of Room #15, north wall. Identifies area of adjacent storage room and interior stairway. Letter designation for beam and rafter added.

August 23, 2016

Dormitory building

Interior of Room #15, north wall and east wall. Shows loft area over stairway. Letter designations for rafters added.

August 23, 2016

Dormitory building

Vaulted ceiling area/loft of Room #15. Identifies area of adjacent storage room and interior stairway. Letter designations for rafters added.

August 23, 2016

Dormitory building

Interior of Room #15, south wall. Letter designations for beam and rafter added.

August 6, 2013

Dormitory building

Interior of Room #15, east wall and south wall, room door.

August 6, 2013

Dormitory building

Interior of Room #15, entry door, floor, hallway.

August 6, 2013

Dormitory building

Door to second floor storage room (adjacent to Room #15

June 30, 2016

Dormitory building

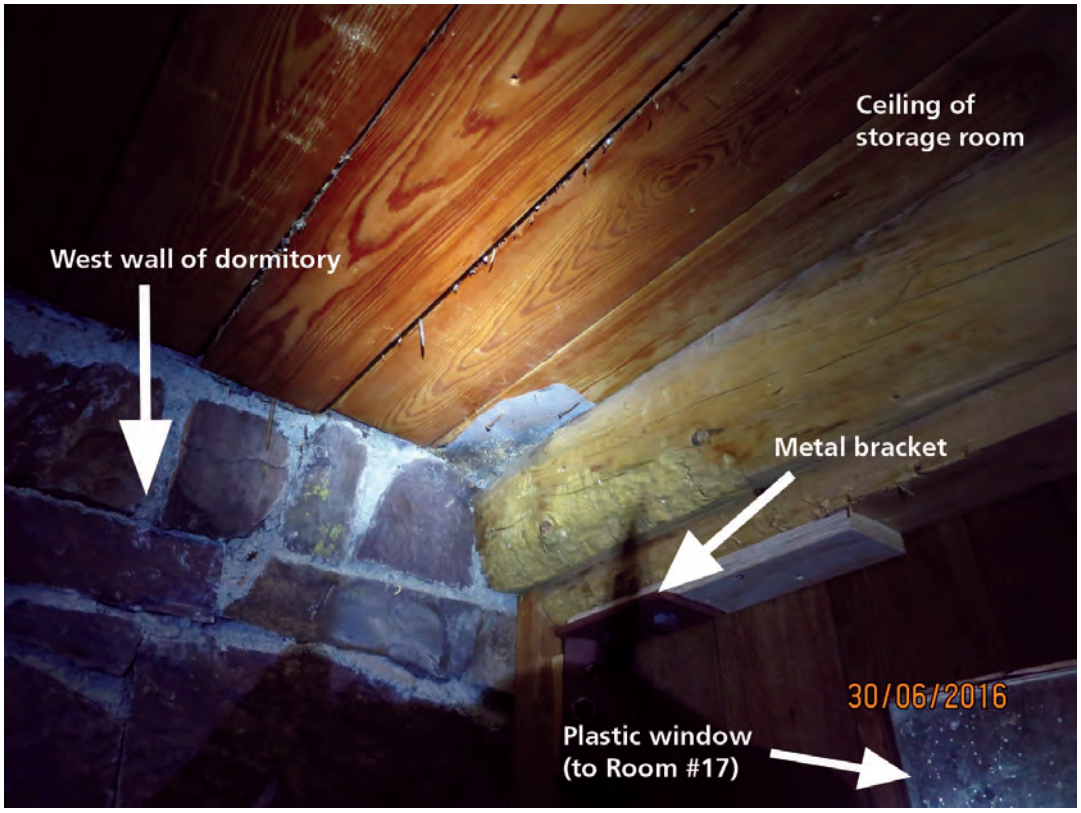
Interior floor of second floor storage room (adjacent to Room #15). Stairway down to first floor is visible in the lower right corner.

June 30, 2016

Dormitory building

Interior ceiling of second floor storage room (adjacent to Room #15).

June 30, 2016



Dormitory building

Close up of interior ceiling of second floor storage room, shows rodent nesting area.

June 30, 2016

Dormitory building

Interior of second floor hallway, fire door.

August 2, 2017

Dormitory building

Interior of north lobby, first floor.

August 6, 2013

Dormitory building

Interior of south lobby, first floor.

August 6, 2013

Dormitory building

Interior of south lobby, first floor.

August 6, 2013

Dormitory building

West side of the dormitory, structure wrap in progress.

August 17, 2017; 6:26 p.m.

Dormitory building

Taken from west side of dormitory on the north end. Shows heavy smoke conditions from the wildland fire.

August 31, 2017; 4:56 p.m.

Dormitory building

Taken from west side of dormitory, on the south end, adjacent to southwest corner of building. Shows relatively clean-burning flames coming from second story window of Room #15. Flames are observed covering the upper half of window opening. Flames are also shown reaching the underside of the dormer. The shutter from Room #15 is completely gone. It appears that possible window glass is remaining in lower right and lower left corners of the window opening. Charring of the exterior side of center window frame is noted. The first floor entry door shutter is in place over doorway.

August 31, 2017; 6:09 p.m.

Dormitory building

Taken from west side of dormitory directly in front of the south lobby entry door. Shows full involvement of Room #15 with flames completely filling the window opening and appearing relatively clean burning with light smoke production. Flames are seen on the dormer and also appearing on the shingles located on the right and left side of the window. Smoke development is seen below the larger dormer located to the left side of Room #15 and heavy smoke development is seen on the right side of the building. The entry door shutter is in place at the south lobby doorway.

August 31, 2017; 6:12 p.m.

Dormitory building

Taken from southwest corner of dormitory, shows the west side and the west half of the south end. Shows heavy fire involvement of the dormer above Room #15. Flames appear relatively clean burning, producing light-colored smoke. Flames are observed involving roof shingles. The west deck appears very wet in the photo. Remnants of the shutter from Room #15 are visible on the deck. Heavy smoke conditions are visible issuing from the south side.

August 31, 2017; 6:15 p.m.

Dormitory building

Taken from south end of the dormitory. Shows light smoke and thin flame showing from Room #15 dormer/ window. Shows heavy smoke development on the south end.

August 31, 2017; 6:17 p.m.

Dormitory building

Taken from south end of the dormitory. Shows more flame length coming from Room #15 dormer/window.

August 31, 2017; 6:17 p.m.

Dormitory building

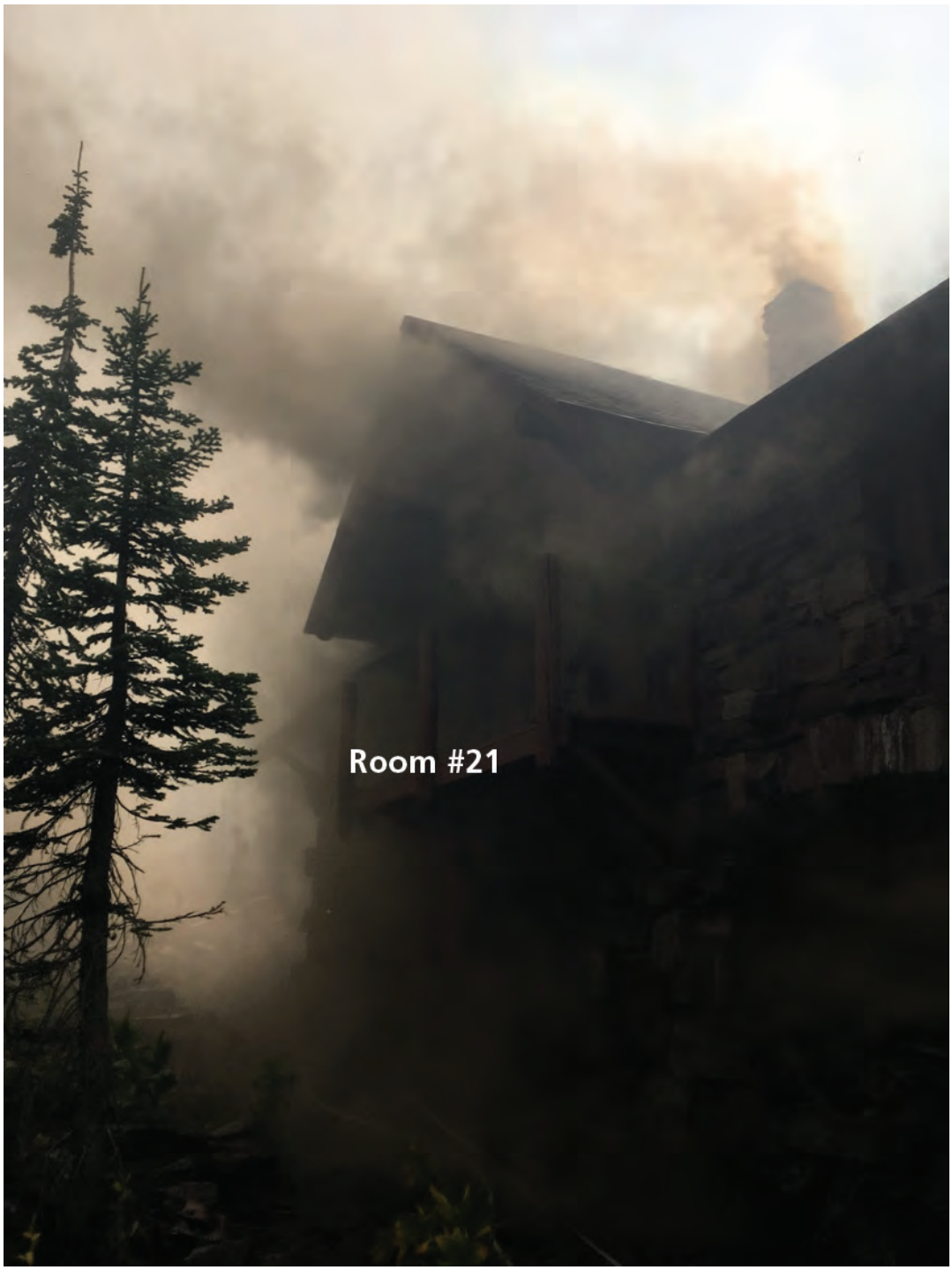
Taken from east side of the dormitory adjacent to Room #16. Shows moderate smoke production from the first floor.

August 31, 2017; 6:22 p.m.

Dormitory building

Taken from east side of the dormitory, north of the exterior porch (Room #21). Shows heavy smoke production from the second floor and smoke production near the chimney area.

August 31, 2017; 6:22 p.m.



Dormitory building

Taken from northeast area, long distance from dormitory. Shows heavy fire involvement on the south half of dormitory with fire through the roof.

August 31, 2017; 7:11 p.m.

Dormitory building

Taken from east side of dormitory, long distance from the dormitory on the east side of the empty water supply bladder (pumpkin). Shows fire decay on the south end of the dormitory and the south roof structure 50% or more consumed by fire. No flames are visible through the north roof structure.

August 31, 2017; 7:18 p.m.

Dormitory building

Taken from northwest corner of dormitory from a distance. Shows fire through the roof structure with heavy smoke conditions on the north end of the dormitory.

August 31, 2017; 7:40 p.m.

Dormitory building

Taken from east side of dormitory, long distance from the dormitory on the east side of the empty water supply bladder (pumpkin). Shows 90% or more fire consumption of the south roof structure. Heavy fire involvement of the north roof structure is seen, with the second floor of the dormitory heavily involved in fire.

August 31, 2017; 8:01 p.m.

Dormitory building

Taken from east side of dormitory, long distance from the dormitory on the east side of the empty water supply bladder (pumpkin). Shows full involvement of the north roof structure and second floor of the dormitory. Fire is visible in the first floor portion of the north end of the dormitory.

August 31, 2017; 8:05 p.m.

Dormitory building

Taken from the northeast side of the dormitory, long distance from the dormitory. Shows full involvement of the entire building with fire decay noted in the south end and the majority of the north roof structure consumed by fire.

August 31, 2017; 8:56 p.m.

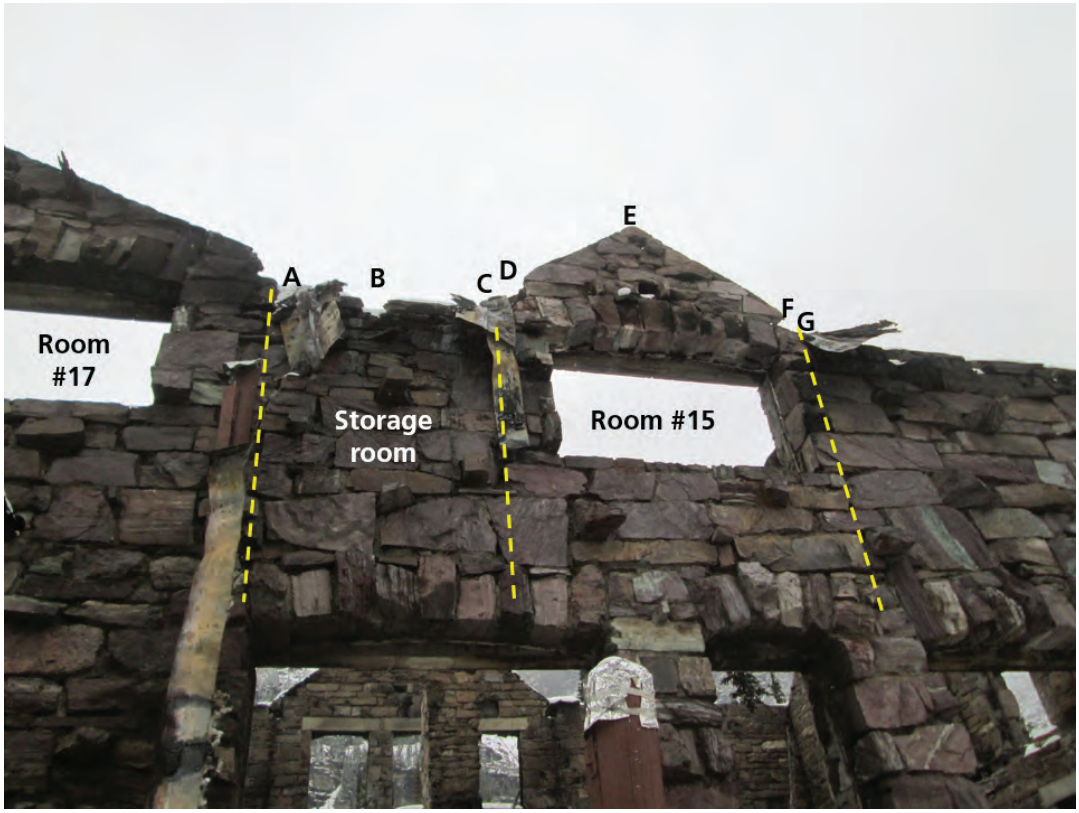
Dormitory building

Taken from north end of the dormitory. Shows fire decay occurring inside the dormitory with fire still showing along the north gable eaves.

August 31, 2017; 9:35 p.m.

Dormitory building

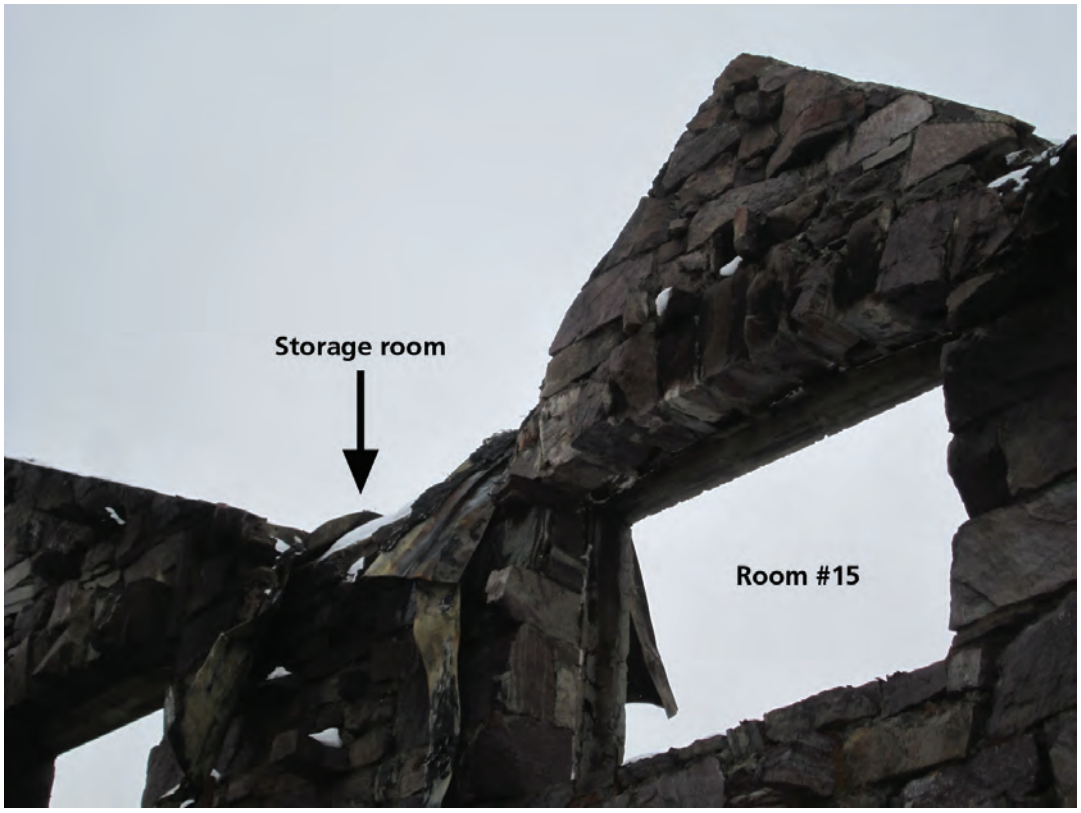
Exterior of west wall, second floor. Letter designations for beam and rafter locations added for clarity. Delineation added to demonstrate approximate wall locations of Room #15 and storage room.



Dormitory building

Exterior of west wall, second floor, upper area. Letter designation added for rafter location.

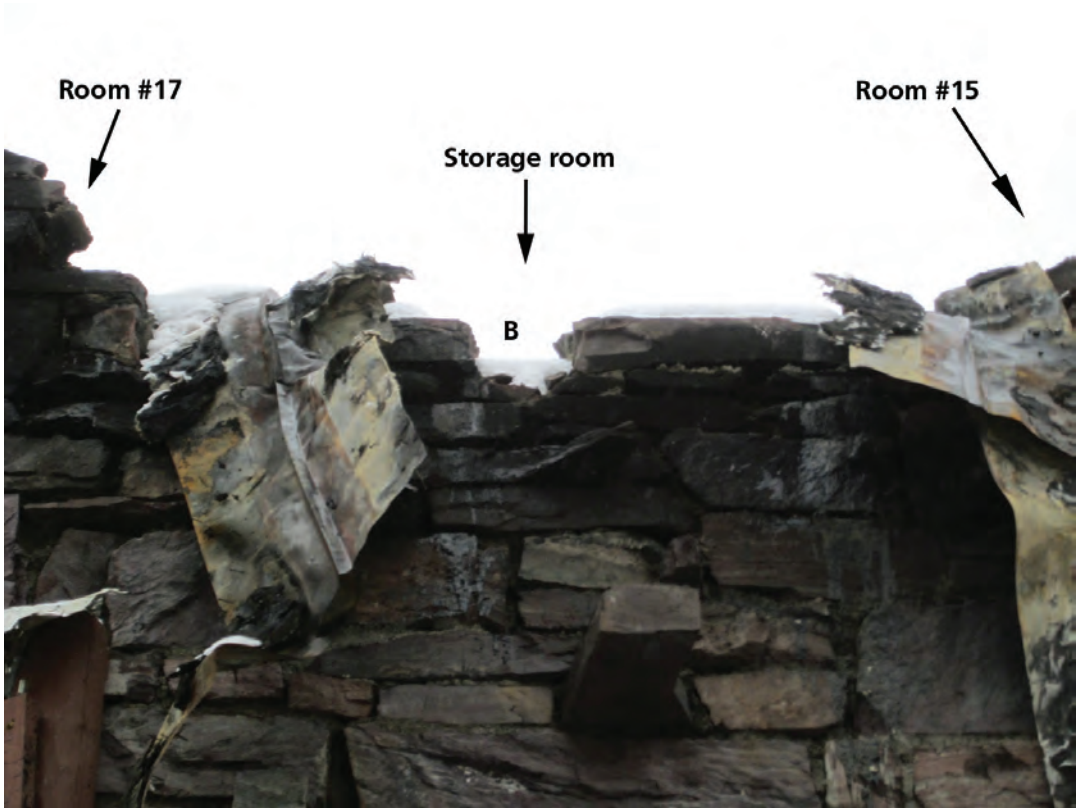
September 23, 2017



Dormitory building

Exterior of west wall, second floor, upper area. Letter designation added for rafter location.

September 23, 2017



Dormitory building

Interior of southwest corner. Letter designations added for beam locations added for clarity.

September 23, 2017

Dormitory building

Interior of southwest corner. Letter designations added for beam locations added for clarity.

September 23, 2017

Dormitory building

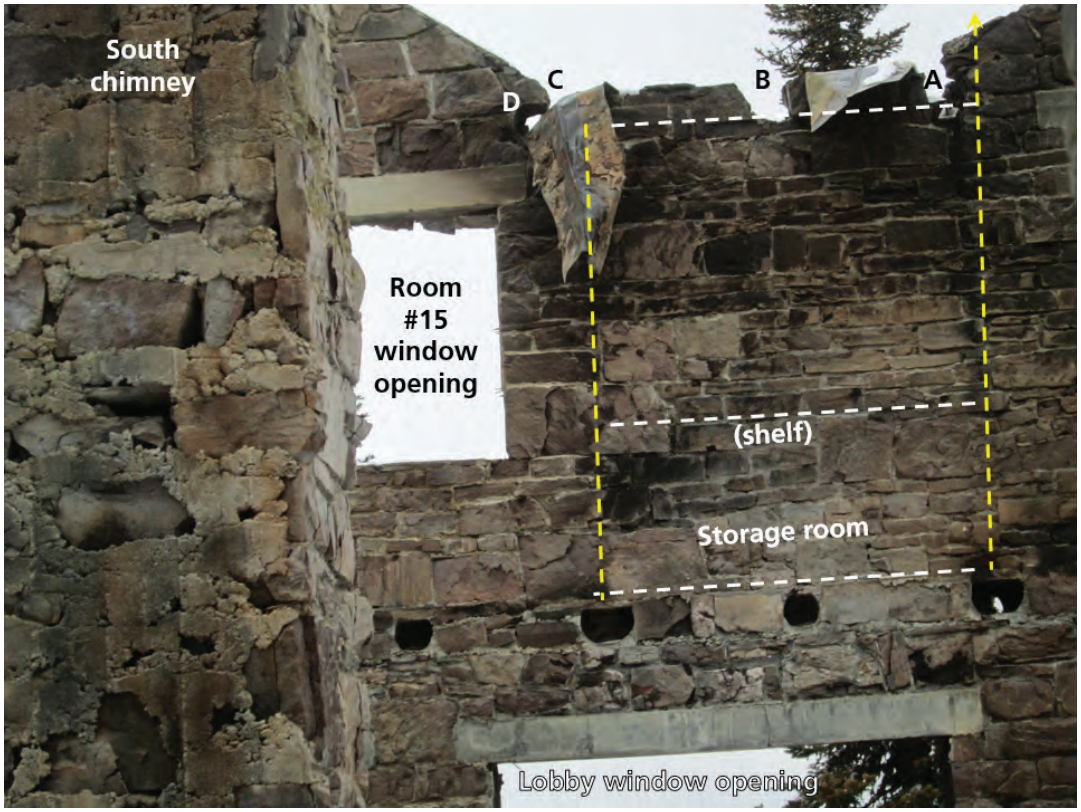
West wall, interior. Letter designations for beam and rafter locations added for clarity. Delineation added to demonstrate approximate wall locations of Room #15 and storage room.

September 23, 2017

Dormitory building

West wall, interior. Letter designations for beam and rafter locations added for clarity. Delineation added to demonstrate approximate wall locations of Room #15 and storage room.

September 23, 2017



Dormitory building

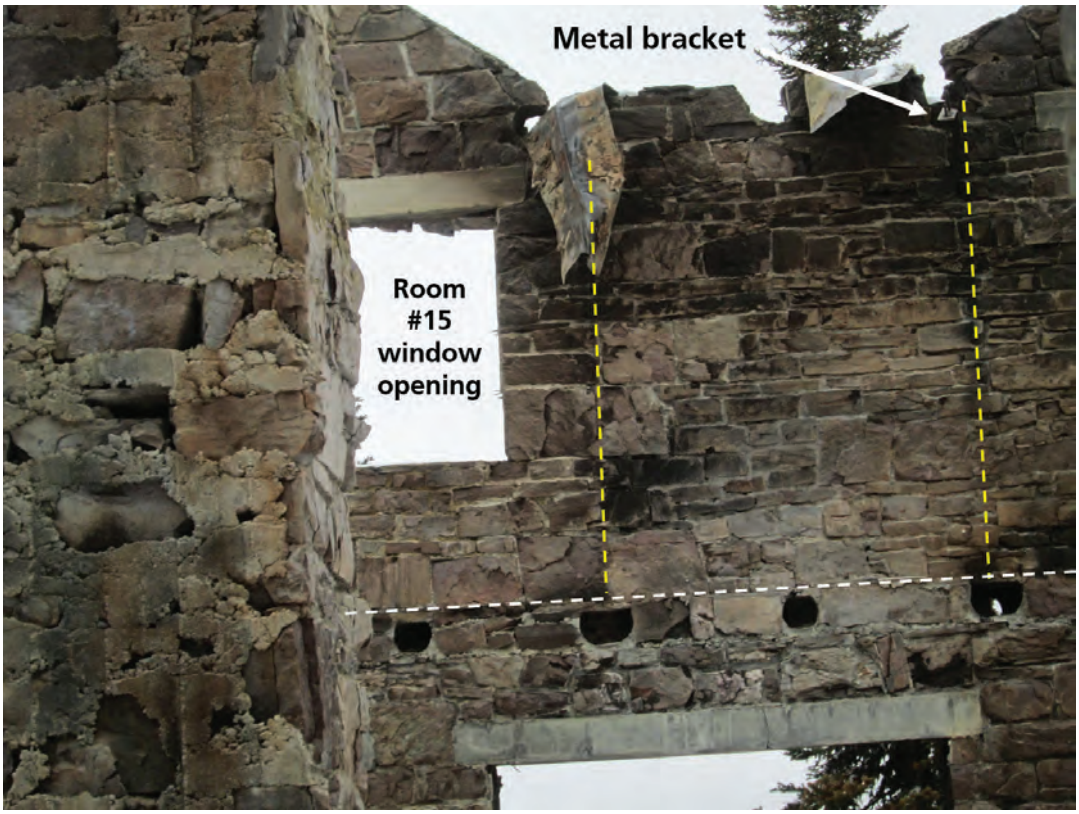
Interior of second floor storage room. Shows shelf location in relation to west wall stonework.

June 30, 2017 (pre-fire)

Dormitory building

West wall, interior. Delineation added to demonstrate approximate wall locations. Note metal bracket in upper right corner.

September 23, 2017



Dormitory building

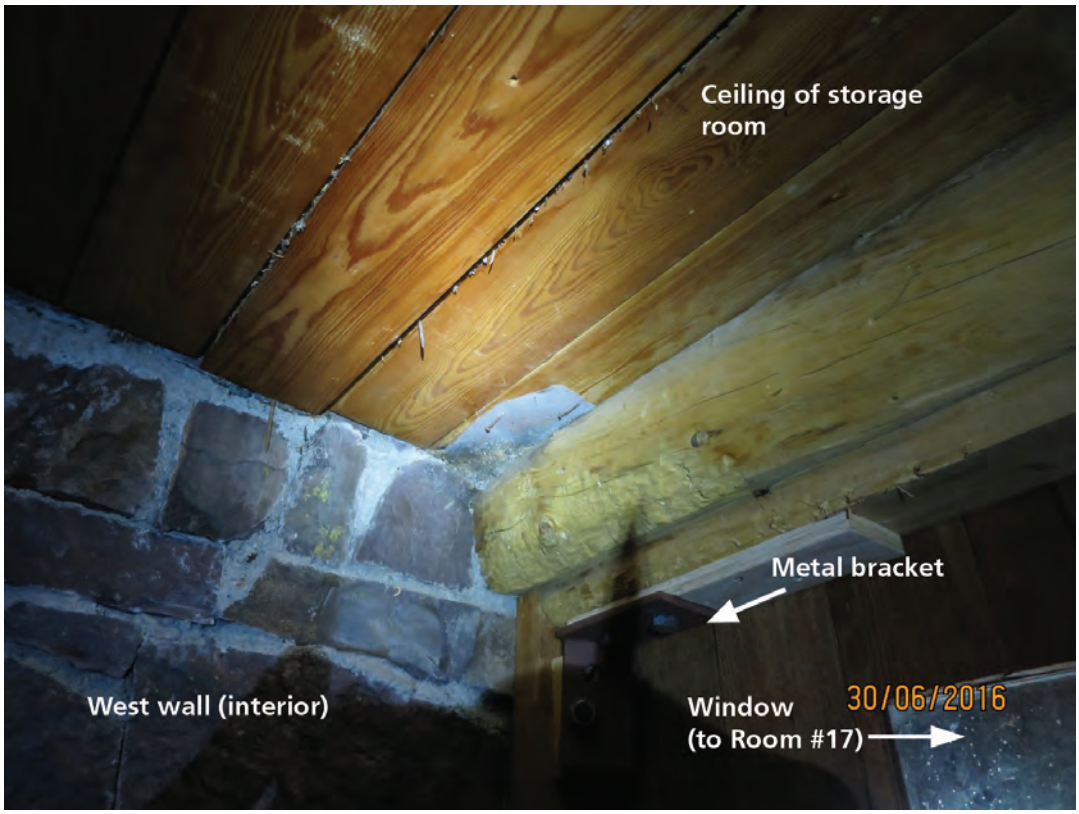
West wall, interior. Delineation added to demonstrate approximate wall locations. Note metal bracket in upper right corner.

September 23, 2017

Dormitory building

Shows metal bracket located in second floor storage room.

June 30, 2016 (pre-fire)



Dormitory building

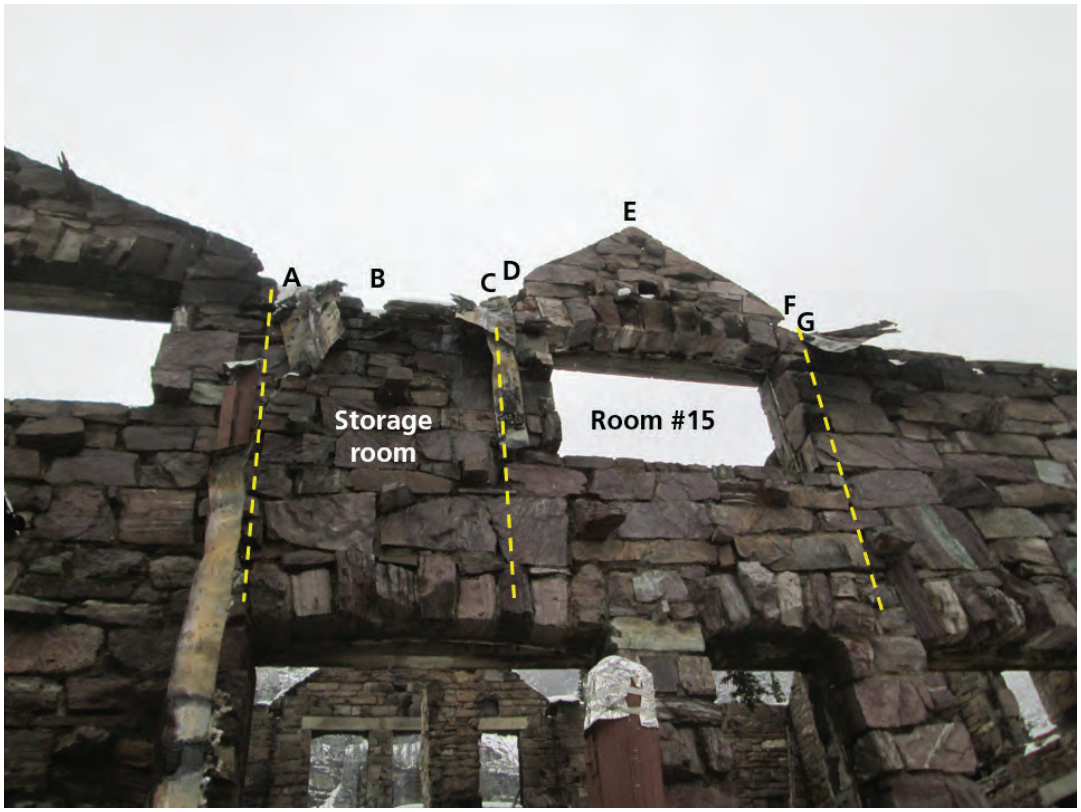
West wall interior. Letter designations for beam and rafter locations added for clarity.

September 23, 2017

Dormitory building

West wall exterior. Letter designations for beam and rafter locations added for clarity. Delineation added to demonstrate approximate wall locations of Room #15 and storage room.

Septermber 23, 2017



Data Analysis

I analyzed the interview notes, photographs, activity reports, and photos from before, during, and after the fire. Pertinent photographs and floor plans were developed into a PowerPoint timeline and were reviewed to evaluate potential areas of origin, ignition, and fire spread. A review of firebrand ignition literature was completed.

Inductive Reasoning

The following scenarios were considered in developing the origin and cause determination of the fire in the Dining/Kitchen building and the fire in the Dormitory building:

- Intentional fire(s)
- Lightning-caused fires striking buildings
- Accidental fires caused by building utilities (electrical, fuel gas, fixed heating)
- Accidental fires caused by carelessness (candles, cooking, smoking, portable heaters)
- Accidental fires caused by building repair/maintenance (hot work, lack of maintenance)
- Accidental fires caused by spontaneous heating (oily rags, chemicals, vegetation)
- Exposure fires caused by fire in adjacent buildings, equipment, trees, and/or vegetation
- Rekindle caused by previous fire(s)
- Fires caused by wildland fire and wind-blown embers (firebrands) coming in contact with combustible building material

Deductive Reasoning

Intentional fire – No evidence of unauthorized access to buildings was evident. Access to the Sperry Chalet complex and buildings was restricted. Guests and staff evacuated on August 11 and August 17. Dormitory doors were locked and covered with wooden shutters attached with wood screws. Firefighting and maintenance personnel (total of five) were in close contact with each other on August 31 during the fires that occurred in and around the complex.

Lightning-caused fires striking buildings – No reports of lightning strikes in the Sperry complex area on or about August 31 were reported by firefighters who were protecting the buildings. I did not observe evidence of lightning strikes impacting the buildings.

Accidental fire caused by building utilities (electrical, fuel gas, fixed heating) – No utilities served the dormitory. No fixed heat sources were present in the dormitory. No electrical utilities are present in the dining/kitchen. The fuel gas (propane) system in dining/kitchen was shut down as part of concessions closing on August 15-16. Wood stove (dining/kitchen) was not used in days preceding the fire.

Accidental fire caused by carelessness (candles, cooking, smoking, portable heaters) – A strong fire prevention program is in place at the Sperry Chalet complex that addresses and prohibits open flame, smoking (including decks), individual cooking, and portable heating. The dining/kitchen and dormitory procedures use detailed checklists to shut down and secure the buildings at the end of each season. Both buildings were closed, locked, secured with shutters, and not in use.

Accidental fire caused by building repair/maintenance (hot work, lack of maintenance) – No recent hot work had been completed. No evidence of maintenance work or lack of maintenance that would have created an ignition source was evident.

Accidental fire caused by spontaneous heating (oily rags, chemicals, vegetation) – Paint stripping was accomplished on the first floor dormitory windows on August 8. Methods did not include heat guns. Stripping operation was conducted by concessioner who used Citristrip®, sandpaper, and water. Painting of exterior decks occurred between August 14-16 using water-based paints. Disposable paint brushes were used and sent out in the final trash. There were no reports of chemical products being used or organic material being stored that would be related to spontaneous heating.

Exposure fires caused by fires in adjacent buildings, equipment, trees, and/or vegetation – The first building ignited was the dining/kitchen. This fire was extinguished quickly. No equipment was observed parked or operated near the Dining/Kitchen building or dormitory. Fuel-fired water pumps utilized by firefighters were not located in close proximity to either structure during operation. Tree fires were reported in the area, including one tree that was approximately three feet from the Dining/Kitchen building. No radiant heat damage was noted on the fascia boards that were in close proximity to that tree. A small section of the lower edge of shingles on

the southwest corner of the dining/kitchen appeared to have damage. This section is approximately 1" deep and 10" to 12" wide. This damage area is in the same area as the fire that was extinguished inside the eave. Firefighters indicated that they did not see this damage prior to the fire and believe it was related to suppression activity.

Rekindle caused by previous fire(s) – No previous fires in either structure were reported or evident during the investigation.

Fire caused by wind-blown embers (firebrands) coming in contact with combustible building material – Interviews with firefighters and the NPS maintenance person onsite during the fire indicated that strong winds occurred throughout the afternoon of August 31. Additionally, all personnel reported intense ember showers throughout the afternoon, along with numerous spot fires on ground vegetation, downed trees, and standing trees.

The Dining/Kitchen building fire was first seen soon after the reports of increased fire behavior, winds, and ember showers. The fire was initially discovered by the division supervisor when smoke was seen issuing from the eave. Firefighters suppressed the fire quickly.

The fire in the Dining/Kitchen building eave was located in a concealed combustible location. Soffit boards enclosed the eave along the entire length of the dining/kitchen west wall. Firefighters opened the combustible soffit with a pulaski and found flaming combustion with flame lengths approximately 6" to 12" in length. During my investigation of the exterior and interior of the southwest room of the dining/kitchen on September 23, I found charring of combustible construction material in the upper corner of the sleeping room, corresponding to the exterior eave/soffit fire that had been extinguished on August 31.

At approximately 5:50 p.m. on August 31, a firefighter noticed smoke issuing from the second story of the dormitory on the west side. The location of the smoke was reported to be the left side of the dormer that was located over Room #15. Smoke continued to be visible at the exterior eave area despite application of water by firefighters. Access to the interior of the structure was gained by the division supervisor who removed the doorway shutter screws with a Leatherman® tool. The entry door window was broken by the maintenance person, allowing the door to be unlocked and opened. Reports from the division supervisor, firefighters, and NPS maintenance person all indicated the first floor south lobby was filled with heavy smoke. Personnel also indicated that there was not a noticeable increase of heat in the south lobby.

Time estimates by all personnel involved in the protection and suppression efforts of the dormitory on August 31 indicate quick fire growth in the dormitory, with visible flames showing from the second story window of Room #15 within a short period of time. Time stamp information on the digital photographs from three different sources are consistent with quick fire growth throughout Room #15 and extension to the exterior dormer and adjacent roof shingles.

Conclusions

Ignition source

The ignition of the fires in the Dining/Kitchen building and the dormitory are hypothesized to be ignited by wind-driven embers that were present throughout the Sperry Chalet complex at multiple times on the afternoon and early evening of August 31. Windborne embers (firebrands) from wildland fires are recognized as a competent heat source. Embers started numerous fires throughout the Sperry Chalet complex on vegetation and in trees before and after the two building fires. Additionally, an area of char related to a small ember-caused fire on the exterior deck of the Dining/Kitchen building was noticed by personnel on scene and photographed by them on August 12 (Slide # 17).

The construction materials that were present in both areas of fire ignition in the Dining/Kitchen building and dormitory included combustible timbers and lumber materials. These materials (cellulose fuels) are susceptible to ignition from smoldering combustion. Both areas of fire ignition also had evidence of nesting material from rodents. This nesting material creates an easily ignitable fuel package, which is also susceptible to smoldering ignition.

Origin

The area of origin of the Dining/Kitchen building fire was determined to be the concealed combustible space above the wooden eave soffit at the southwest corner of the building. During suppression activity firefighters noticed combustible "nesting" material similar to a rat's nest that fell out of the burning area when the soffit board was forcibly removed. This finely divided combustible material creates an easily ignitable combustible fuel. The concealed combustible area of the exterior eave communicated with the interior sleeping room, which provided an avenue for fire travel. During my site

investigation on September 23, I observed smoke staining and charring inside the Dining/Kitchen building in the upper southwest corner of the sleeping room.

The area of origin of the dormitory fire was determined to be the west side of the dormitory, on the second floor, on the north side of Room #15, above the ceiling of the second floor storage room. Combustible roof timbers penetrated the stone masonry wall in this area, which corresponded to the area where the initial smoke was seen by firefighters. The construction technique of wooden timbers passing through the masonry wall presented a path through the wall and into the ceiling area of Room #15 that would allow firebrands to travel into the dormitory wall area. These timbers also presented a combustible fuel capable of ignition by a smoldering ember (firebrand). Photographs taken after the fire show irregular shapes in the stone construction where timber rafters passed through the exterior wall. These gaps create an avenue for ember travel and smoldering fire.

First fuel ignited

Dining/Kitchen building – The first fuel ignited in the Dining/Kitchen building was determined to be either concealed combustible construction material or concealed nesting material in the southwest eave area. Firefighters found flaming combustion inside the soffit area and also found nesting material similar to a "rat's nest." Both were found actively burning when firefighters opened the soffit with a pulaski.

Dormitory – The first fuel ignited in the Dormitory building was determined to be building construction material, nesting material, or windblown dry vegetation material on the west side of the building, in or near the exposed timbers that penetrated the second floor west wall of the dormitory, on the north side of Room #15, above the second floor storage room.

Fire progression

Dining/Kitchen building – After ignition by smoldering combustion, it is hypothesized that flaming combustion occurred, charring portions of the concealed combustible soffit area and progressing into the sleeping room on the southwest corner of the building. Fire progression was stopped by firefighters who used a pulaski to open the soffit and then used water to suppress the fire.

Dormitory – After ignition by smoldering combustion, it is hypothesized that flaming combustion occurred on combustible construction materials located on the north side of Room #15, directly above the second floor storage room ceiling. This flaming combustion continued undetected until smoke conditions were visible by firefighters outside, at the dormer on the left side of Room #15.

The area directly above the second floor storage room ceiling was open to the vaulted ceiling of Room #15. The intersection of the top of the storage room and the slope of the ceiling of Room #15 also corresponded with the area of rafter penetrations of the west stone wall. In photographs taken in 2016, this area of the storage room ceiling had visible rodent nesting material both in the corner area of the storage room ceiling as well as in the areas between the individual pieces of lumber. It is hypothesized that the finely divided combustible fuel in this area would be easily ignited by smoldering combustion from an ember (firebrand) or by smoldering/flaming combustion of a rafter that penetrated the west wall.

The peaked ceiling in Room #15 provided a large area for smoke to collect before smoke levels were seen issuing from the dormer eave. This peaked ceiling also provided a combustible fuel geometry and orientation that supported rapid fire growth within the compartment. The peaked ceiling area allowed for heavy flames to develop inside the room before the heat level descended to the level of the window of Room #15, eventually causing it to fail. Failure of this window corresponded with the first area to have flames visible by firefighters outside.

It is hypothesized that the fire was initially compartmentalized within Room #15, due to heavy lumber roof construction, vertical walls, and a closed room door. During a review of photographs taken in 2016, small plastic windows were observed in the south and north walls of the second floor storage room. These windows would fail quickly as the heat horizon was driven downward, providing additional avenues for smoke, heat, and flames to involve the storage room and the adjacent guest room to the north (Room #17).

Heavy fire conditions within these rooms would quickly involve the interior wooden doors and allow fire to progress into the hallway and then into the other second floor rooms on the south end of the dormitory. The fire-resistive wall appears to have initially maintained a fire separation between the south and north areas of the dormitory. In reviewing photographs taken during the fire on August 31, this wall appears to have sustained fire for a considerable period of time.

Combustible furnishings were removed from Room #15 during the dormitory shutdown in mid-August, which minimized combustible fuel loads in the room. However, the guest rooms were constructed of combustible walls, floors, and ceilings that provided an interior environment readily ignitable by flaming combustion. This environment would support rapid fire growth within the compartment.

Fire Cause

Dining/Kitchen building – The probable cause of the Dining/Kitchen building fire was determined to be smoldering combustion carried in airborne and wind-driven embers from a wildland fire that lodged in combustible areas of the building exterior eave/soffit. Combustible construction materials were subject to a competent heat source that was sufficient to produce flaming combustion. Construction methods in the Dining/Kitchen building allowed for fire spread within concealed combustible locations.

Dormitory – The probable cause of the Dormitory building fire was determined to be smoldering combustion carried in airborne and wind-driven embers from a wildland fire that lodged in either combustible construction material, nesting material, or windblown dry vegetation material on the west side of the dormitory, on the north side of the second floor sleeping room #15. Combustible construction material, nesting material, or windblown dry vegetation materials were subject to a competent heat source that was sufficient to produce flaming combustion. Flaming combustion continued, involving interior combustible construction material. Fire conditions continued to grow until the window of Room #15 failed and flames were seen by firefighters.

Classification

Dining/Kitchen building – the fire is classified as natural caused, related to wildfire.

Dormitory building – the fire is classified as natural caused, related to wildfire.

Branch of Wildland Fire
National Park Service
Division of Fire and Aviation
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