Study of Structural Failures Associated with the Winter 2008-2009 Snow Event in the Spokane/Coeur d’Alene Area

December 2009

Structural Engineers Association of Washington (SEAW)

Spokane Chapter
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**Ad Hoc Committee of the Spokane Chapter of the Structural Engineers Association of Washington:**

Robert W. Graper, PE, SE – Committee Chair
Krista M. Brown, PE, PhD
Brett C. Danielson, PE
Robert E. Green, PE
Randall J. LaPlante, PE, SE
Timothy M. Lawton, PE
Darcy M. Morden, PE
William T. Rafferty, PE, SE
Joseph D. Scholze, PE, SE
Tony E. Stenlund, PE
David A. VanDerostyne PE, SE
Jeffrey L. Van Leuven, PE

The committee would like to thank local engineering firms and building officials who provided data and information necessary for the preparation of this report.
**Executive Summary**

This report was prepared by an ad hoc committee of the Spokane Chapter of the Structural Engineers Association of Washington to study structural failures which resulted from the extreme weather event the Inland Northwest experienced during the December 2008-January 2009 period. Record snowfalls were recorded in the region with the majority of the winter’s snowfall occurring in a 3 ½ week period.

Although many buildings experienced structural failures due to the snow loads, the total number of affected buildings was very small relative to the total building inventory in the region. Most of the failures occurred at snow loads less than the minimum design roof loads currently required by local building officials, thus other factors led to the failures.

Based on evaluation of the data collected for the 2008-2009 winter snow event, the Ad-Hoc Committee of the Spokane Chapter of Structural Engineers Association of Washington recommends retaining minimum design roof snow loads currently adopted by jurisdictions in the Spokane and Coeur d’Alene area. Structures at higher elevations should be evaluated on a case by case basis.

The committee reminds the engineering community that proper, code-compliant structural design of any structure includes modifications of the minimum basic design roof snow load based on various factors such as roof geometry, exposure conditions, insulation levels, building heating, adjacent structures, etc. In many cases, portions of a roof structure may be susceptible to drifting or sliding snow loads in excess of the minimum basic design snow load. Correct implementation of current code requirements in addition to improved communication between design professionals, contractors and building officials will reduce the number of future structural failures.
Introduction

The Spokane Chapter of the Structural Engineers Association of Washington formed an ad hoc committee to study the structural failures resulting from the extreme weather event the Inland Northwest experienced during the December 2008-January 2009 period.

During the winter of 2008-2009, the Spokane/Coeur d'Alene area experienced record setting snowfalls. The majority of the snowfalls occurred from December 12, 2008 through January 6, 2009. A considerable amount of snow accumulated in a short time period without any intermittent warmer temperatures that would normally result in a melt-off. This somewhat unusual pattern of consecutive snowfalls caused heavy ground and roof snow loads which resulted in an unusual number of roof failures. These failures varied from minor to total.

During late December and early January, most of the structural engineering firms in the region responded to requests from building owners to assess either the structural capacity of their roofs or snow-related damage and/or collapse of their buildings. The committee solicited input from these firms to determine the location of damaged structures, date of damage and/or collapse, in situ snow measurements, approximate building age, structural framing system, roof slope, approximate building size, and any conclusions they may have drawn. The local firms were very cooperative and a database was developed.

We also received the cooperation of local building departments which provided us with lists of properties that reportedly had snow-related damage and/or collapses. Where there was sufficient information, these were added to the database.

The committee’s goal is to learn from the observed failures and determine how future occurrences might be prevented. Furthermore, this report summarizes actual snow loads based on available recorded data and makes recommendations concerning the appropriateness of the current design roof snow loads required for building design. This study is limited to the geographical region of Spokane County, WA and Kootenai County, ID.

The hope is that the information from this study will be useful not only to architects and engineers, but also to building owners and building officials. Conclusions drawn from this study are general in nature. A detailed analysis of the specific mechanism for each failure is beyond the scope of this study.
Current Design Criteria

The states of Washington and Idaho have both adopted the 2006 International Building Code (2006 IBC). The 2006 IBC has numerous provisions related to snow loads, and addresses issues such as ground snow versus roof snow, drifting and sliding snow, and unbalanced snow loading. Snow provisions of this type were first introduced in the 1988 Uniform Building Code. Many building officials also allow the use of the following documents as a basis for determining ground snow loads:

2. *Ground and Roof Snow Loads in Idaho*, 1986, Sack and Sheikh-Taheri

The International Building Code makes a distinction between ground snow load and roof snow load. Ground snow load is defined as the weight of snow on the ground surface. The roof snow load is the weight of snow on the roof surface and is a function of:

- The ground snow load
- The structure’s exposure to wind (Sheltered structures retain more roof snow than structures in open fields)
- The thermal characteristics of the roof (Well insulated and ventilated roofs retain more snow than poorly insulated, poorly ventilated roofs)
- The slope of the roof (Steeper roofs shed snow more easily than flatter roofs)
- The texture of the roof surface (Metal roofs shed snow more easily than shingled roofs)
- Drifted/sliding snow potential at roof offsets and vertical projections

Thus, two buildings on the same block can have different roof snow loads based on the factors listed above.

The cities of Spokane and Spokane Valley currently require a minimum basic design roof snow load of 30 pounds per square foot (psf). Coeur d’Alene, Idaho requires a minimum basic design roof snow load of 40 psf. Kootenai County provides a snow load map on their website based on the reference by Sack and Sheikh-Taheri.

Weather History

The city of Spokane receives an average of 48” of snow per winter, while in Coeur d’Alene the average is 67”. The winter of 2008-2009 had the highest recorded snowfall for Spokane at 97.7”. Table 1 shows the seasonal snowfall records for Spokane.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Winter</th>
<th>Total Snowfall (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2008-2009</td>
<td>97.7”</td>
</tr>
<tr>
<td>2</td>
<td>1949-1950</td>
<td>93.5”</td>
</tr>
<tr>
<td>3</td>
<td>2007-2008</td>
<td>92.6”</td>
</tr>
<tr>
<td>4</td>
<td>1974-1975</td>
<td>89.0”</td>
</tr>
<tr>
<td>5</td>
<td>1992-1993</td>
<td>87.3”</td>
</tr>
</tbody>
</table>


What made the 2008-2009 Winter unique was that most of the snow fell during a 3-1/2-week period from December 12, 2008 to January 6, 2009.
During the first half of December 2008, the weather was relatively mild with minimal precipitation, but the weather pattern changed dramatically on December 11 as very cold arctic air moved into the area. Initially, this arctic front only brought a few inches of snow to Spokane, but points north and east of the city received nearly a foot. The temperatures remained extremely cold, with highs in the single digits and teens.

The first of the series of snowstorms occurred on December 17 and 18. The two-day storm accumulation was more than 23" with 19.4" of snow recorded in a 24 hour period at Spokane International Airport (SIA). Prior to this the 24-hour snowfall record in Spokane was 13", set in 1950. Additional storms occurred on December 21, 22, 24, 27 and 29 with several other days of minimal snowfall. As a result, December 2008 became the snowiest December on record with 61.5". The previous record was 42.7" set in 1996. In addition, strong winds gusting to 50 mph occurred on December 29, which caused considerable drifting.

In January 2009, more storms occurred during the beginning of the month with significant snowfall during the first week of January. On January 6, 2009, the weather pattern changed leading to warmer, drier conditions, thus marking the end of the severe snow event.

Figure 1 shows the ground snow that was recorded at five stations during the 3½ week period. For this same period Table 2 shows the cumulative depth of ground snow, water equivalency and load equivalent along with required minimum basic design roof snow load for these same areas. Note that the actual ground snow load equivalents are consistently less than the minimum basic design roof snow loads.

**Figure 1.** Accumulated Ground Snow Load

![WINTER 2008/2009 GROUND SNOW LOAD](image-url)
Table 2. Comparison of Actual and Design Snow Loads for Local Areas

<table>
<thead>
<tr>
<th>Location</th>
<th>Ground Snowfall (in)</th>
<th>Water Equivalent (in)</th>
<th>Ground Load Equivalent (psf)</th>
<th>Minimum Basic Design Roof Snow Load (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spokane International Airport (SIA)</td>
<td>77.8</td>
<td>4.73</td>
<td>24.6</td>
<td>30</td>
</tr>
<tr>
<td>Deer Park</td>
<td>-</td>
<td>5.66</td>
<td>29.4</td>
<td>40</td>
</tr>
<tr>
<td>Felts Field</td>
<td>-</td>
<td>4.48</td>
<td>23.3</td>
<td>30</td>
</tr>
<tr>
<td>Airway Heights Weather Forecast Office (WFO)</td>
<td>-</td>
<td>4.49</td>
<td>23.3</td>
<td>30</td>
</tr>
<tr>
<td>Coeur d’ Alene</td>
<td>-</td>
<td>6.81</td>
<td>35.4</td>
<td>40</td>
</tr>
</tbody>
</table>

References: National Weather Service - Records of River and Climatological Observations

In addition to the official measurements shown in Table 2, snow depths and weights were also collected and reported at many other locations, though careful measuring techniques were not always used by well-intentioned owners and occupants. In Spokane County, measured roof snow weights were reported between 22 psf and 34 psf. In Kootenai County reported values ranged between 31 and 40 psf. Measured snow weights exceeding the current minimum basic roof snow load may very well have occurred in drifted snow areas.

**Basis of Evaluations**

For the purpose of this report, a distinction is made between Primary Structures and Secondary Structures. Primary Structures are defined as buildings, including barns and open structures such as riding arenas. Secondary Structures are structures such as detached garages, awnings, storage sheds, and carports. In general, failures of Primary Structures pose the greater danger to public health, safety and welfare.

What constitutes a structural failure? The term “structural failure” refers to the loss of the load-carrying capacity of a component or member within a structure, or of the structure itself. Structural failure is initiated when a member or its connection is stressed to its strength limit, thus causing fracture or excessive deformation. Beyond the strength limit, the load-bearing capacity is permanently reduced and excessive member deflection and/or collapse can occur suddenly.

Structural failures might include separated connections, broken, cracked or split members, and buckled columns or compression members. Collapsed members are generally replaced while sagging members can be repaired or replaced. Only members which required replacement or repair are considered to have experienced a structural failure.
As members are loaded in their elastic range, they deflect much like a spring. If the loads are removed, the members return to their original position. It was not uncommon for deflecting members to result in cracked interior drywall, or “sticky” doors and windows. As the snow melted, most members returned to their original position. Because no repair or replacement of the roof members was necessary, these instances do not constitute a structural failure.

**Observations**

Data were collected and inventoried for 108 structures in Spokane and Kootenai counties. These structures were reviewed by structural engineering firms in the area or were reported to local building departments. Not all sites were visited by structural engineers, and not all damaged structures were available for viewing. In several instances, repair or demolition was under way soon after the damage or failure occurred.

Of these 108 structures, 95 were noted as sustaining some form of structural failure resulting from the snow event. The remaining 13 structures inventoried exhibited roof deflections sufficient to cause concern for occupants, or were structures visited as a preventative measure at the direction of building owners.

It is important to note that most of the structural failures occurred prior to the roofs receiving the city or county required minimum basic roof snow load, thus other factors led to these failures. Therefore, properly designed and constructed structures in good condition should have been adequate to resist the loading from the 2008-2009 snow event.
Structural Systems

The 95 failures evaluated for this report included a broad array of structure types and building ages. The collected data are found in the Appendix and are categorized in Table 3.

Table 3. Summary of Reported/Observed Structural Failure Types

<table>
<thead>
<tr>
<th>Type of Structure</th>
<th>Number of Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Structures</strong></td>
<td></td>
</tr>
<tr>
<td>Plate Connector Wood Trusses</td>
<td>24</td>
</tr>
<tr>
<td>Heavy Timber Trusses with Purlins</td>
<td>15</td>
</tr>
<tr>
<td>Beam and Joist Framing</td>
<td>13</td>
</tr>
<tr>
<td>Agricultural Pole Buildings</td>
<td>3</td>
</tr>
<tr>
<td>Other Wood Framed Structures</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Wood Framed Structures</strong></td>
<td>57</td>
</tr>
<tr>
<td>Pre-Engineered Steel Structures</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total Primary Structures</strong></td>
<td>68</td>
</tr>
<tr>
<td><strong>Secondary Structures</strong></td>
<td></td>
</tr>
<tr>
<td>Carports and Canopies</td>
<td>15</td>
</tr>
<tr>
<td>Residential Garages</td>
<td>9</td>
</tr>
<tr>
<td>Sheds/Utility Buildings</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Secondary Structures</strong></td>
<td>27</td>
</tr>
<tr>
<td><strong>Total Reported/Observed Failures</strong></td>
<td>95</td>
</tr>
</tbody>
</table>

As shown in Table 3, there were a variety of structural systems that experiences failures. The committee has made the following observations of the various structural systems:
• **Plate Connector Wood Truss Structures**

Plate connector wood truss structures represented the single most prevalent system exhibiting failures during the 2008-2009 snow event. The 24 reported failures for this building type constitute 35% of the 68 primary structure failures evaluated. Failures included member fractures and joint failures, as well as lateral buckling type failures resulting from improper installation of stability bracing. At several of the failure sites, it appeared that the failure of a single truss resulted in load being transferred to the adjacent trusses. These trusses then become overloaded and the failure propagated along the roof line. These failures are often sudden and provide occupants with little or no advanced warning to vacate the structure.

![Photo 5: Failed Trusses at Retail Building](image)

![Photo 6: Failed Trusses Over Indoor Pool](image)

![Photo 7: Failed Bowstring Truss Heel Connection](image)

• **Heavy Timber Truss Construction**

Fifteen (15) failures evaluated were of heavy timber truss construction with sawn-lumber purlins spanning between the trusses. This represents 22% of the primary structure failures observed. Observed failures were primarily caused by broken or split truss members and/or failure of truss connections.

These types of structures were very common in the 1930’s through the 1960’s, but are not common in more contemporary structures. The number of structures of this type has diminished over time, and their...
numbers will continue to decrease as they reach the end of their useful life. All of the heavy timber truss failures evaluated from the 2008-2009 snow event were older buildings; 40 to 100 years old.

At least two of the buildings had been renovated in recent years to provide better insulation and ventilation of the attic space. The better-insulated roofs resulted in less snow melt from interior heat transmission, and consequently more snow was retained on the roof than in previous winters.

- **Wood Beam and Joist Framing Systems**

  Failures in wood beam and joist framing systems were also a significant portion of the total evaluated. Thirteen (13) such wood framing systems were evaluated representing 19% of the primary structure failures, with a wide variety of configurations and modes of failure. Several appear to have failed due to a single weak point, such as a knot or split in a sawn lumber component, or an inadequate ledger connection.

  The majority of the wood beam and joist framing systems were low-slope roofs, most having slopes of ¼” per foot or less. These roofs are more susceptible to drainage and ponding issues.

- **Steel Framed Structures**

  As indicated in Table 3, conventional steel framed structures generally performed well during the 2008-2009 snow event. An exception to this performance record is pre-engineered steel structures, 11 of which exhibited failures.
Pre-engineered steel structures are designed by the supplier. Most often, they employ rigid moment-resisting frames with cold rolled steel roof purlins and wall girts. Bracing of column and beam flanges is often critical in order for the structure to support the design loads. Flange bracing was observed missing on three of the structural failures and had presumably either not been installed or had been removed at some point.

- **Secondary Structures**

Secondary structures evaluated were of both wood and metal construction. Carports were typically steel framed or aluminum framed; garages most often wood framed. Most of the secondary structures were estimated to be between 30 and 50 years old, although 3 of the carport structures were reported to be only a few years old.

- **Flat or Low-Slope Roofs**

Flat or low-slope roofs (1/4” per foot or less) constituted 47% of the 68 primary structure failures evaluated. The observed failure mechanisms included member overstreess, connection failure and ledger failure. Evidence of inadequate drainage was also observed.

Low slope roofs do not always drain properly with heavy snow loads. Under normal conditions, rainwater or snow-melt flows to the low spot in the roof, where drains are located. Heavy snow loads can cause the joists to deflect to
the extent that the middle of the joist becomes the low spot, thus collecting water away from a drain. As water collects at this location it results in increased load on the joist, which in turn results in further joist deflection. This increased deflection allows for collection of more water becoming a vicious cycle until the joist becomes overstressed and fails. This phenomenon is known as “ponding” and it is an issue specific to low-slope roofs.

**Building Age**

The 95 primary and secondary failures evaluated for this report were categorized into three age groups: 0-19 years old, 20-39 years old, and 40 and older as shown in Table 4. The ages of several of the structures were estimated as the exact age was unknown.

<table>
<thead>
<tr>
<th>Age</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-19 years old</td>
<td>8</td>
<td>9%</td>
</tr>
<tr>
<td>20-39 years old</td>
<td>46</td>
<td>48%</td>
</tr>
<tr>
<td>40 years and older</td>
<td>41</td>
<td>43%</td>
</tr>
<tr>
<td><strong>Total Number of Failures Evaluated</strong></td>
<td><strong>95</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

The majority of failures occurred in structures over 20 years old. Recent building codes have more adequately provided design provisions for snow drifting, sliding and unbalanced loading conditions.

Older buildings are also more likely to have been modified during their service life. Modifications might include the application of additional layers of roofing materials, the addition of equipment loads, and non-engineered alterations of structural members or bracing. Added loads, whether they are roofing, equipment, or otherwise, diminish the structural capacity remaining for snow loads.

Over time, wood members are susceptible to creep, shrinkage and checking. Defects such as knots often become more brittle when subjected to seasonal moisture and thermal cycles.

Older building codes did not require as much site inspection and testing as current codes. This may have allowed more construction errors or omissions to go unnoticed. The purpose for the current level of inspection and testing is to insure that the quality, workmanship and material properties meet the designer’s intent.

**Recommendations**

Based on evaluation of the data gathered, the Ad-Hoc Committee of the Spokane Chapter of Structural Engineers Association of Washington recommends retaining minimum design roof snow loads currently adopted by jurisdictions in the Spokane and Coeur d’Alene area. The committee encourages improved communication among design professionals, building officials/inspectors, and contractors to ensure that the built structure conforms to the design intent. It is the duty of the design professional to correctly implement the code design provisions for the building type and location. For structures constructed without design professional involvement, this responsibility rests with the permit-issuing government agency.
Specific recommendations are as follows:

- **Plate Connector Wood Truss Structures**
  Plate connector wood trusses are an efficient and common component of roof structures in contemporary construction. They are typically designed by the truss supplier for prescribed roof snow loads. Bracing of these truss framing systems must also be properly designed and installed. To achieve the design performance required, manufacturing, delivery, installation, and inspection must follow the IBC 2006 and the current Truss Plate Institute recommendations.

- **Heavy Timber Truss Construction**
  The structural design community is aware of the poor historical performance of this type of structure and its potential for sudden collapse. Recent codes have also recognized that unbalanced snow loads can cause stress reversals in web members and have provided design provisions to address this issue. Properly renovated and strengthened, heavy timber trusses can provide safe and stable continued use.

- **Wood Beam and Joist Framing Systems**
  The committee recommends that care is taken by the design professional to account for any low-slope areas where ponding could occur.

- **Steel Framed Structures**
  Of steel framed structures, pre-engineered buildings were the most problematic. Current methods of design, manufacturing, permitting, installation, and inspection should be reviewed. Inadequate bracing resulted in a number of the failures observed during the snow event. Better communication between all parties would result in a better performing structure.

- **Secondary Structures**
  Many of the failed wood-framed secondary structures observed were likely not designed. Of these structures, most were garages or outbuildings, and most were more than 20 years old. For structures of this nature, not required to be designed by a design professional, proper inspection is paramount to insure that good construction practices are being incorporated.

  Metal framed carports with long cantilevered roof decks did not perform well. Proper design, considering unbalanced loads will reduce the number of future failures.

- **Flat or Low-Slope Roofs**
  For new buildings, designers should give serious consideration to increasing roof slopes to 3/8” per foot or more to avoid ponding.

  It is imperative in a low-slope roof to keep roof drains cleared and unobstructed. Unfortunately, this is often overlooked by building owners and the buildup of ice, snow, or debris around a drain can prevent the roof from draining properly.
• *Miscellaneous*
  Some of the failures observed were due to additions or changes in roof geometry resulting in additional loads due to drifting and sliding snow. Proper evaluation of affected existing structures could reduce the number of structures that perform unsatisfactorily.

Any repair to a damaged member must be designed to meet the requirements of the current building code. It should be noted that in a well-designed system, a localized failure should not cause immediate or progressive collapse of the entire structure.
APPENDIX
<table>
<thead>
<tr>
<th>#</th>
<th>Building Name</th>
<th>Street Address</th>
<th>City</th>
<th>State</th>
<th>Date of Collapse</th>
<th>Age of Building (years)</th>
<th>Structural System</th>
<th>Roof Slope (in/ft)</th>
<th>Measured Roof Snow at Time of Collapse (psf)</th>
<th>Approx. Building Size (LxW)</th>
<th>Is Engineering Report Available?</th>
<th>Is roof ponding suspected (yes/no)?</th>
<th>Was snow drifting observed (yes/no)?</th>
<th>Conclusions on Failure Mechanism</th>
<th>General Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Distribution center</td>
<td>Coeur d'Alene</td>
<td>ID</td>
<td>Jan 2, 2009</td>
<td>10</td>
<td>Open-web steel joists and joist girders</td>
<td>1/4'</td>
<td>40 psf measured 1/2/09</td>
<td>221'x226'</td>
<td>Yes, Coffman Engineers</td>
<td>no</td>
<td>no</td>
<td>No failure occurred other than non-structural gyp walls with cracks</td>
<td>Building was evacuated while snow was removed, reoccupied after snow removal, no structural failures occurred</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Federal courthouse</td>
<td>Coeur d'Alene</td>
<td>ID</td>
<td>Jan 2, 2009</td>
<td>1</td>
<td>Steel beams with metal deck</td>
<td>1/4'</td>
<td>40 psf measured 1/2/09</td>
<td>180'x160'</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>No failure occurred</td>
<td>Snow was removed from roof</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ice rink</td>
<td>Coeur d'Alene</td>
<td>ID</td>
<td>12/29/2008 &amp; 1/2/2009</td>
<td>--</td>
<td>Rigid wood frames w/ 2x purlins</td>
<td>0.133</td>
<td>not measured</td>
<td>110x191</td>
<td>Yes, Coffman Engineers</td>
<td>No</td>
<td>No</td>
<td>Frame failure at center splice connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Barn</td>
<td>Deer Park</td>
<td>WA</td>
<td>late Dec 2008</td>
<td>1</td>
<td>Pre-engineered steel building</td>
<td>1/12</td>
<td>35 psf (approx)</td>
<td>150'x300'</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No failure</td>
<td>Total Bldg Collapse - Due to form exclusion in permitting improper design was not checked.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Horse Arena</td>
<td>Deer Park</td>
<td>WA</td>
<td>late Dec 2008</td>
<td>4</td>
<td>Fabric Covered Frames</td>
<td>-</td>
<td>15 psf (approx)</td>
<td>80x150'</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No failure</td>
<td>Total Bldg Collapse - Due to form exclusion in permitting improper design was not checked.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Medical Center</td>
<td>Downtown</td>
<td>Spokane</td>
<td>late Dec 2008/early Jan 2009</td>
<td>Various</td>
<td>Steel joists and concrete pan joists</td>
<td>1/4'</td>
<td>30 psf</td>
<td>Varies</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Slightly around mech units</td>
<td>No failure</td>
<td>Steel framed and concrete roofs were performing well with 30 psf load.</td>
</tr>
<tr>
<td>7</td>
<td>Retail store</td>
<td>Downtown</td>
<td>Spokane</td>
<td>Jan 2, 2009</td>
<td>--</td>
<td>Parallel chord press-plate wood trusses</td>
<td>25:12</td>
<td>not measured</td>
<td>40x86</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>One truss failed, causing <code>zipper</code> effect.</td>
<td>CMU suffered significant damage as it was ungrouted/unreinforced</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Office building</td>
<td>Downtown</td>
<td>Spokane</td>
<td>late Dec 2008/early Jan 2009</td>
<td>--</td>
<td>Steel trusses and columns, wood 6x14 purlins</td>
<td>1/4'</td>
<td>not measured</td>
<td>30 psf - measured</td>
<td>12000 sf</td>
<td>No</td>
<td>No</td>
<td>No failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>School</td>
<td>East Central</td>
<td>Spokane</td>
<td>late Dec 2008/early Jan 2009</td>
<td>--</td>
<td>Steel trusses and columns, wood 6x14 purlins</td>
<td>1/4'</td>
<td>not measured</td>
<td>12000 sf</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Warehouse</td>
<td>Fairchild AFB</td>
<td>WA</td>
<td>Jan 2, 2009</td>
<td>57</td>
<td>Steel trusses and columns, wood 6x14 purlins</td>
<td>1/4'</td>
<td>23 psf measured 1/2/09</td>
<td>200x300'</td>
<td>Yes, Coffman Engineers</td>
<td>no</td>
<td>no</td>
<td>Existing purlins failed under snow load</td>
<td>Purlins repaired by adding steel channels each side</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Warehouse</td>
<td>Fairchild AFB</td>
<td>WA</td>
<td>Jan 2, 2009</td>
<td>67</td>
<td>Heavy-timber wood trusses with 2x12 purlins</td>
<td>1/4'</td>
<td>not measured, approx 25' depth based on verbal reports</td>
<td>160'x180'</td>
<td>Yes, Coffman Engineers</td>
<td>no</td>
<td>no</td>
<td>Existing wood trusses failed near the bottom chord splice locations where split ring connectors were used. During WWII, many large warehouse buildings such as this one were erected quickly using green timber trusses that subsequently dried and had bolted splice connections that shrank and split the wood in cross-grain tension, weakening the connection. The bottom chord members were also underestimated based on an overestimation of the allowable tensile stress of the wood, causing failures of the bottom chord under less than the design snow loading.</td>
<td>Repairs were made by adding high-strength steel tension rods to each side of the bottom chords of the failed trusses.</td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>Building Name</td>
<td>Street Address</td>
<td>City</td>
<td>State</td>
<td>Date of Collapse</td>
<td>Age of Building (years)</td>
<td>Structural System</td>
<td>Roof Slope (in/ft)</td>
<td>Measured Roof Snow at Time of Collapse (psf)</td>
<td>Approx. Building Size (LxW)</td>
<td>Is Engineering Report Available? (yes/no)</td>
<td>Is roof ponding suspected (yes/no)?</td>
<td>Was snow drifting observed (yes/no)?</td>
<td>Conclusions on Failure Mechanism</td>
<td>General Comments</td>
</tr>
<tr>
<td>-----</td>
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<td>------------------------------------------------</td>
</tr>
<tr>
<td>12</td>
<td>Warehouse</td>
<td>Fairchild AFB</td>
<td>Fairchild AFB</td>
<td>WA</td>
<td>Jan 3, 2009</td>
<td>58</td>
<td>Heavy-timber wood trusses with 2x10 purlins</td>
<td>1/4&quot;/ft.</td>
<td>31 psf</td>
<td>200'x192'</td>
<td>Yes, Coffman Engineers</td>
<td>no</td>
<td>no</td>
<td>Yes no</td>
<td>Existing wood trusses failed near the bottom chord splice locations where split ring connectors were used. During WWII, many large warehouse buildings such as this one were erected quickly using green timber trusses that subsequently dried and had bolted splice connections that shrank and split the wood in cross-grain tension, weakening the connection. The bottom chord members were also undersized based on an overestimation of the allowable tensile stress of the wood, causing failures of the bottom chord under less than the design snow loading. Repairs are to be made by adding high-strength steel tension rods to each side of the bottom chords of the failed trusses.</td>
</tr>
<tr>
<td>13</td>
<td>Warehouse</td>
<td>North Spokane County</td>
<td>Spokane</td>
<td>WA</td>
<td>late Dec 2008</td>
<td>40</td>
<td>2x6 rafters with heavy timber trusses at 10 feet on center</td>
<td>1/4&quot;/ft.</td>
<td>snow had been removed</td>
<td>36'x50'</td>
<td>Yes, Coffman Engineers</td>
<td>no</td>
<td>snow had been removed NO</td>
<td>Failure of tension chord of heavy timber truss</td>
<td>Poor design of heavy timber truss</td>
</tr>
<tr>
<td>14</td>
<td>Schools</td>
<td>North Spokane County</td>
<td>Spokane</td>
<td>WA</td>
<td>late Dec 2008/early Jan 2009</td>
<td>Various</td>
<td>Steel bar joists</td>
<td>1/4&quot;/ft.</td>
<td>32 psf</td>
<td>Varies</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Poor quality in construction of trusses.</td>
</tr>
<tr>
<td>15</td>
<td>Athletic club</td>
<td>Sandpoint</td>
<td>Sandpoint</td>
<td>WA</td>
<td>late Dec 2008</td>
<td>25</td>
<td>Wood plate-stained trusses at 24 feet on center</td>
<td>3/12</td>
<td>30 psf (approx)</td>
<td>70'x100'</td>
<td>Yes, Coffman Engineers</td>
<td>No</td>
<td>No</td>
<td>Trusses were failing at pressed plates; large vertical deflection.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Retail store</td>
<td>South Hill</td>
<td>Spokane</td>
<td>WA</td>
<td>late Dec 2008</td>
<td>30</td>
<td>Pre-engineered wood trusses, parallel chord</td>
<td>1/4&quot;/ft.</td>
<td>26' high, approx 30 psf</td>
<td>30'x100'</td>
<td>Yes, Coffman Engineers</td>
<td>No</td>
<td>no</td>
<td>Some trusses supporting a mech unit had bottom chords that completely broke (gross tension failure), most likely due to the combined weight of snow and the mechanical unit. Trusses may not have been designed for the mech. Unit + snow loading.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Warehouse</td>
<td>Spokane</td>
<td>Spokane</td>
<td>WA</td>
<td>late Dec 2008</td>
<td>25</td>
<td>Pre-engineered steel building</td>
<td>1/12</td>
<td>30 psf (approx)</td>
<td>70'x200'</td>
<td>Yes, Coffman Engineers</td>
<td>No</td>
<td>No</td>
<td>Improper snow load design.</td>
<td>Poor design of snow load.</td>
</tr>
<tr>
<td>19</td>
<td>Warehouse (730 N. Hamilton)?</td>
<td>Spokane</td>
<td>Spokane</td>
<td>WA</td>
<td>late Dec 2008/early Jan 2009</td>
<td>--</td>
<td>Bowstring trusses on cmu shear/bearing walls</td>
<td>not measured</td>
<td>unbalanced snow load was observed</td>
<td>80'x180'</td>
<td>Yes, Coffman Engineers</td>
<td>no</td>
<td>no</td>
<td>Many bowstring truss issues under-designed elements and consideration of uniform load only coupled with sliding snow that created severe unbalanced snow load condition. Most trusses showed signs of damage, some severe. Widespread cracking prompted use of repair concept on all trusses as a strengthening measure to upgrade the building. Facility has been well-maintained.</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Warehouse</td>
<td>Spokane Valley</td>
<td>Spokane</td>
<td>WA</td>
<td>Jan 2, 2009</td>
<td>55</td>
<td>2x6 rafters with glulam beams at 20 ft on center</td>
<td>1/4&quot;/ft.</td>
<td>snow had been removed</td>
<td>90'x120'</td>
<td>Yes, Coffman Engineers</td>
<td>yes</td>
<td>no</td>
<td>Failure of two glulam beams due to severe ponding at reflective roof drain</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Warehouse</td>
<td>Spokane Valley</td>
<td>Spokane</td>
<td>WA</td>
<td>late Dec 2008/early Jan 2009</td>
<td>65</td>
<td>3x12 rafters with bowstring trusses at 20 feet on center</td>
<td>--</td>
<td>snow had been removed</td>
<td>70'x200'</td>
<td>No</td>
<td>no</td>
<td>no</td>
<td>Failure of tension chord of bowstring truss</td>
<td>Bowstring truss failure due to snow drift.</td>
</tr>
<tr>
<td>#</td>
<td>Building Name</td>
<td>Street Address</td>
<td>City</td>
<td>State</td>
<td>Date of Collapse</td>
<td>Age of Building (years)</td>
<td>Structural System</td>
<td>Roof Slope (in/ft)</td>
<td>Measured Roof Snow at Time of Collapse (psf)</td>
<td>Approx. Building Size (LxW)</td>
<td>Is Engineering Report Available?</td>
<td>Is roof ponding suspected?</td>
<td>Was snow drifting observed? (yes/no)</td>
<td>Conclusions on Failure Mechanism</td>
<td>General Comments</td>
</tr>
<tr>
<td>-----</td>
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<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>24</td>
<td>Exhibition building</td>
<td>Spokane Valley</td>
<td>Spokane</td>
<td>WA</td>
<td>late Dec 2008</td>
<td>~30</td>
<td>Pre-engineered steel trusses, parallel chord</td>
<td>0.175</td>
<td>not measured; approx 50 psf</td>
<td>24'x114'</td>
<td>No</td>
<td>no</td>
<td>Not observed, but sliding snow may have occurred</td>
<td>Sliding snow from upper roof collected on eave of lean-to structure precipitating failure of the lean-to.</td>
<td>Rebuild underway - See also #77</td>
</tr>
<tr>
<td>25</td>
<td>Retail store</td>
<td>Spokane Valley</td>
<td>Spokane</td>
<td>WA</td>
<td>late Dec 2008/early Jan 2009</td>
<td>40</td>
<td>TJI's spanning to interior steel framing lines and exterior CMU</td>
<td>25.12</td>
<td>22 psf on adjoining roof on date of first collapse</td>
<td>100x60</td>
<td>Yes, Coffman Engineers</td>
<td>No</td>
<td>Yes - on adjacent roof</td>
<td>TJI’s appeared to be the first member to fail</td>
<td>Potential reroof with ballast</td>
</tr>
<tr>
<td>26</td>
<td>Storage</td>
<td>Spokane Valley</td>
<td>Spokane</td>
<td>WA</td>
<td>late Dec 2008/early Jan 2009</td>
<td>–</td>
<td>Pre-engineered metal bidg with multiple additions</td>
<td>0.1333</td>
<td>Not measured</td>
<td>Dd shaped - includes approx 80,000sf</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Multiple areas of failure - purlins in two locations, rigid frames in another</td>
<td>Excessive deflection in purlins appeared to cause ponding</td>
</tr>
<tr>
<td>27</td>
<td>School</td>
<td>Spokane Valley</td>
<td>Spokane</td>
<td>WA</td>
<td>late Dec 2008/early Jan 2009</td>
<td>–</td>
<td>Varied</td>
<td>Varied</td>
<td>Varies</td>
<td>Yes, Coffman Engineers</td>
<td>No</td>
<td>No</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Fairchild AFB</td>
<td>38815</td>
<td>Spokane</td>
<td>WA</td>
<td>39815</td>
<td>52</td>
<td>Steel trusses and columns, wood 6x14 purlins</td>
<td>1/4'ft.</td>
<td>not measured; approx 25' depth based on verbal reports</td>
<td>200'x300'</td>
<td>Yes, Coffman Engineers</td>
<td>no</td>
<td>no</td>
<td>Some existing wood 6x14 purlins split due to snow load</td>
<td>Roof snow removed and purlins repaired using steel channels both sides</td>
</tr>
<tr>
<td>32</td>
<td>The Village on Broadway</td>
<td>12623 E Broadway</td>
<td>Spokane Valley</td>
<td>WA</td>
<td>12/28/2008</td>
<td>20</td>
<td>Carport with corrugated metal roof, cold-formed purlins and cantilevered columns</td>
<td>0.25</td>
<td>18'x12'</td>
<td>Baja Construction</td>
<td>no</td>
<td>no</td>
<td>Roof deck buckling at supports and mid-span and excessive deflections</td>
<td>1 1/2&quot; decked&quot; cantilevers+10&quot; span on 10&quot;x2 1/4&quot; purlins with cantilever 1 column bents</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>River Rock Apartments</td>
<td>12721 E Shannon</td>
<td>Spokane Valley</td>
<td>WA</td>
<td>12/29/2008</td>
<td>1</td>
<td>Carport with corrugated metal roof, cold-formed purlins and wood columns</td>
<td>0.25</td>
<td>18x96'</td>
<td>Wyatt Architects</td>
<td>no</td>
<td>yes</td>
<td>Roof deck buckling at supports and mid-span and excessive deflections</td>
<td>1 1/2&quot; decked&quot; cantilevers+10&quot; span on 10&quot;x3 1/4&quot; purlins with two wood column bents</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Value Village</td>
<td>13112 E Sprague</td>
<td>Spokane Valley</td>
<td>WA</td>
<td>12/31/2008</td>
<td>50</td>
<td>Truss and pressed plate trusses on glulam beams on cmu walls</td>
<td>0.25</td>
<td>120'x140'</td>
<td>Arch</td>
<td>Yes, 425-462-915</td>
<td>no</td>
<td>Leaks. No sagging</td>
<td>Declared safe by engineer</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Vacant Space</td>
<td>13118 E Sprague</td>
<td>Spokane Valley</td>
<td>WA</td>
<td>12/31/2008</td>
<td>30</td>
<td>Carport with corrugated metal roof, cold-formed purlins and cantilevered columns</td>
<td>0.25</td>
<td>120'x120'</td>
<td>Arch</td>
<td>Yes, 425-462-915</td>
<td>no</td>
<td>Leaks. No sagging</td>
<td>Declared safe by engineer</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Motion Auto Supply</td>
<td>13124 E Sprague</td>
<td>Spokane Valley</td>
<td>WA</td>
<td>12/31/2008</td>
<td>30</td>
<td>Carport with corrugated metal roof, cold-formed purlins and cantilevered columns</td>
<td>0.25</td>
<td>120'x120'</td>
<td>Arch</td>
<td>Yes, 425-462-915</td>
<td>no</td>
<td>Leaks. No sagging</td>
<td>Declared safe by engineer</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Dollar Tree</td>
<td>10520 E Sprague</td>
<td>Spokane Valley</td>
<td>WA</td>
<td>12/27/2008</td>
<td></td>
<td>Carport with corrugated metal roof, cold-formed purlins and cantilevered columns</td>
<td>0.25</td>
<td>120'x120'</td>
<td>Arch</td>
<td>Yes, 425-462-915</td>
<td>no</td>
<td>Leaks. No sagging</td>
<td>Declared safe by engineer</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Fred Meyer</td>
<td>15609 E Sprague</td>
<td>Spokane Valley</td>
<td>WA</td>
<td>12/21/2008</td>
<td></td>
<td>Carport with corrugated metal roof, cold-formed purlins and cantilevered columns</td>
<td>0.25</td>
<td>120'x120'</td>
<td>Arch</td>
<td>Yes, 425-462-915</td>
<td>no</td>
<td>Leaks. No sagging</td>
<td>Declared safe by engineer</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Eagle Rock Apartments</td>
<td>2410 N Cherry</td>
<td>Spokane Valley</td>
<td>WA</td>
<td>12/29/2008</td>
<td>9</td>
<td>Carport with corrugated metal roof, cold-formed purlins and cantilevered columns</td>
<td>0.25</td>
<td>18x18'-72'</td>
<td>Baja Construction</td>
<td>yes</td>
<td>no</td>
<td>Roof deck buckling at supports and mid-span and excessive deflections</td>
<td>1 1/2&quot; decked&quot; cantilevers+10&quot; span on 10&quot;x2 1/4&quot; purlins with cantilever 1 column bents</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Mieleke Muffler</td>
<td>323 N Pines</td>
<td>Spokane Valley</td>
<td>WA</td>
<td>1/5/2009</td>
<td>10</td>
<td>Pressed plate trusses supported on glulam beams and CMU walls</td>
<td>0.25</td>
<td>40'x220'</td>
<td>Third Ave Properties, Green Ridge Fund?</td>
<td>no</td>
<td>no</td>
<td>Excessive deflection, cracked gypsum</td>
<td>Restored after shovelling</td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>Building Name</td>
<td>Street Address</td>
<td>City</td>
<td>State</td>
<td>Date of Collapse (years)</td>
<td>Age of Building (years)</td>
<td>Structural System</td>
<td>Roof Slope (in%)</td>
<td>Measured Roof Snow at Time of Collapse (psf)</td>
<td>Approx. Building Size LxW</td>
<td>Is Engineering Report Available? (yes/no)?</td>
<td>Is roof ponding suspected (yes/no)?</td>
<td>Was snow drifting observed (yes/no)?</td>
<td>Approx. Collapse 1/10th of Building (years)</td>
<td>Conclusions on Failure Mechanism</td>
</tr>
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</tr>
<tr>
<td>43</td>
<td>Oak Club</td>
<td>726 N McDonald</td>
<td>Spokane</td>
<td>WA</td>
<td>12/29/2008</td>
<td>28</td>
<td>Carport with corrugated metal roof, cold-formed purlins and tube steel columns</td>
<td>0.25</td>
<td>18'x10'</td>
<td></td>
<td>Saja Construction no no</td>
<td>false</td>
<td>false</td>
<td>1/4'' deck&quot; cantilevers+10' span on 10''x2 1/2'' purlins with two steel column bents</td>
<td>unheated structure</td>
</tr>
<tr>
<td>44</td>
<td>American Thrift</td>
<td>1010 N. Atlantic</td>
<td>Spokane</td>
<td>WA</td>
<td>12/29/2008</td>
<td>30</td>
<td>Pressed plate trusses supported on CMU</td>
<td>4</td>
<td>33' x 100'</td>
<td>limited</td>
<td>no no</td>
<td>true</td>
<td>false</td>
<td>Truss failed possibly bottom chord</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>American Thrift</td>
<td>1010 N. Atlantic</td>
<td>Spokane</td>
<td>WA</td>
<td>12/29/2008</td>
<td>70'</td>
<td>Long span multi-ply trusses and joists</td>
<td>0</td>
<td>unknown</td>
<td>limited</td>
<td>no no</td>
<td>true</td>
<td>false</td>
<td>Unsure-possible column failure</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>Hancock Fabrics</td>
<td>1020 W Francis</td>
<td>Spokane</td>
<td>WA</td>
<td>12/31/2008</td>
<td>27</td>
<td>Pressed-plate trusses clean-spanning between wood stud bearing walls</td>
<td>0.25</td>
<td>unknown</td>
<td></td>
<td>false</td>
<td>yes</td>
<td>no</td>
<td>Possible failure of truss due to unbraced top chord</td>
<td>Partial failure of approx. 70' of building on south end</td>
</tr>
<tr>
<td>47</td>
<td>Spokane Sperthorne Riding Arena</td>
<td>10710 S. Sherman Road</td>
<td>Spokane</td>
<td>WA</td>
<td>12/5/2009</td>
<td>20</td>
<td>Pre-engineered metal building</td>
<td>3</td>
<td>216' x 122'</td>
<td></td>
<td>no no</td>
<td>no no</td>
<td>false</td>
<td>Column buckling followed by progressive collapse</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Rosauers-5 Mile</td>
<td>1724 W Francis Ave.</td>
<td>Spokane</td>
<td>WA</td>
<td>12/29/2008</td>
<td>52</td>
<td>Wood bow string trusses</td>
<td>22</td>
<td>100' x 125'</td>
<td>limited</td>
<td>no no</td>
<td>true</td>
<td>false</td>
<td>Failure of supporting column caused collapse. Added canopy also collected snow</td>
<td>Bowstring trusses, bolt pull through in bottom chord</td>
</tr>
<tr>
<td>50</td>
<td>3229 Ferry Warehouse</td>
<td>3229 E Ferry Ave.</td>
<td>Spokane</td>
<td>WA</td>
<td>1/10/2009</td>
<td>48</td>
<td>Long-span wood bow string truss supporting solid saw purlins</td>
<td>18</td>
<td>65' x 230'</td>
<td>no (yes-MKA)</td>
<td>no no</td>
<td>true</td>
<td>false</td>
<td>Failure of supporting column caused collapse. Added canopy also collected snow</td>
<td>Rickers @ truss and did not allow truss to deflect</td>
</tr>
<tr>
<td>51</td>
<td>Evergreen Parking</td>
<td>707 W 2nd</td>
<td>Spokane</td>
<td>WA</td>
<td>12/25/2008</td>
<td>approx. 50</td>
<td>Bow string trusses supporting solid saw purlins</td>
<td>Arch</td>
<td>unknown</td>
<td>yes DCI</td>
<td>no no</td>
<td>true</td>
<td>false</td>
<td>Likely tension failure in bottom chord</td>
<td>One truss out of 10 failed, others show signs of distress</td>
</tr>
<tr>
<td>52</td>
<td>Rocker Arm Supply Building, RAS Properties</td>
<td>815 N Lincoln</td>
<td>Spokane</td>
<td>WA</td>
<td>1/2/09</td>
<td>approx. 50</td>
<td>Wood post and beam, 2-story supported by URM Walls</td>
<td>6</td>
<td>67' x 75'</td>
<td>Limited Calcs, DCI no no</td>
<td>Failure of Main Roof Support Beams in (2) locations, damage to URM wall occurred</td>
<td>2 Failure of truss not centered on connections and inadequately designed for strength and deflection</td>
<td>2 Beams were made up of (5) 2 x 12's and were not sufficient for span under code loads.  Column maybe removed at some point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Mel's Nursery</td>
<td>800 N Division</td>
<td>Spokane</td>
<td>WA</td>
<td>12/12/2008</td>
<td>approx. 20</td>
<td>Pressed-plate trusses, wood stud bearing walls</td>
<td>4</td>
<td>91' x 55'</td>
<td>No, debris removed before site visit</td>
<td>no no</td>
<td>true</td>
<td>false</td>
<td>Failure of leaning carport roof ledger</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>Fishern/Mow Residence</td>
<td>1016 S Madison</td>
<td>Spokane</td>
<td>WA</td>
<td>12/22/2008</td>
<td>50</td>
<td>Conventional wood framing</td>
<td>4</td>
<td>40'x26'</td>
<td>No, debris removed before site visit</td>
<td>no no</td>
<td>true</td>
<td>false</td>
<td>Failure of leaned carport roof ledger</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>Tranny Shack</td>
<td>1401 N Division Street</td>
<td>Spokane</td>
<td>WA</td>
<td>12/26/2008</td>
<td>30</td>
<td>Pressed-plate trusses supported on glulam beams and CMU walls</td>
<td>0.5</td>
<td>144'x60'</td>
<td>Yes, Inland Northwest Engineering no no</td>
<td>Failure of pressed plates not centered on connections and inadequately designed for strength and deflection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>Ash Street Plaza</td>
<td>2223 North Ash Street</td>
<td>Spokane</td>
<td>WA</td>
<td>12/9/2008</td>
<td>30</td>
<td>Pressed-plate trusses supported on glulam beams and wood framed walls</td>
<td>0.25</td>
<td>120'x49'</td>
<td>Yes, Inland Northwest Engineering yes no</td>
<td>Failure of pressed plates not centered on connections.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>57</td>
<td>Thrifty Supply Company</td>
<td>3210 E Trent Ave</td>
<td>Spokane</td>
<td>WA</td>
<td>12/29/2008</td>
<td>30</td>
<td>Pressed-plate trusses supported on glulam beams and CMU walls</td>
<td>0.25</td>
<td>120'x180'</td>
<td>Yes, Inland Northwest Engineering no no</td>
<td>Failure of pressed plates not centered on connections.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>Williams Barn</td>
<td>8001 S Hangman Valley Road</td>
<td>Spokane</td>
<td>WA</td>
<td>12/30/2008</td>
<td>20</td>
<td>Pressed-plate trusses supported on dimensional lumber beams and wood framed walls</td>
<td>4</td>
<td>97'x68'</td>
<td>No, Debris removed before site visit no yes</td>
<td>False Failure of wood trusses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>Global Fitness</td>
<td>110 W Price Ave</td>
<td>Spokane</td>
<td>WA</td>
<td>12/30/2008</td>
<td>+/-30</td>
<td>Parallel chord, pressed plate trusses on steel beams</td>
<td>0 na</td>
<td>50x50'</td>
<td>Yes, Integrus yes no</td>
<td>Failure of leaning carport roof ledger</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Inland Empire Drywall</td>
<td>5113 E Railroad Ave</td>
<td>Spokane</td>
<td>WA</td>
<td>12/23/2008</td>
<td>50</td>
<td>Pressed plate wood trusses supported on exterior concrete walls</td>
<td>3</td>
<td>100'x50'</td>
<td>Yes, Integrus no yes</td>
<td>Failure of wood trusses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Abadan Reprographics</td>
<td>2615 4th Street</td>
<td>Coeur d'Alene</td>
<td>ID</td>
<td>Jan. 2009</td>
<td>30</td>
<td>Pressed plate wood trusses supported on wood framed walls</td>
<td>0.25</td>
<td>30 est</td>
<td>no no</td>
<td>Failure of wood trusses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>Coeur d'Alene Siding Supply</td>
<td>500 Dalton Ave.</td>
<td>Coeur d'Alene</td>
<td>ID</td>
<td>Jan. 2009</td>
<td>30</td>
<td>Pressed plate wood trusses supported on steel beams and concrete tilt-up walls</td>
<td>0.25</td>
<td>30 est</td>
<td>no no</td>
<td>Failure of wood trusses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>Building Name</td>
<td>Street Address</td>
<td>City</td>
<td>State</td>
<td>Date of Collapse</td>
<td>Age of Building (years)</td>
<td>Structural System</td>
<td>Roof Slope (in/ft)</td>
<td>Measured Roof Snow at Time of Collapse (in/ft)</td>
<td>Is Engineering Report Available? (yes/no)</td>
<td>Is roof ponding suspected (yes/no)?</td>
<td>Was snow drifting observed (yes/no)?</td>
<td>Conclusions on Failure Mechanism</td>
<td>General Comments</td>
<td></td>
</tr>
<tr>
<td>-----</td>
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<td>----------------------------------</td>
<td>-----------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Redinger Horse Arena</td>
<td>560 Naulee Lane</td>
<td>Coeur d'Alene</td>
<td>ID</td>
<td>2/28/2008</td>
<td>1</td>
<td>Pressed plate wood trusses supported on wood posts embedded in the ground</td>
<td>3</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Wood post instability</td>
<td>Supporting posts were too slender for the combination of load and unbraced length</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>Cœur d'Alene Tractor</td>
<td>W 1112 Appleway</td>
<td>Coeur d'Alene</td>
<td>ID</td>
<td>2/24/2008</td>
<td>30 est</td>
<td>Pressed plate wood trusses supported on CMU walls with 2x joints bearing spanning to glulam beams</td>
<td>0.25</td>
<td>25 est</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Failure of wood trusses</td>
<td>Failure occurred near a roof drain that may not have been working</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>Spokane Hardware Supply</td>
<td>2001 E Trent Avenue</td>
<td>Spokane</td>
<td>WA</td>
<td>1/20/2008</td>
<td>40-50</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>25-50</td>
<td>Not taken</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>2 glulam beams failed</td>
<td>See also #75</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>Wren Plierson Center</td>
<td>150 2nd Street</td>
<td>Cheney</td>
<td>WA</td>
<td>15/50/2009</td>
<td>50-60</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>25-50</td>
<td>Not taken</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Multiply wood truss failed at bottom chord</td>
<td></td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>Trinity Baptist Church</td>
<td>6502 N Monroe</td>
<td>Spokane</td>
<td>WA</td>
<td>12/30/2008</td>
<td>27</td>
<td>Site fabricated wood trusses on wood beams and posts</td>
<td>0.25</td>
<td>28</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Rotation due to lack of lateral bracing</td>
<td>Collapsed 2 walls as well</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>Barn</td>
<td>+/- 15000 N. Muzzy</td>
<td>Newman Lake</td>
<td>WA</td>
<td>1/4/2009</td>
<td>+/- 50</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>3.12</td>
<td>38</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Member overstress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>Spokane Raceway Park-Warehou</td>
<td>102 N Hayford Rd</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>+/- 40</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>2.12</td>
<td>Unknown</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Steel Truss Frame</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>Commercial Building</td>
<td>126 N Crestline</td>
<td>Spokane</td>
<td>WA</td>
<td>12/24/2008</td>
<td>35</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>4.12</td>
<td>15-20</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Building of web members due to lack of bracing</td>
<td>Only 1/5 of roof collapsed. Remaining trusses had several loose press plates</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>Commercial Building</td>
<td>1403 N Greene</td>
<td>Spokane</td>
<td>WA</td>
<td>12/29/2008</td>
<td>25</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>1.12</td>
<td>20-Est</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Rotation due to lack of lateral bracing</td>
<td>Mostly 1/5 of roof collapsed. Remaining trusses had several loose press plates</td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>Simson Lumber</td>
<td>1610 W Pichie</td>
<td>Spokane</td>
<td>WA</td>
<td>12/30/2008</td>
<td>40</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>25-50</td>
<td>50'x120'</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Usually designed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>Hangman Valley CC</td>
<td>1020 E Hangman Valley Rd</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Heavy timber trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>14</td>
<td>Unknown</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Not collapsed- Damaged trusses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>Reliance Corp</td>
<td>2807 E Central</td>
<td>Spokane</td>
<td>WA</td>
<td>12/19/2008</td>
<td>30</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>4.12</td>
<td>120'x100'</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Frame overstressed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>Strip Mall</td>
<td>Country Homes &amp; Division</td>
<td>Spokane</td>
<td>WA</td>
<td>1/1/2009</td>
<td>Unknown</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>25 Est</td>
<td>30 Est</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Collapse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>Metal Building</td>
<td>1327 E Joseph</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>Old</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>25 Est</td>
<td>40'x60'</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Did not see failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Doucetel Hut</td>
<td>142 E Mikos</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>Curved</td>
<td>Unknown</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>One side of structure collapsed</td>
<td>Very old looking structure</td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>Residential Garage</td>
<td>1023 E Wellington</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>40</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>Flat</td>
<td>Unknown</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Wood member or nailed joint failed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Apartment Carport</td>
<td>1711 W 7th Ave.</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>50</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>Flat</td>
<td>Unknown</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Unknown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Residential Garage</td>
<td>2102 E 1st Ave.</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>50</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>Flat</td>
<td>Unknown</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Unknown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>Apartment Walkway</td>
<td>2126 E Boone</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>40-50</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Damaged roof framing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>Residential Garage</td>
<td>2305 W Gardner</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>50-60</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Wood member or nailed joint failed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>Residential Garage</td>
<td>2529 W Gardner</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>50-60</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Wood member or nailed joint failure</td>
<td></td>
<td></td>
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<tr>
<td>84</td>
<td>Industrial</td>
<td>3117 E Ferry</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>30-40</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Damaged roof framing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>Apartment Carport</td>
<td>3141 E 37th Ave.</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>40-50</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>Unknown</td>
<td>Unknown</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Damaged roof framing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>Residential Garage</td>
<td>322 S Freya</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Pressed plate trusses supported on 2x wood framed walls with 2x joints spanning to multi-ply wood trusses, cmu perimeter walls</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Damaged roof framing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>Building Name</td>
<td>Street Address</td>
<td>City</td>
<td>State</td>
<td>Date of Collapse</td>
<td>Age of Building (years)</td>
<td>Structural System</td>
<td>Roof Slope (in/ft)</td>
<td>Measured Roof Snow at Time of Collapse (psf)</td>
<td>Approx. Building Size (LxW)</td>
<td>Is Engineering Report Available?</td>
<td>Is roof snow drifting observed?</td>
<td>Conclusions on Failure Mechanism</td>
<td>General Comments</td>
<td></td>
</tr>
<tr>
<td>-----</td>
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</tr>
<tr>
<td>98</td>
<td>Residential Garage</td>
<td>325 E North</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>40-50</td>
<td>2x wood framed roof to wood stud bearing wall</td>
<td>3:12+/-</td>
<td>Unknown</td>
<td>25x25</td>
<td>No</td>
<td>No</td>
<td>2x wood framing or nailed joint failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Residential Garage</td>
<td>3901 W Kiwan</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>Unknown</td>
<td>2x framing to 2x wood stud wall with metal roof</td>
<td>1:12 or 2:12</td>
<td>Unknown</td>
<td>20x20</td>
<td>No</td>
<td>No</td>
<td>Wood member or nailed connection failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>Commercial</td>
<td>3501 W Sprague</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>30+/-</td>
<td>Unreinforced brick masonry bearing wall with built-up wood trusses and stick framing</td>
<td>Flat or very low pitch</td>
<td>Unknown</td>
<td>60' or 100'</td>
<td>Yes</td>
<td>No</td>
<td>Possible deflection of roof causing brick wall to bow outward and collapse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>Commercial Warehouse</td>
<td>3597 E Olive</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>40-50</td>
<td>Wood 2x framing was not professionally designed</td>
<td>3:12+/-</td>
<td>Unknown</td>
<td>40 or 100</td>
<td>No</td>
<td>No</td>
<td>Members and/or connections failed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>Residential Garage</td>
<td>9028 N Elin</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>40-50</td>
<td>Wood stick frame</td>
<td>Low pitch or flat</td>
<td>Unknown</td>
<td>40 or 100</td>
<td>No</td>
<td>No</td>
<td>Did not see failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>Residential Garage</td>
<td>906 E Rowan</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>20+/-</td>
<td>Steel or aluminum storage shed</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>No</td>
<td>No</td>
<td>Failed nail connection and 2x member</td>
<td></td>
<td></td>
</tr>
<tr>
<td>109</td>
<td>Storage Shed</td>
<td>907 N Howard</td>
<td>Spokane</td>
<td>Valley</td>
<td>Unknown</td>
<td>30+/-</td>
<td>Wood frame walkway canopy</td>
<td>Flat</td>
<td>Unknown</td>
<td>10'X50'</td>
<td>No</td>
<td>No</td>
<td>Looked like “off the shelf” metal storage building</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>Apartment Building</td>
<td>911 E Indiana</td>
<td>Spokane</td>
<td>WA</td>
<td>No collapse</td>
<td>25+/-</td>
<td>Metal building storage Shed</td>
<td>Flat</td>
<td>Metal bldg, Gable frame steel metal roof</td>
<td>Unknown</td>
<td>No</td>
<td>No</td>
<td>Could have been between ridges on gable roof</td>
<td></td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>Commercial Space</td>
<td>911 N Division</td>
<td>Spokane</td>
<td>Valley</td>
<td>Unknown</td>
<td>30+/-</td>
<td>Wood</td>
<td>Flat or very low pitch</td>
<td>Unknown</td>
<td>60' or 70+'</td>
<td>No</td>
<td>No</td>
<td>Old age, not well maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>Residential Carport</td>
<td>904 S Ash</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>40-50</td>
<td>Assume wood stick frame – could not see collapse</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>No</td>
<td>No</td>
<td>Old structure, not well maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>Quonset Hut</td>
<td>915 E Rosewood</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>40-50</td>
<td>Curved</td>
<td>Curved</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Yes</td>
<td>No</td>
<td>Site cleaned-up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>Storage Building</td>
<td>916 S Hatch</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>40-50</td>
<td>Flat</td>
<td>Flat</td>
<td>Unknown</td>
<td>30' or 60'+</td>
<td>No</td>
<td>No</td>
<td>Wood members failed</td>
<td>Ridley’s Plumbing</td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>Commercial</td>
<td>918 W Mallon</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>40-50</td>
<td>Press plate truss- masonry bearing wall</td>
<td>Flat</td>
<td>Unknown</td>
<td>30' or 60'+</td>
<td>No</td>
<td>No</td>
<td>Tension of light gauge metal carport</td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>Mead School District</td>
<td>Transportation Bldg.</td>
<td>Market St.</td>
<td>Mead</td>
<td>WA</td>
<td>1/5/2009</td>
<td>Swan timber roof joists supported by bowstring wood trusses and unreinforced masonry walls and pilasters</td>
<td>curved</td>
<td>25</td>
<td>50'x144'</td>
<td>Collapse</td>
<td>See also #79</td>
<td>Commercial space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>124</td>
<td>Residence</td>
<td>910 W Bradford Cl.</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>25+/-</td>
<td>Front porch canopy 4x wood framed column and knee brace beam</td>
<td>4:12</td>
<td>Unknown</td>
<td>Section of collapse 24'8&quot;</td>
<td>Yes</td>
<td>No</td>
<td>Knee brace forced base of column to push into house- not a complete collapse</td>
<td>Knebe Architecture</td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>New Heights Church</td>
<td>708 W Nora Ave.</td>
<td>Spokane</td>
<td>WA</td>
<td>Unknown</td>
<td>100+</td>
<td>1x sheathing, 4x purlin to 4x wood truss</td>
<td>3 or 4:12</td>
<td>Unknown</td>
<td>large- Not measured</td>
<td>Yes</td>
<td>No</td>
<td>Wood beam split at almost bottom of beam. May have been from snow falling from nearby trees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>126</td>
<td>Sunshine Disposal</td>
<td>3407 North University</td>
<td>Spokane</td>
<td>Valley</td>
<td>WA</td>
<td>40</td>
<td>Metal Systems Frames</td>
<td>0.25m2</td>
<td>7</td>
<td>80'x100</td>
<td>No</td>
<td>No</td>
<td>Damaged frame bending</td>
<td></td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>University Apartments</td>
<td>3205 South University</td>
<td>WA</td>
<td>12/29/2008</td>
<td>25 Light gauge metal canopy</td>
<td>0.25m2</td>
<td>7</td>
<td>20'x60</td>
<td>7</td>
<td>80'x100</td>
<td>No</td>
<td>No</td>
<td>Roof deck, column and beams failed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>Building Name</td>
<td>Street Address</td>
<td>City</td>
<td>State</td>
<td>Date of Collapse</td>
<td>Age of Building (years)</td>
<td>Structural System</td>
<td>Measured Roof Snow at Time of Collapse (psf)</td>
<td>Approx. Building Size (LxW)</td>
<td>Is Engineering Report Available?</td>
<td>Is roof ponding suspected (yes/no)?</td>
<td>Was snow drifting observed (yes/no)?</td>
<td>Conclusions on Failure Mechanism</td>
<td>General Comments</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>------------------------</td>
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<td>--------------</td>
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<td>-----------------------------------------------</td>
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<td>----------------------------------</td>
<td>---------------------------------</td>
<td>-------------------------------------</td>
<td>----------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>129</td>
<td>Pheasant Ridge Apartments</td>
<td>601 South Woodruff</td>
<td>Spokane</td>
<td>WA</td>
<td>12/29/2008</td>
<td>3</td>
<td>Light gage metal canopy</td>
<td>0.25:12 (24&quot;)</td>
<td>20x200</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>Bending of light gage metal carport</td>
<td>Deck overhang bending only.</td>
<td></td>
</tr>
<tr>
<td>130</td>
<td>Amberwood Club Apartments</td>
<td>2020 South Clinton</td>
<td>Spokane</td>
<td>WA</td>
<td>1/7/2009</td>
<td>25</td>
<td>Light gage metal canopy</td>
<td>0.25:12 (7&quot;)</td>
<td>20x200</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>Bending of light gage metal carport</td>
<td>Roof deck, column and beams failed.</td>
<td></td>
</tr>
<tr>
<td>131</td>
<td>Private Residence</td>
<td>3904 South Skipworth</td>
<td>Spokane</td>
<td>WA</td>
<td>12/29/2008</td>
<td>20</td>
<td>Pressed plate scissors</td>
<td>4:12 (48&quot;)</td>
<td>30x40</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>Bottom chord tension</td>
<td>Walls pushed when trusses failed.</td>
<td></td>
</tr>
<tr>
<td>132</td>
<td>Unoccupied Commercial Building</td>
<td>509 North Ella</td>
<td>Spokane</td>
<td>WA</td>
<td>12/29/2008</td>
<td>30</td>
<td>Metal building with steel trusses</td>
<td>0.5:12 (24&quot;)</td>
<td>50x60</td>
<td>?</td>
<td>no</td>
<td>no</td>
<td>Steel truss failure</td>
<td>Unheated at failure-nearby identical buildings ok.</td>
<td></td>
</tr>
<tr>
<td>133</td>
<td>Capel Rugs</td>
<td>1221 North Mullan</td>
<td>Spokane</td>
<td>WA</td>
<td>12/31/2008</td>
<td>30</td>
<td>Pressed plate trusses on steel joist girders</td>
<td>0.25:12 (7&quot;)</td>
<td>200x100</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>Steel truss failure</td>
<td>Bending and end sheat top chord failure.</td>
<td></td>
</tr>
<tr>
<td>134</td>
<td>Canwash</td>
<td>11409 East Sprague Avenue</td>
<td>Spokane</td>
<td>WA</td>
<td>12/31/2008</td>
<td>25</td>
<td>Light gage metal canopy</td>
<td>3:12 (30x50)</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>Bending in roof decking</td>
<td>Minor damage.</td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>Buck’s Tire</td>
<td>918 W Mallon Ave</td>
<td>Spokane</td>
<td>WA</td>
<td>12/25/1/1</td>
<td>60</td>
<td>Wood Trusses on CMU bearing walls</td>
<td>25:12 (60x100)</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>Wood Ledger Failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>136</td>
<td>Church</td>
<td>Spokane</td>
<td>Spokane</td>
<td>WA</td>
<td>12/25-1/1</td>
<td>30</td>
<td>Wood Trusses on Wood Bearing Walls</td>
<td>3:12 (80x80)</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>Truss failure/improper compression bracing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>137</td>
<td>Warehouse</td>
<td>Spokane</td>
<td>Spokane</td>
<td>WA</td>
<td>12/25-1/1</td>
<td>50+</td>
<td>Bowstring trusses on CMU sheath bearing walls</td>
<td>arch (yes/no)</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>Shed roof failed. Connection to main building pulled wall out from under bowstring trusses.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>138</td>
<td>Spokane Seed</td>
<td>9015 East Alki</td>
<td>Spokane</td>
<td>WA</td>
<td>1/5/2009</td>
<td>30</td>
<td>Wood truss pole building</td>
<td>3:12 (12&quot;)</td>
<td>200x50</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>Wood truss failure</td>
<td>Other sdb trusses were damaged before snow load.</td>
<td></td>
</tr>
</tbody>
</table>