SBC ASSOCIATION

Research Report

Sprinkler Loads on Trusses

SRR No. 1504-02

Structural Building Components Association (SBCA)

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SBCA is an APPROVED SOURCE

This research report is based on practical scientific research (literature review, testing, analysis, etc.). This research report complies with the following sections of the building code:

- *IBC* Section 104.11.1 and Section 1703.4.2 – "**Research reports.** Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from *approved sources*."
- *IBC* Section 202 – "**APPROVED SOURCE.** An independent person, firm or corporation, *approved* by the *building official*, who is competent and experienced in the application of engineering principles to materials, methods or systems analyses."

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Introduction:

Building Designers need to account for the dead and live loads of fire sprinkler systems, in addition to the other load requirements imposed under the model building codes. Truss Designers are responsible for incorporating the additional load from the fire sprinkler systems into the truss design.

The information in this *SBCA Research Report* is applicable to both floor and roof systems. Only vertical loads from fire sprinkler systems are discussed; lateral loads, where required, should be evaluated separately by a Registered Design Professional.

The requirements discussed are considered standard in the industry and are presented as a guide. Specific designs should be confirmed with the local building authorities, who may have unique regulations not addressed in this report. The guidelines provided in this *SBCA Research Report* are not intended to exclude alternative solutions for specific projects that have been designed by a qualified Registered Design Professional.

Key Definitions:

AUTHORITY HAVING JURISDICTION: (*IBC* Section 104.1)
The building code official authorized and directed to enforce the provisions of a building code who also has the authority to render interpretations of this code and to adopt policies and procedures in order to clarify the application of its provisions.

BUILDING DESIGNER: (*ANSI/TPI 1* Section 2.2)
The owner of the building or the person that contracts with the owner for the design of the framing structural system and/or who is responsible for the preparation of the construction documents. When mandated by the legal requirements, the Building Designer shall be a registered design professional.

DEAD LOAD: (*IBC* Section 202)
The weight of materials of construction incorporated into the building, including but not limited to walls, floors, roofs, ceilings, stairways, built-in partitions, finishes, cladding and other similarly incorporated architectural and structural items, and the weight of fixed service equipment, such as cranes, plumbing stacks and risers, electrical feeders, heating, ventilating and air-conditioning systems and automatic sprinkler systems.

FIRE SPRINKLER SYSTEM:
A system of pipes and accessories that distribute and discharge water to protect a structure and its occupants from damage or injury due to fire. In a truss system, the pipes are usually supported by the truss top chords, although sometimes they may be suspended from the bottom chord.

LIVE LOAD: (*IBC* Section 202)
A load produced by the use and occupancy of the building or other structure that does not include construction or environmental loads such as wind load, snow load, rain load, earthquake load, flood load or dead load.

PANEL:
Chord segment defined by two adjacent panel points (see Figure 1).

PANEL LENGTH:
Horizontal distance between the centerlines of two consecutive panel points along the top or bottom chord (see Figure 1 and Figure 2).

PANEL POINT:
Location on a truss where the web members and top or bottom chords intersect and are connected by metal connector plates (see Figure 1 and Figure 2).

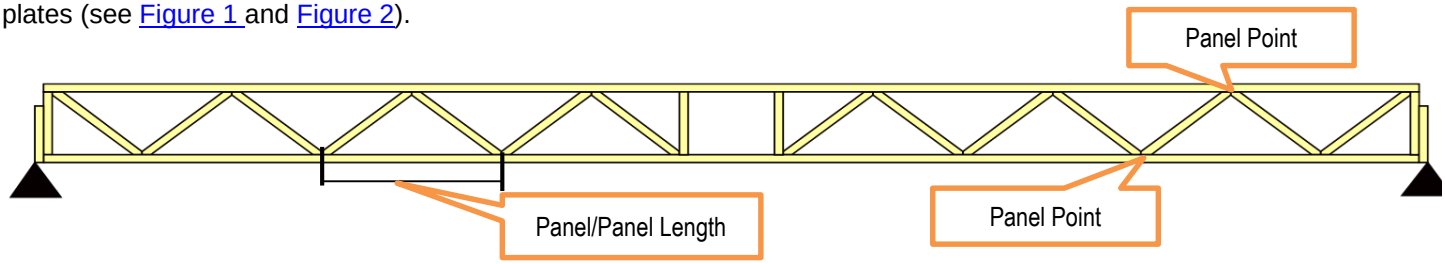

Figure 1: Floor Truss Nomenclature

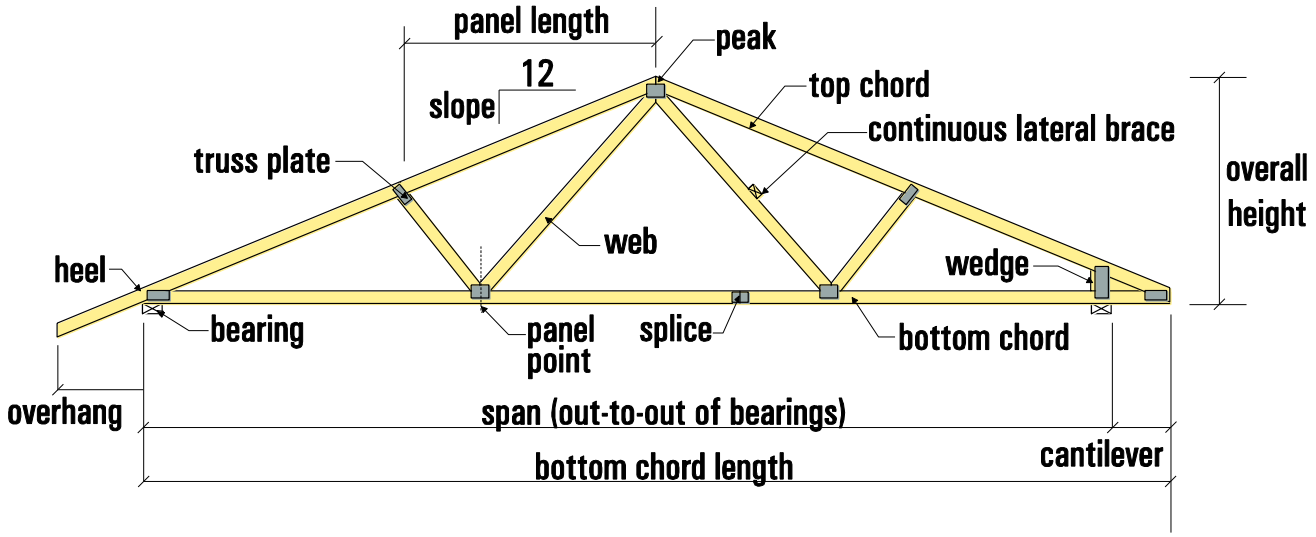

Figure 2: Roof Truss Nomenclature

REGISTERED DESIGN PROFESSIONAL (RDP): (*IBC* Section 202)
An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

TRUSS DESIGNER: (*ANSI/TPI 1* Section 2.2)
The person responsible for the preparation of the truss design drawings.

TRUSS MANUFACTURER: (*ANSI/TPI 1* Section 2.2)
An individual or organization engaged in the manufacturing of trusses.

Background:

Fire sprinkler systems may be used as an effective method of providing fire protection. When fire sprinkler systems are used with truss systems, it is essential to design the trusses to carry the additional dead load and required live loads imposed by the fire sprinkler system. This *SBCA Research Report* provides information to aid in the design of wood floor and roof trusses that are required to support fire sprinkler systems.

The use of automatic fire sprinkler systems in commercial, multifamily, and residential construction is intended to provide improved protection to a building and its contents from damage due to fire. It is also intended to provide improved protection from injury of the building's occupants. As metal plate connected wood truss usage has become more prevalent in all construction types, it is essential for the Building Designer to consider the loads imposed on the truss system and provide the Truss Designer with this information. This allows the Truss Designer to make provisions in the truss design for the structural effects of the fire sprinkler systems.

The open webbing of truss construction makes it highly compatible with other building trades. Water lines for sprinkler systems can be run through the open webbing, making maximum use of the available space and eliminating costs associated with drilling or the loss of headroom. Occasionally, a building's use or its contents demand a fire sprinkler system with special layout requirements and heavy main waterlines that cannot be compromised. Truss construction can easily be manipulated with adjustments to panel lengths and web configurations to accommodate most special requirements.

Application:

The Building Designer must provide the Truss Designer with a specified uniform load to account for the dead weight of the fire sprinkler system. The Building Designer must also provide the location and magnitude of any concentrated dead loads required that are not covered by the uniform load. The value of these loads will typically depend on the size of the pipes being used, the layout of the system, design criteria provided by the fire sprinkler system designer or other qualified professional, the requirements of the local building code, and the Building Designer's own experience.

The Truss Designer should design the trusses for this additional uniform dead load and any concentrated dead loads that may be required (as specified by the Building Designer) to account for the weight of water-filled pipe. In addition to these dead loads, the Truss Designer should also design the trusses for a minimum 250-lb. concentrated live load to be applied to any single fire sprinkler support point, but not simultaneously to all support points. The 250-lb. live load need not be considered simultaneously with other live loads (i.e., roof, snow, wind, etc.). For ease of application, typical truss design software allows the Truss Designer to specify this load and automatically have it applied to each panel and mid-panel point in separate load cases. This is a conservative approach, but one that insures that this live load has been covered for any variance in the installed location of the fire sprinkler system.

Truss Design Dead Loads

In addition to load requirements imposed under the model building codes, the Building Designer must include adequate additional dead load allowance in the truss design loads, to provide for the weight of the fire sprinkler system per the definition of dead loads in the *IBC* Section 202. Such loads are generally expressed in pounds per square foot (psf). The magnitude of the dead loads is not specifically addressed in the *NFPA 13* standards, the *IBC*, or *ASCE 7* but must be determined on a case-by-case basis.

The fire sprinkler system can be supported from either the top chord or the bottom chord of the truss. Regardless of which chord the fire sprinkler system attachment will be on, the Building Designer must notify the Truss Manufacturer, who will make special provisions for attachments and loads. Alternatively, concentrated dead loads for the sprinkler system may be given when attachment locations are known. While SBCA does not specify or recommend values for these loads, typical values used range from 1.5 to 6 PSF, depending on the nominal size of the pipe and the hanger spacing. Always consult the Building Designer or delegated Engineer of the sprinkler system to obtain the dead loads to be used in the truss design.

It is up to the Building Designer to specify the load values to be used and to communicate those values to the Truss Designer.

Installation Loads

In addition to the dead load of the water-filled pipe, the trusses must be able to support a minimum concentrated live load of 250 lbs. applied at the point of attachment per *NFPA 13 or NFPA 13R*[1]. Since the truss is already designed to handle the dead loads from the fire sprinkler system, it only needs to be checked for the additional 250-lb. live load. The 250-lb. live load provision is intended to accommodate the weight of sprinkler installation personnel for a very short time (load duration factor of 2.0, impact load) per the *National Design Specification for Wood Construction* (*NDS*). In keeping with this intention, the 250-lb. load is to be applied to any single fire sprinkler support point, but not simultaneously to all support points. Also, the 250-lb. load need not be checked simultaneously with other short duration live loads such as live, snow or wind loads. If multiple sprinkler lines are attached to the same truss, the 250-lb. load should be applied at only one location at a time, representing only one worker on the individual truss. Each point of attachment on an individual truss should be evaluated to determine which load causes the most critical effect.

In residential sprinkler system installations, *NFPA 13D*[2] assumes that the system will use the domestic water delivery system, and one may not need to account for additional dead loads. However, the truss designs and the fire sprinkler system design need to be coordinated, to eliminate conflicts for sprinkler head location or pipe runs.

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[1] *2010* and *2013* editions of *NFPA 13 – Standard for the Installation of Sprinkler Systems* and *NFPA 13R – Standard for the Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height*

[2] *2010* and *2013* editions of *NFPA 13D – Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, by the National Fire Protection Association (NFPA)

Structural Considerations

Trusses are capable of supporting significantly higher loads at panel points than in the spaces between the panel points. The location of the pipe support in relation to the panel points of the truss is very important and should be included in the analysis.

The Building Designer or Owner should provide the Truss Designer with as much information as possible about the fire sprinkler system prior to the truss design process. This will give the Truss Designer a more accurate estimate of the overall load so that, prior to truss manufacturing and installation, the Truss Designer can identify the locations of special support points to accommodate attachment of the fire sprinkler system.

Conditions of Use:

This report includes information on supporting sprinkler dead loads and installer live loads on trusses. Resistance of truss chords and other structural elements to lateral loads shall be considered by the Building Designer.

Large diameter pipe lines (4" or greater), significant risers, and lines running parallel to trusses may require special design provisions and/or additional members. Pilot holes are required for all screws. Locating supports within truss panels containing chord splices should be avoided.

Screw and bolt sizes and other mechanical connections or parts thereof shall be sized in accordance with *NFPA 13*[3] or the applicable NFPA standard and *NDS*. Alternative sizes may be used to meet specific project conditions provided that the intent of all applicable codes and standards are met and the design is accomplished by a Registered Design Professional.

There should be no more than one fire sprinkler system support attached to each truss panel. If more than one fire sprinkler system support is needed in one panel, special engineering is required, and a Registered Design Professional should be contracted.

With the approval of the Truss Designer or other Registered Design Professional, the accommodation of the sprinklers in the truss system may vary from that presented in this document. Where required by the authority having jurisdiction (AHJ) in which the project is to be constructed, this report and the installation instructions shall be submitted at the time of permit application.

Building Designer Responsibility:

Unless the AHJ allows otherwise, the Construction Documents shall be prepared by a Building Designer (e.g., Owner, Registered Design Professional, etc.) for the Building and shall be in accordance with *IRC* Section R106 and *IBC* Section 107. The Construction Documents shall be accurate and reliable and shall provide the location, direction and magnitude of all applied loads and shall be in accordance with *IRC* Section 301 and *IBC* Section 1603. Construction Documents shall be submitted to the Building Official for approval and shall contain the plans, specifications and details needed for the Building Official to approve such documents.

Responsibilities:

- The information contained herein is a product, engineering or building code compliance research report prepared in accordance with the referenced building codes, testing and/or analysis using accepted engineering procedures, experience, and good technical judgment.
- Product design and code compliance quality control are the responsibility of the referenced company. Consult the referenced company for the proper detailing and application for the intended purpose. Consult your local jurisdiction or design professional to assure compliance with the local building code.
- SBCA Research Reports provide an assessment of only those attributes specifically addressed within a given report.
- The engineering evaluation was performed on the dates provided in this report, within SBCA's scope of work.

This research report is subject to periodic review and revision. For the most recent version of this report, visit sbcindustry.com. For information on the current status of this report, contact SBCA.

[3] 2010 and 2013 editions of *NFPA 13 – Standard for the Installation of Sprinkler Systems*, National Fire Protection Association (NFPA)

References:

ANSI/AWC National Design Specification (*NDS*) *for Wood Construction*; American Wood Council; 2015.

ANSI/TPI 1 – National Design Standard for Metal Plate Connected Wood Truss Construction; Truss Plate Institute; 2007.

ASCE/SEI 7 – Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers and the Structural Engineering Institute; 2010.

International Building Code; International Code Council; 2015.

International Residential Code; International Code Council; 2015.

NFPA 13 – Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2010 and 2013.

NFPA 13R – Standard for the Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height; National Fire Protection Association; 2010 and 2013.

NFPA 13D – Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes; National Fire Protection Association; 2010 and 2013.