



DrJ Research Report

DRR 1506-12

Design for Sprinkler Loads on Trusses

**Structural Building Components
Associations**

**Code Compliance Process:
Fire sprinkler system loads on
floor and roof systems**

Issue Date:

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October 19, 2020



REPORT HOLDER
INFORMATION:

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DIVISION: 00 00 00 – NAME OF DIVISION 21 00 00 Fire Suppression

SECTION: 21 13 00 Fire-Suppression Sprinkler Systems

1 CODE COMPLIANCE PROCESS EVALUATED¹

- 1.1 Fire sprinkler system loads on floor and roof systems

2 APPLICABLE CODES AND STANDARDS^{2,3}

2.1 Codes

- 2.1.1 *IBC—12, 15, 18: International Building Code®*
- 2.1.2 *IRC—12, 15, 18: International Residential Code®*

2.2 Standards and Referenced Documents

- 2.2.1 *ANSI/AWC NDS: National Design Specification (NDS) for Wood Construction*
- 2.2.2 *ASCE/SEI 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures*
- 2.2.3 *NFPA 13: Standard for the Installation of Sprinkler Systems*
- 2.2.4 *NFPA 13D: Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*
- 2.2.5 *NFPA 13R: Standard for the Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height*
- 2.2.6 *TPI 1: National Design Standard for Metal-plate-connected Wood Truss Construction*

¹ Building codes require data from valid research reports be obtained from approved sources. Work of licensed registered design professionals (RDPs) meets the code requirements for approval by the building official.

Building official approval of a licensed RDP is performed by verifying the RDP and/or their business entity complies with all professional engineering laws of the relevant jurisdiction. Therefore, the work of licensed RDPs is accepted by building officials, except when plan (i.e. peer) review finds an error with respect to a specific section of the code. Where this DRR is not approved, the building official responds in writing stating the reasons for disapproval.

For more information on any of these topics or our mission, product evaluation policies, product approval process, and engineering law, visit drjengineering.org or call us at 608-310-6748.

² Unless otherwise noted, all references in this DRR are from the 2018 version of the codes and the standards referenced therein (e.g., *ASCE 7*, *NDS*, *ASTM*). This material, design, or method of construction also complies with the 2000-2015 versions of the referenced codes and the standards referenced therein.

³ All terms defined in the applicable building codes are italicized.



3 EVALUATION SCOPE

- 3.1 This research report evaluates load requirements of sprinkler systems installed on floor and roof systems.
 - 3.1.1 Only Vertical loads are discussed in this report; lateral loads, where required, should be evaluated by a Registered Design Professional.
- 3.2 The requirements discussed are considered standard in the industry and are presented only 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 are not intended to exclude alternative solutions for specific projects that have been designed by a qualified Registered Design Professional.
- 3.3 This research report is a code compliance evaluation report that is intended only to provide information on the code compliance process relating to the topic listed in Section 1 of this report. For the purposes of this report, DrJ is not certifying a process but rather is providing the user with information for the process discussed. For specific details, see the applicable building code or standard.
- 3.4 Any code compliance issues not specifically addressed in this section are outside the scope of this DRR.
- 3.5 Any engineering evaluation conducted for this DRR was performed on the dates provided in this DRR and within DrJ's professional scope of work.

4 APPLICATIONS

4.1 *IRC Sprinkler Requirements*

- 4.1.1 Automatic sprinkler systems are discussed in IRC Section R313 and are to be designed and installed in accordance with Section P2904 or *NFPA 13D*.
- 4.1.2 Neither the *IRC* nor *NFPA 13D* address specific design or installation loads but IRC Section P2904.3 and *NFPA 13D* Section 7.4.2 do mention piping support:

IRC Section P2904.3 Sprinkler piping shall be supported in accordance with requirements for cold water distribution piping. Sprinkler piping shall comply with the requirements for cold water distribution piping...

NFPA 13D Section 7.4.2 Pipe that is not listed, and listed pipe with listing limitations that do not include piping support requirements, shall be supported from structural members using support methods comparable to those required by applicable local plumbing codes.

- 4.1.3 Since most residential sprinkler systems use the domestic water system to deliver water to both fire sprinklers and plumbing fixtures per IRC Section P2904.1, minimal design loading is required for floor or roof systems. Often, the standard design dead loads are sufficient to account for this load.

4.2 *IBC Sprinkler Requirements*

- 4.2.1 The *IBC* is not any clearer on sprinkler system loads than the *IRC*. Automatic sprinkler systems must comply with the provisions of Section 903.2 through 903.2.12, with installation requirements falling under Section 903.3 but ultimately deferring to *NFPA 13* or *NFPA 13R*.

4.3 *NFPA 13 Requirements*

- 4.3.1 *NFPA 13* Chapter 9: *Hanging, Bracing, and Restraint of System Piping of NFPA 13* gives the most detailed explanation of structural loads needed to support fire sprinklers.
- 4.3.2 Section 9.2.1.3 gives the broad definition of load requirements on the building structure itself:

9.2.1.3.1 ...sprinkler piping shall be substantially supported from the building structure, which must support the added load of the water filled pipe plus a minimum of 250 lb. (114 kg) applied at the point of hanging...



4.3.3 Section 9.1 addresses the requirements of hangers used to support sprinkler piping as follows:

9.1.1.2 Hangers certified by the registered design professional engineer to include all of the following shall be an acceptable alternative to the requirements of Section 9.1:

- (1) Hangers shall be designed to support five times the weight of the water-filled pipe plus 250 lb (114 kg) at each point of piping support.
- (2) These points of support shall be adequate to support the system.
- (3) The spacing between hangers shall not exceed the value given for the type of pipe as indicated in Table 9.2.2.1(a) or Table 9.2.2.1(b)
- (4) Hanger components shall be ferrous.
- (5) Detailed calculations shall be submitted, when required by the reviewing authority, showing stresses developed in hangers, piping, and fittings, and safety factors allowed.

4.3.4 Wood fasteners used with hangers meeting requirements of *NFPA 13* include drive screws (9.1.5.1), ceiling flanges and u-hooks with screws (9.1.5.2), bolt or lag screws (9.1.5.3), wood screws (9.1.5.4) and coach screw rods (9.1.5.7). Wood nails are not acceptable for fastening hangers per 9.1.5.5. Fastener design capacities should be verified using specifications in *NDS*.

4.4 *Truss Design Load Requirements*

4.4.1 Load requirements imposed under the model building codes are of concern in every design for floor and roof trusses, and include provisions found in the following: *IRC Section R301, R502 and R802; IBC Section 106, Chapter 16 and 23*; and Section 6.2 of *TPI 1-2014*.

4.4.2 In addition to these standard load requirements, the Building Designer must include adequate 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*.

4.4.2.1 Such loads are determined on a case-by-case basis as they are dependent upon length of pipe, pipe size, and mounting hardware.

4.4.3 The fire sprinkler system is best supported from the top chord of a truss but can be supported from the bottom chord of the truss as well. 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.

4.5 *Installation Loads*

4.5.1 In addition to the normally imposed load requirements noted in Section 4.4, a 250-lb. load is to be applied to every single fire sprinkler support point but not simultaneously to all support points. Furthermore, the 250-lb. load need not be checked simultaneously with other short duration live loads such as snow or wind loads.

4.5.1.1 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.

5 FINDINGS

5.1 For buildings constructed under the *IRC* using *NFPA 13D* sprinkler systems, the weight of the water-filled pipes as part of the domestic water system are generally included in the dead loads applied to the design for roof and floor trusses. Additional loading for the sprinkler system is usually not required.



5.2 For buildings constructed under the *IBC* using *NFPA 13* and *13R* systems, design of roof and floor trusses shall include the additional loads imposed by the system. These loads include both the dead load of the water-filled pipe and an additional 250 pound live load at the each point of attachment. The 250 pound live load is to be applied at only one location at a time and is applied non-concurrently with other live loads.

5.3 *IBC* Section 104.11 (*IRC* Section R104.11 and *IFC* Section 104.9 are similar) states:

104.11 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the *building official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code...Where the alternative material, design or method of construction is not *approved*, the *building official* shall respond in writing, stating the reasons the alternative was not *approved*.

6 CONDITIONS OF USE

- 6.1 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.
- 6.2 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.
- 6.3 Screw and bolt sizes and other mechanical connections or parts thereof shall be sized in accordance with *NFPA 13* 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.
- 6.4 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 contacted.
- 6.5 Where required by the *building official*, also known as the authority having jurisdiction (AHJ) in which the project is to be constructed, this DRR and the installation instructions shall be submitted at the time of *permit* application.
- 6.6 Any generally accepted engineering calculations needed to show compliance with this DRR shall be submitted to the AHJ for review and approval.
- 6.7 Design loads shall be determined in accordance with the building code adopted by the *jurisdiction* in which the project is to be constructed and/or by the Building Designer (e.g., *owner* or *registered design professional*).
- 6.8 The actual design, suitability, and use of this DRR, for any particular building, is the responsibility of the *owner* or the owner's authorized agent. Therefore, the DRR shall be reviewed for code compliance by the *building official* for acceptance.

7 REVIEW SCHEDULE

- 7.1 For the most recent version or current status of this DRR, visit drjengineering.org or contact [DrJ Engineering](http://DrJEngineering.com).