



### Structural Building Components Association (SBCA)

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#### 1. Code Compliance Process Evaluated:

- 1.1. Fire sprinkler system loads on floor and roof systems.
- 1.2. For the most recent version of this report, visit [drjengineering.org](http://drjengineering.org). For more detailed state professional engineering and code compliance legal requirements and references, visit [drjengineering.org/statelaw](http://drjengineering.org/statelaw). DrJ is fully compliant with all state professional engineering and code compliance laws.

#### 2. Applicable Codes and Standards:<sup>1</sup>

- 2.1. *2009, 2012 and 2015 International Building Code (IBC)*
- 2.2. *2009, 2012 and 2015 International Residential Code (IRC)*
- 2.3. *ANSI/AWC NDS-2015 – National Design Specification for Wood Construction*
- 2.4. *ANSI/TPI 1 – National Design Standard for Metal Plate Connected Wood Truss Construction*
- 2.5. *ASCE/SEI 7 – Minimum Design Loads for Buildings and Other Structures*
- 2.6. *NFPA 13 – Standard for the Installation of Sprinkler Systems*
- 2.7. *NFPA 13R – Standard for the Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height*
- 2.8. *NFPA 13D – Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*

#### 3. Performance Evaluation:

- 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.

<sup>1</sup> Unless otherwise noted, all references in this research report are from the 2015 version of the codes and the standards referenced therein, including, but not limited to, ASCE 7, SDPWS and WFCM. This product also complies with the 2000-2012 versions of the IBC and IRC and the standards referenced therein. As required by law, where this research report is not approved, the building official shall respond in writing, stating the reasons this research report was not approved. For variations in state and local codes, if any, see [Section 8](#).

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- 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 report.

## 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 [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

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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 *ANSI/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. Test and Engineering Substantiating Data:

- 5.1. The code compliance process evaluated by this report falls within the scope of one or more of the model, state or local building codes for building construction. The testing and/or substantiating data used in this report is limited to buildings, structures, building elements, construction materials and civil engineering related specifically to buildings.
- 5.2. The provisions of model, state or local building codes for building construction do not intend to prevent the installation of any material or to prohibit any design or method of construction. Alternatives shall use consensus standards, performance-based design methods or other engineered alternative means of compliance. This report assesses compliance with defined standards, generally accepted engineering analysis, performance-based design methods, etc. in the context of the pertinent building code requirements.
- 5.3. Some information contained herein is the result of testing and/or data analysis by other sources, which DrJ relies on to be accurate as it undertakes its engineering analysis.
- 5.4. DrJ has reviewed and found the data provided by other professional sources are credible. This information has been approved in accordance with DrJ's procedure for acceptance of data from approved sources.
- 5.5. DrJ's responsibility for data provided by approved sources is in accordance with professional engineering law.
- 5.6. Where appropriate, DrJ relies on the derivation of design values, which have been codified into law through codes and standards (e.g., *IRC*, *WFCM*, *IBC*, *SDPWS*, etc.). This includes review of code provisions and any related test data that helps with comparative analysis or provides support for equivalency to an intended end-use application.

## 6. Findings:

- 6.1. 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.
- 6.2. 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

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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.

6.3. [IBC Section 104.11](#) and [IRC Section R104.11](#) ([IFC Section 104.9](#) is similar) state:

**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, at least 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*.<sup>2</sup>

6.4. This process has been evaluated with the codes listed in [Section 2](#), and is compliant with all known state and local building codes. Where there are known variations in state or local codes that are applicable to this evaluation, they are listed here:

6.4.1. No known variations

6.5. This report uses professional engineering law, the building code, ANSI/ASTM consensus standards and generally accepted engineering practice as its criteria for all testing and engineering analysis. DrJ's professional engineering work falls under the jurisdiction of each state Board of Professional Engineers, when signed and sealed.

## 7. Conditions of Use:

- 7.1. 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.
- 7.2. Any generally accepted engineering calculations needed to show compliance with this report shall be submitted to the code official for review and approval.
- 7.3. Design loads shall be determined in accordance with the building code adopted by the jurisdiction in which the project is to be constructed.
- 7.4. 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.
- 7.5. 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.
- 7.6. Screw and bolt sizes and other mechanical connections or parts thereof shall be sized in accordance with *NFPA 13*<sup>3</sup> 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.
- 7.7. 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.

7.8. Design

7.8.1. Building Designer Responsibility

7.8.1.1. 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](#).

7.8.1.2. 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](#).

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<sup>2</sup> The last sentence is adopted language in the 2015 codes.

<sup>3</sup> 2010 and 2013 editions of *NFPA 13 – Standard for the Installation of Sprinkler Systems*, National Fire Protection Association (NFPA)

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### 7.8.2. Construction Documents

7.8.2.1. 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.

### 7.9. Responsibilities

- 7.9.1. The information contained herein is a product, engineering or building code compliance research report performed in accordance with the referenced building codes, testing and/or analysis through the use of accepted engineering procedures, experience and good technical judgment.
- 7.9.2. DrJ research reports provide an assessment of only those attributes specifically addressed in the Products Evaluated or Code Compliance Process Evaluated section.
- 7.9.3. The engineering evaluation was performed on the dates provided in this report, within DrJ's professional scope of work.
- 7.9.4. The actual design, suitability and use of this research report for any particular building is the responsibility of the Owner or the Owner's authorized agent, and the report shall be reviewed for code compliance by the Building Official.
- 7.9.5. The use of this research report is dependent on the manufacturer's in-plant QC, the ISO/IEC 17020 third-party inspection process, proper installation per the manufacturer's instructions, the Building Official's inspection and any other code requirements that may apply to assure accurate compliance with the applicable building code.

### 8. Review Schedule:

- 8.1. This research report is subject to periodic review and revision. For the most recent version of this report, visit [drjengineering.org](http://drjengineering.org).
- 8.2. For information on the current status of this report, contact [DrJ Engineering](#).