

Bottom Chord Live Load Concurrency and Truss Design

Overview
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SBCATM

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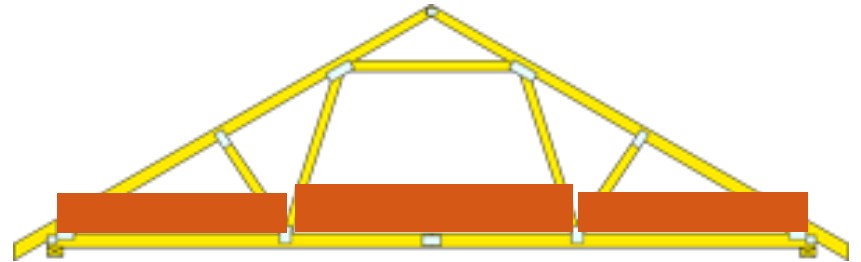
Introduction

- Correct loading is key to proper truss design and results in safer trusses, better truss performance, and ultimately lower costs.
- The truss industry relies on ASCE 7 for correct loading guidance.
- Buildings containing trusses must also comply with building codes.
- Occasionally there are interpretation questions between the ASCE and the building codes, and the designer may be unsure how to proceed.



Introduction

- This presentation seeks to explain how to correctly apply live loads to the bottom chord of trusses for uninhabitable attics in accordance with *IRC* Table R301.5 and *IBC* Table 1607.1 and *ASCE* 7-10 Table 4-1.



Key Definitions

- **ATTIC** ([IBC Section R202](#)) – The unfinished space between the ceiling assembly and the roof assembly.
- **DEAD LOADS (D)** ([IBC Section 2](#)) – The weight of the material 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 fixed service equipment, such as cranes, plumbing stacks and risers, electrical feeders, heating, ventilating and air-conditioning systems and automatic sprinkler systems.
- **HABITABLE SPACE** ([IBC Section 2](#)) – A space in a building for living, sleeping, eating or cooking. Bathrooms, toilet rooms, closets, halls, storage or utility spaces and similar areas are not considered habitable spaces.
- **LIVE LOAD (L)** ([IBC Section 2](#)) – 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.
- **LOADS** ([IBC Section 2](#)) – Forces or other actions that result from the weight of building materials, occupants and their possessions, environmental effects, differential movement and restrained dimensional changes. Permanent loads are those loads in which variations over time are rare or of small magnitude, such as dead loads. All other loads are variable loads (see “Nominal loads”).

Background

- The truss industry uses *ASCE 7*, a referenced standard in both the *IBC* and the *IRC*, as the basis for the design of trusses with respect to the application of loads applied to uninhabitable attics with and without storage.



Background – ASCE 7-10

- *ASCE 7-10* Table 4-1 is similar to tables found in the *IRC* and the *IBC*.
- Footnote “l” defines uninhabitable attics without storage, specifically stating:
 - [...] This live load need not be assumed to act concurrently with any other live load requirement.
- Footnote “m” defines uninhabitable attics with storage, specifically stating:
 - [...] The remaining portions of the bottom chords shall be designed for a uniformly distributed nonconcurrent live load of not less than 10 lb/ft² (0.48 kN/m²).

Table 4-1

Occupancy or Use	Uniform psf (kN/m ²)
Residential	
One- and two- family dwellings	
Uninhabitable attics without storage	10 (0.48) ^l
Uninhabitable attics with storage	20 (0.96) ^m

Background – ASCE 7-10

- While ASCE 7-10 (both 1st and 3rd printing) treats the non-storage live load as non-concurrent, the ASCE 7-10 Errata, dated January 11, 2011, contains a modification to footnote “m”:
 - [...] The remaining portions of the bottom chords shall be designed for a **uniformly distributed concurrent live load** of not less than 10 lb/ft² (0.48 kN/m²).
- This anomaly did not make it into the 3rd printing of ASCE 7-10 in 2013, but did create a discrepancy in the 2012 & 2015 IRC.

Background – IRC 2012/2015

- Footnote “b” of 2012/2015 IRC Table R301.5 states:
 - [...] This live load need not be assumed to act concurrently with any other live load requirements.
- However footnote “g” states:
 - [...] The remaining portions of the joists or truss bottom chords shall be designed for a uniformly distributed concurrent live load of not less than 10 lb/ft²
- Note that, in footnote “b”, the uninhabitable attics without storage have a 10 psf non-concurrent live load while this same load in footnote “g” (i.e. the area of the attic where storage loads are not applied) is listed as a concurrent 10 psf live load.

Table R301.5

USE	LIVE LOAD
Uninhabitable attics without storage ^b	10
Uninhabitable attics with limited storage ^{b, g}	20

Background – IBC 2012/2015

- The discrepancy is similarly found in 2012/2015 IBC Table 1607.1, where footnote “i” states:
 - [...] This live load need not be assumed to act concurrently with any other live load requirements.
- However, footnote “j” states:
 - [...] The remaining portions of the joists or truss bottoms chords shall be designed for a uniformly distributed concurrent live load of not less than 10 lb./ft².

Table 1607.1

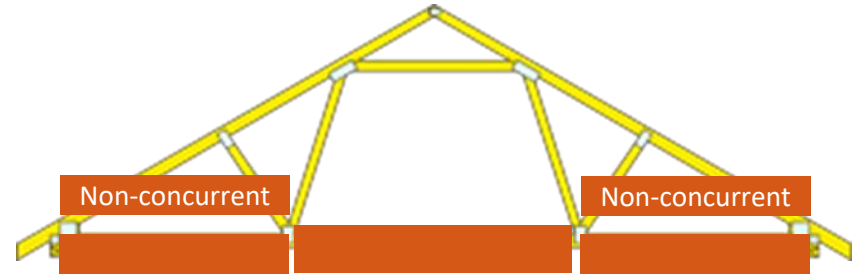
25. Residential	
One- and two-family dwellings	
Uninhabitable attics without storage ⁱ	10
Uninhabitable attics with storage ^{i, j, k}	20

Analysis

- During the 2012 ICC code development process, proposal S57-09/10 was approved that changed the language in the footnotes for *IBC* Table 1607.1 and *IRC* Table R301.5 that deal with uninhabitable attics without storage.
- The ICC proposal was based on a proposal to change ASCE 7-10 which ultimately was not approved:
 - **Reason:** The purpose for this proposal is to correlate the IBC and IRC with the 2010 edition of ASCE 7. The need for correlation is due to ASCE 7 Proposal LLSC-LL-9 [⋯]

Analysis

- The 10 psf live load on those portions of the bottom chords not serving as storage areas was intended to reflect the requirement to provide a 10 psf load per *IBC* Table 1607.1 and *IRC* Table R301.5, for uninhabitable attics without storage.
- Current truss design methodology also treats this 10 psf non-storage load as a non-concurrent maintenance load.



Analysis

- Furthermore, the Commentary in *IBC* Section 1607.1 Live Loads, General clearly states that the maintenance live load is non-concurrent with other live loads (emphasis added):
 - Historically, a minimum load of 10 psf (0.48 Kn/m²) has been viewed as appropriate where occasional access to the attic is anticipated for maintenance purposes, but significant storage is restricted by physical constraints, such as low clearance or the configuration of truss webs. It provides a minimum degree of structural integrity, allowing for occasional access to an attic space for maintenance purposes. Allowing the application of this load to be independent of other live loads is deemed appropriate, since it would be rare for this load and other maximum live loads to occur at once.

Conclusion

- SBCA recommends that truss design should continue the use of ASCE 7's provisions for bottom chord storage live load **non-concurrent** with other live loads.
- The language of the *IBC* and *IRC* was inadvertently created from an erroneous version of the ASCE 7, which it was intended to match.
- Subsequently, ASCE 7 was corrected to revert back to the non-concurrent status of these loads.

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; 2012.
- *International Residential Code*; International Code Council; 2012.
- *International Building Code*; International Code Council; 2015.
- *International Residential Code*; International Code Council; 2015.