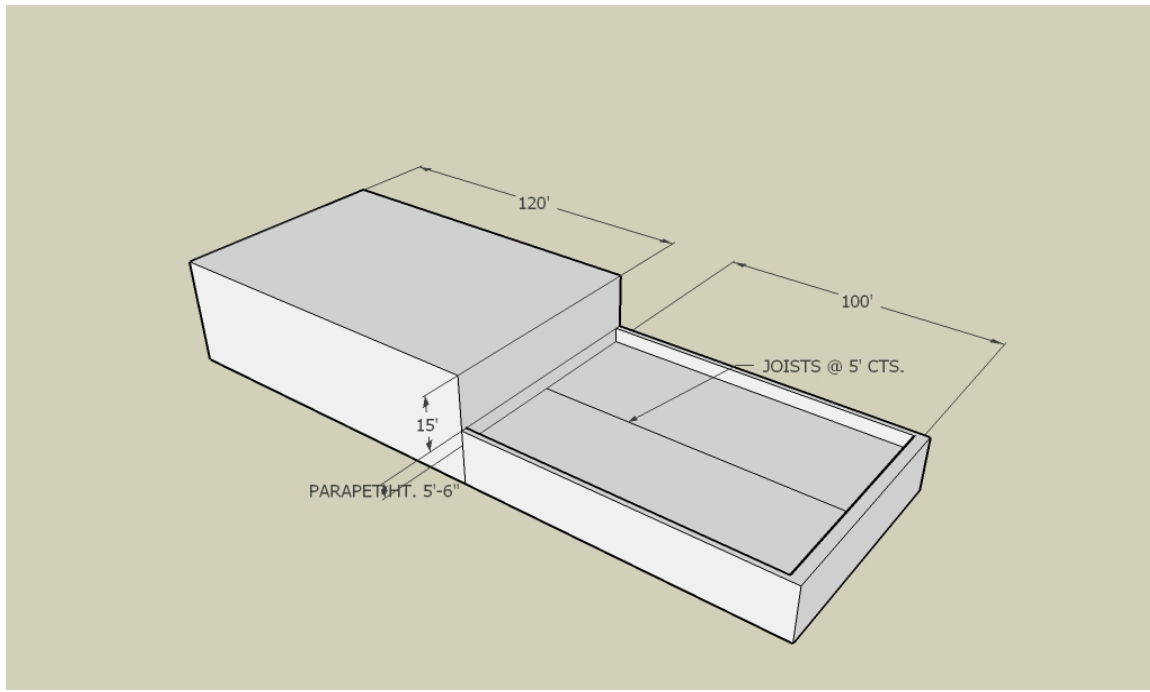


WHITE PAPER  
TRIAL DESIGN PROBLEM 01-08  
JUNE 5, 2009

## 1.0 Introduction

In a continued effort to evaluate general understanding of various technical code requirements, the Design Practices Committee developed Trial Design Problem 01-08 regarding snow loading. The problem consists of determining the snow loads for a typical roof member of a multi-level roof industrial building per the requirements of ASCE 7-05.

- a. Determine if the current Snow Load provisions of ASCE 7-05 are clearly understood and consistently applied.
- b. Identify needed revisions and clarification to the Snow Load provisions of ASCE 7-05.
- c. Promote dialog and continuing education among practicing engineers related to snow load provisions of ASCE 7-05.



## 2.0 Demographics of Participants

There were a total of 71 participants submitting solutions for this trial design problem. We sincerely thank those engineers who took the time to submit a solution. The more solutions that are submitted for these trial design problems, the more representative the results are of the entire engineering community. A break down of the participants is as follows:

|                            |                    |                     |                            |                  |
|----------------------------|--------------------|---------------------|----------------------------|------------------|
| Highest Educational Degree | None/Unknown<br>4% | Bachelors<br>54%    | Masters<br>39%             | PhD<br>3%        |
| Years Experience           | 0-5 Years<br>44%   | 6-10 Years<br>23%   | 11-20 Years<br>14%         | 21+ Years<br>19% |
| Professional Licensure     | None or EI<br>43%  | PE Only<br>34%      | PE + SE<br>23%             |                  |
| States                     | Virginia<br>18%    | Pennsylvania<br>15% | Ohio, North Carolina<br>7% | Others<br>53%    |

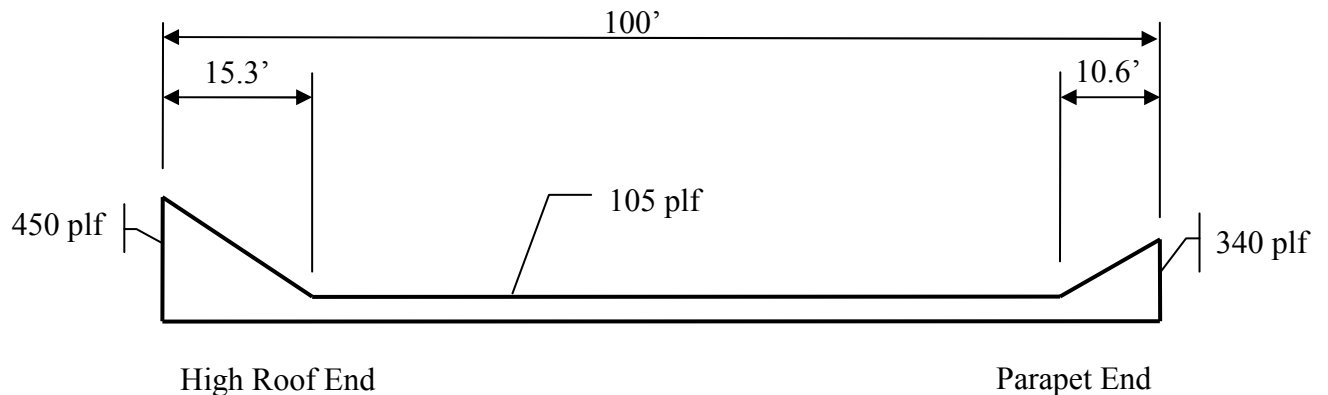
### 3.0 Evaluation of Responses

#### 3.1 Published Committee Solution

The trial solutions were evaluated relative to the final solution determined by the committee. The published solution developed by the committee is summarized as follows (a copy of the Published Committee Solution is attached):

|                     |                        |             |           |             |                        |
|---------------------|------------------------|-------------|-----------|-------------|------------------------|
| Flat Roof Snow Load | $P_g = 30 \text{ psf}$ | $C_e = 1.0$ | $I = 1.0$ | $C_t = 1.0$ | $P_f = 21 \text{ psf}$ |
|---------------------|------------------------|-------------|-----------|-------------|------------------------|

|                  |                          |                             |                           |
|------------------|--------------------------|-----------------------------|---------------------------|
| Lower Roof Drift | Drift Ht., $h_d = 3.83'$ | Drift Surcharge = 69 psf    | Drift Width = 15.3'       |
| Parapet Drift    | Drift Ht., $h_d = 2.64'$ | Drift Surcharge = 47 psf    | Drift Width = 10.6'       |
| Joist Snow Loads | Uniform = 105 plf        | Max. at Roof Step = 450 plf | Max. at Parapet = 340 plf |



Published Committee Solution Joist Load Diagram

## 3.2 Trial Solution Results

### 3.2.1 General

Most areas of the ASCE 7-05 Snow Load provisions were consistently implemented, including the ground snow load ( $P_g$ ), importance factor (I), and the thermal factor ( $C_t$ ). Over 94% of the solutions properly selected the ground snow load of 30 psf, while three submissions used a conservative ground snow load of 35 psf, and only one used an unconservative value of 25 psf. All but three of the submitted solutions used an importance factor of 1.0, two used 1.1 and one used an unconservative value of 0.8. All of the submittals included a thermal factor of at least 1.0 (four submittals used a conservative value of 1.1).

The values calculated for the flat roof snow load and lower roof drift at the roof step were accurate and consistent, when compared to the published committee solution. The mean values for the flat roof snow load all of the drift load values (height, surcharge pressure, and width) were very close to the published solutions, with relatively small standard deviations.

There were a few areas where significant percentages of the submitted solutions did not properly implement the snow load provisions of ASCE 7-05. Those items are discussed in detail below.

### 3.2.2 Exposure Factor, $C_e$

Six submittals, or roughly 8.5%, incorrectly assumed a “fully exposed” condition with an unconservative exposure coefficient of 0.9. Footnote *a* to Table 7-2, Exposure Factor,  $C_e$ , states that roofs with parapets that extend above the height of the balanced snow (or other obstructions) are not considered to be in the fully exposed category.

### 3.2.3 No Roof Projection Drift Load at Parapet

The ASCE 7-05 snow load provisions require the calculation and application of snow drift loads at roof projections, including parapet walls. Over 20% of the solutions did not apply a drift load at the parapet of the low roof. The snow drift load calculated in the published committee solution represents a significant increase to the normal flat roof uniform snow load, and could potentially cause significant performance issues in an actual structure if unaccounted for in design.

### 3.2.4 Determination of Flat Roof Length for Parapet Drift Calculation

The published committee solution and approximately 85% of the trial solutions with parapet drifts used the length of the lower flat roof in calculating the parapet drift height (i.e.  $l_u = 100'$ ). The remaining 15% of the trial solutions which included parapet drift calculations used the combined length of the upper and lower roofs in the calculation of

the parapet drift (i.e.  $l_u = 220'$ ). Although this results in a conservative calculation of the projection drift height, pressure, and width, it may be considered overly conservative since potentially the snow from the upper flat roof is being accounted for twice, once in the drift at the roof step and again at the exterior parapet.

#### 4.0 Recommendations

Based on the results of the solutions submitted for this trial design problem, we recommend the following:

- Consider increasing the visibility of the footnotes related to the application of the snow load coefficient tables, especially the parapet condition as it relates to the exposure coefficient, or consider including this description in the definition of the exposure conditions rather than in a footnote.
- Incorporate the parapet condition into a figure or exhibit which demonstrates the application of projection drifts. It appears that with over 20% of the solutions not including a drift at the parapet in this trial problem that the requirement for drifting snow load at parapets is not clearly understood.
- Include the condition of a multi-level roof with a parapet in a figure or exhibit to clarify the definition of  $l_u$  used in the equation for calculating projection drift height. Based on the trial solutions, this condition combining a multi-level roof with parapets, is not clearly understood, and is fairly common in building construction.