Determination of Live & Roof Live Loads as Per ASCE7-16

An Online Continuing Education Course for Engineers

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Determination of Live & Roof Live Loads as Per ASCE7-16

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1. Introduction

Structural design is a set of processes that assures that the building is capable of resisting applied loads, fulfilling its functions, and sustaining its stability.

The processes of structural design can be summarized in the following steps (Figure 01):

1. Determination of applied loads
2. Selection of economic and proper structural system
3. Structural analysis of structural systems to get internal actions
4. Design of structural members to resist internal actions

The determination of loads is a critical step because any deviation in calculations of applied loads will lead to an underestimation of loads, which may cause structural failures, or it will lead to an overestimation of loads, which may cause uneconomic design.

To understand the behavior of any structural load, the structural designer should know the following properties:

1. Value of the load
2. Minimum value set by the code of loads
3. Direction of the load with respect to the building or structural elements
4. Classification of load in load combinations
5. Load cases pattern

The value of the load is calculated from actual load applied on the building, such as dead load, or is extracted from code of load (ASCE7-16), such as live, roof live, snow, wind, and seismic load.

The minimum value of the load is the value that must be maintained and is set by code of loads (ASCE7-16) for certain loads, such as live, roof live, snow, wind, and seismic loads.

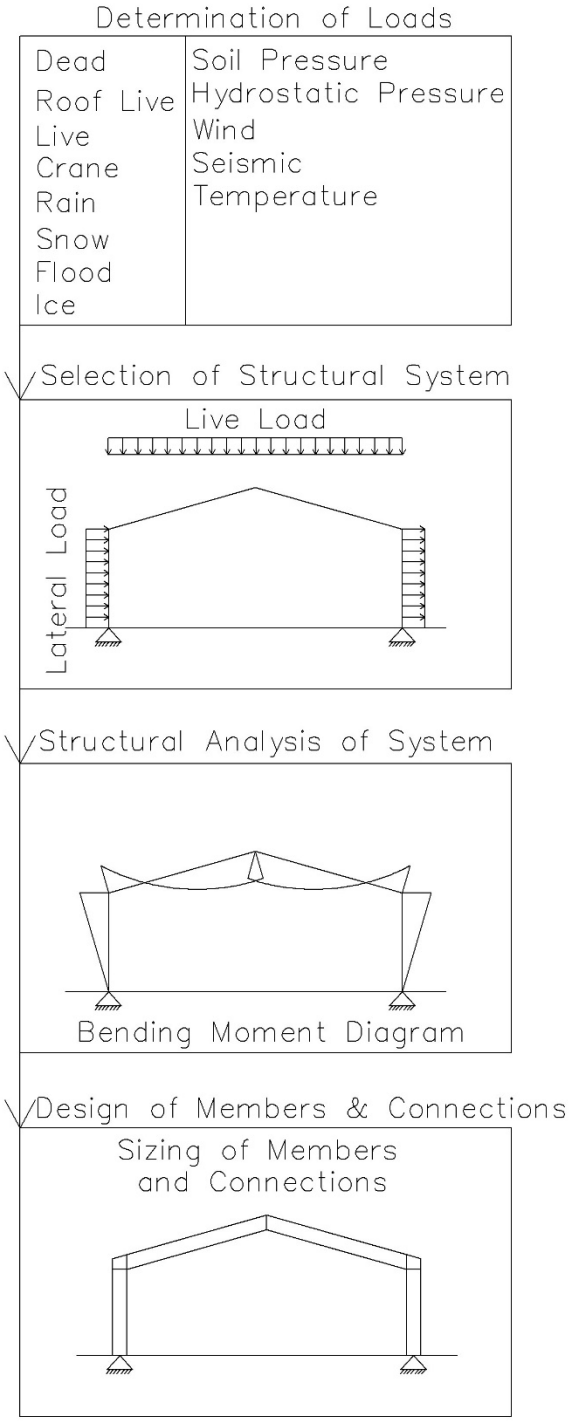


Figure (01). Steps of Structural Design

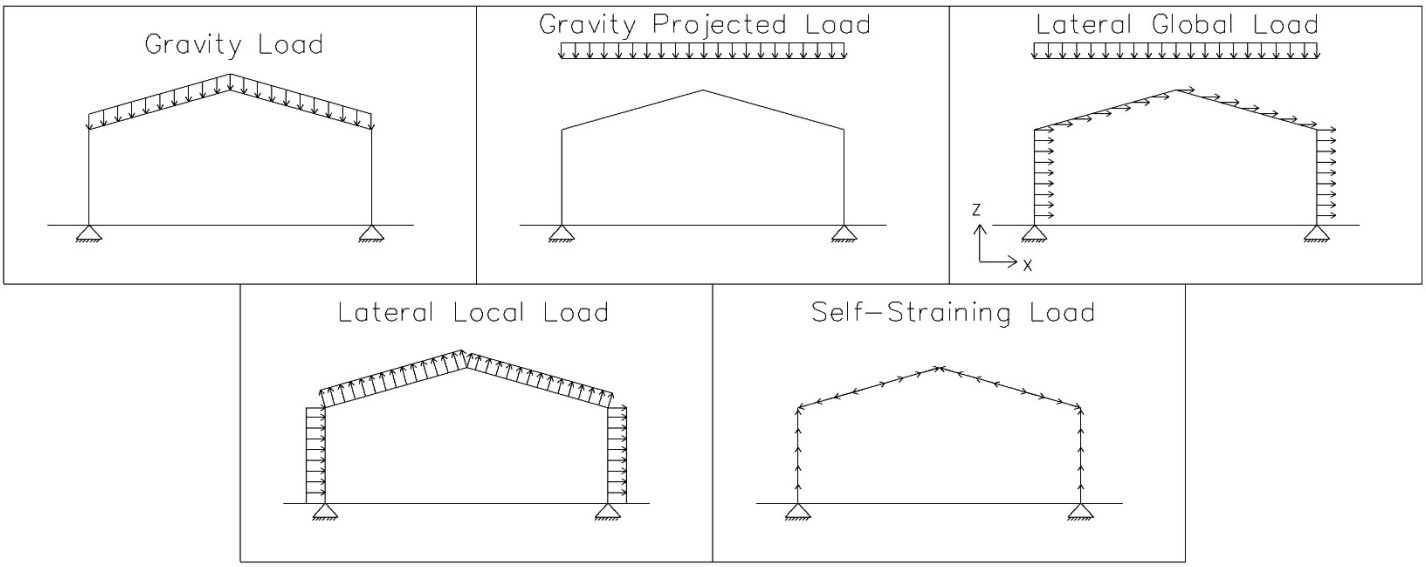
Sometimes, the code gives two values for the same load, a calculated value, and a minimum value. The structural designer should check that the calculated value is larger than the minimum value.

The direction of the load is quite important, as it translates the behavior of load. For example, the direction of wind pressure acting on frame rafter is perpendicular to the surface itself, which is different from the direction of a seismic load, which is acting in X, Y, or Z global directions.

Types of load directions (Figure 02):

1. Gravity loads: at which the load is distributed on the actual length of the structural member, like inclined roof members, and its direction is parallel to gravity force, such as dead, collateral loads.
2. Gravity projected loads: at which the load is distributed on the horizontal projection of the structural member, and its direction is parallel to gravity force, such as roof live, snow, and live loads.
3. Lateral global X, Y, or Z loads: at which the load is acting laterally at each unit of area of the floors and vertical elements, commonly these loads are a ratio of vertical loads, and its direction is parallel to X, Y, and Z direction, such as seismic, structural integrity and notional loads.
4. Lateral local loads: at which the load is distributed perpendicularly to the structural elements, even the member is inclined, such as wind loads.
5. Self-straining loads: such as temperature change, settlement, creep, and shrinkage loads.

Figure (02). Types of Directions of Loads



Classification of loads in load combinations is also important, as the improper determination of load, may increase or decrease the effect of the load, away from the true value, especially when the structural designer deal with loads that are not mentioned explicitly in the code of loads (ASCE7-16)

Classification of loads in load combinations:

1. A_k: load of extraordinary event
2. D: such as dead, collateral load
3. D_i: weight of ice
4. E: earthquake load

5. F: loads of fluids with well-defined pressures and maximum heights
6. F_a flood load
7. H: load due to lateral earth pressure, groundwater pressure, or pressure of bulk materials
8. L: Live load, crane lifted capacity, machine loads
9. L_r: roof live load
10. R: Rain load
11. S: Snow load
12. T: such as temperature change, settlement, creep, and shrinkage loads
13. W: Wind load
14. W_i: Wind on Ice

Load cases pattern, is the relation between the cases of the load, the following types of pattern demonstrate the concept clearly:

1. Single pattern: the load has only one load case, such as dead load of weights of materials and construction, as shown in Figure 03.

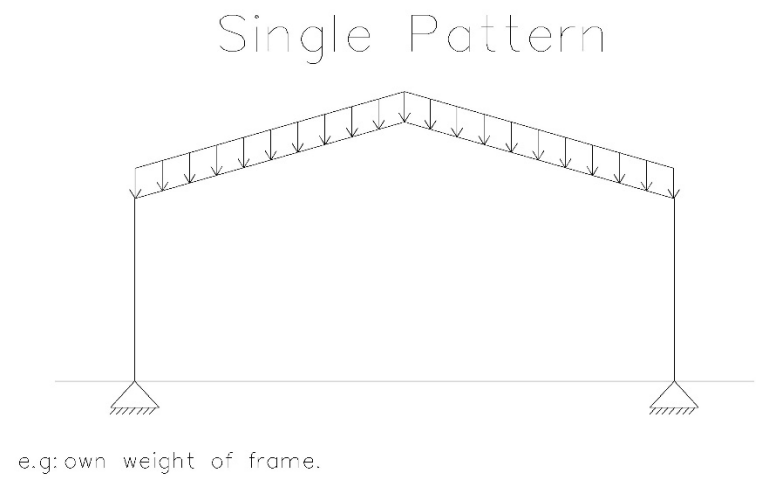


Figure (03). Single Pattern Loading

2. Separate patterns: each case of loading is added separately to the load combinations, such as varying dead loads of fixed service equipment, vegetation and landscaped roofs, snow load, or temperature variance, as shown in Figure 04.

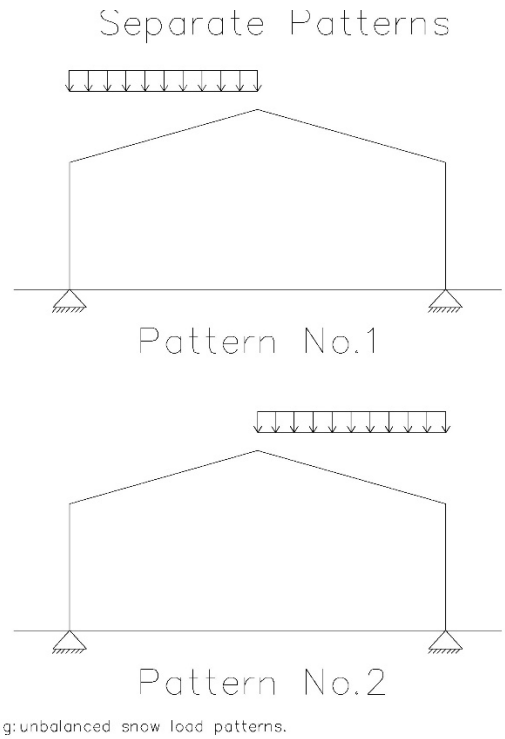


Figure (04). Separate Patterns Loading

3. Alternative patterns: cases of loads are added to each other's, in a way to give the maximum load effects on the structural elements, such as live load and roof live loads on continuous beams or frames, then adding these load patterns to the load combinations, as shown in Figure 05.

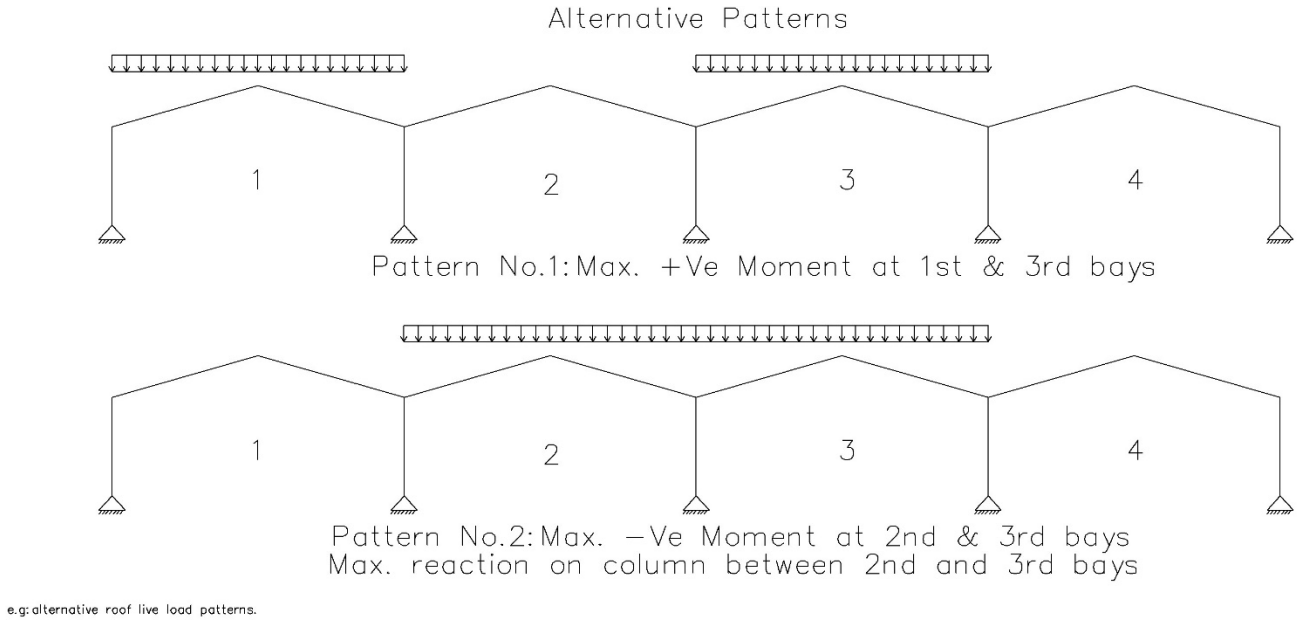


Figure (05). Alternative Patterns Loading

4. Summed patterns: cases of loads are combined in certain equations, such as summing some wind load cases with different directions, or some seismic load cases with different directions, as shown in Figure 06.

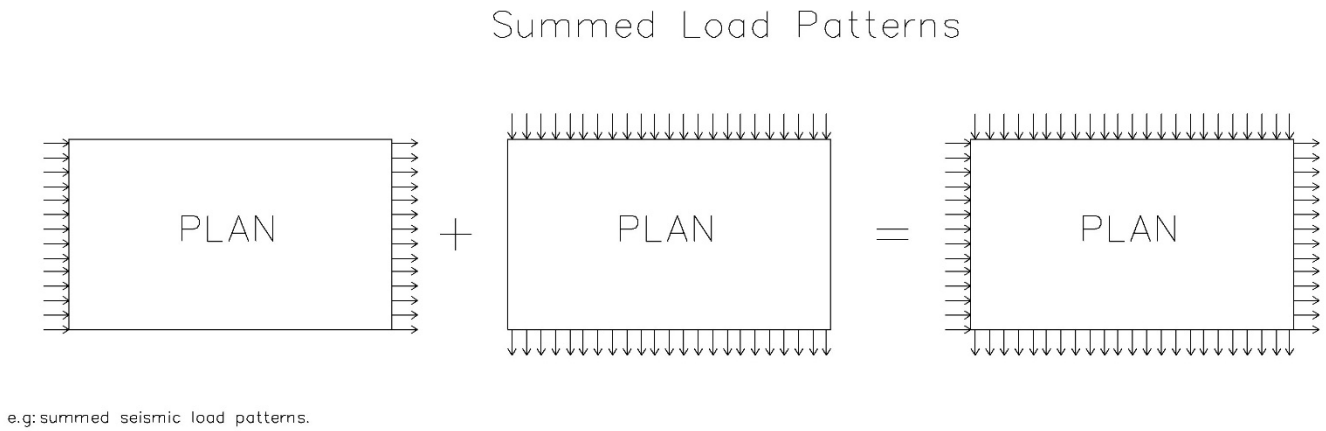


Figure (06). Summed Patterns Loading

In this course, we will study the determination of Live & Roof Live Loads, demonstrating the above information for each load.

2. Live Load (L) :

Based on the definition of ASCE7-16 f l produced by the use of occupancy of the bui onstruction or environmental l or dead loads.

Live load has ma f the building, such as loads of resident building.

Other forms of liv rs, grab bar systems, guardrail systems,

The live loads hav nd Concentrated Load. It is not requ the structure shall be designed to resis

According to 2018I ll be treated as Live Load.

All forms of live loa iations.

Based on the ASCE7 , Live Loads may be classified as the following:

1. Uniformly distributed live loads
2. Partition loads