VULCAN

STEEL STRUCTURES, INC.

DESIGN PRACTICES

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DESIGN PRACTICES

1. INTRODUCTION

Construction using a building systems approach has gained acceptance as the preferred method for all types of low-rise, non-residential building projects. Today, in the United States, the metal building industry accounts for over 65% of all construction in this category using the systems approach. The results are high quality, attractive buildings with higher reliability, flexibility, and lower life cycle costs than alternatives.

The building systems industry has gained its leadership position by constantly researching and developing technology to meet modern construction demands. The industry has developed structural systems designed to be compatible with ordinary construction materials such as masonry, glass and wood. Through research, this industry has been able to refine materials, manufacturing and construction techniques to gain the optimum results for in-place construction.

Throughout the history of the metal building industry, certain practices relating to the design, manufacture, sale and erection of a metal building have become traditional. These practices have delegated certain responsibilities to each of the parties involved in the sale of a metal building.

The objective of this Design Practices section is to provide general design information used by some building codes. Unfortunately, this information has not been consistent from one edition of a code to the next edition, much less among the different codes themselves. More specific information may be obtained by referring to the required code, or your Vulcan representative can provide a condensed summary of information for most of the major building codes.

2. DESIGN RESPONSIBILITY

If the Buyer or End Customer retains a design professional (Architect or Engineer as may be required by Code) for a construction project, it is the responsibility of this design professional to specify the design criteria for the metal building including all applicable design loads.

If, for any reason, the Buyer or End Customer does not retain a design professional, it then becomes the responsibility of the Buyer or End Customer, in consultation and coordination with local authorities having jurisdiction, to specify the design criteria for the metal building including all applicable design loads.

In no case is it the responsibility of the metal building manufacturer's personnel, to include the building designer/specialty engineer, to determine or specify any design loads.

It is Vulcan's responsibility to design the metal building to meet the specifications including the design criteria and design loads incorporated in the Order Documents. Vulcan is not responsible for making an independent determination of any local codes or any other requirements not part of the Order Documents.

Vulcan is responsible only for the structural design of the metal building it provides. Vulcan or Vulcan's engineer is not the Design Professional or Engineer of Record for the construction project. Vulcan is not responsible for the design of any components or materials not provided by Vulcan or their interface and connection with the metal building unless such design responsibility is specified in the Order Documents.

Vulcan does not investigate the influence of the metal building on existing building or structures. The End Customer assures that such buildings and structures are adequate to resist snowdrifts, wind loads or other conditions as a result of the presence of the metal building.

When specified by the Order Documents, Vulcan is responsible for supplying adequate evidence of compliance with the specifications, design criteria, and design loads, and other specified information.

3. BUILDING CODES

The dominant building code in the United Sates today is the International Building Code published by the International Code Council. The International Code Council (ICC) was established in 1994 as a nonprofit organization dedicated to developing a single set of comprehensive and coordinated national model construction codes. The founders of the ICC are Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International, Inc. (SBCCI). Since the early part of the last century, these nonprofit organizations developed the three separate sets of model codes used throughout the United States. Although regional code development has been effective and responsive to our country's needs, the time came for a single set of codes. The nation's three model code groups responded by creating the International Code Council and by developing codes without regional limitations the International Codes.

A second building code available today is published by the National Fire Protection Association, NFPA 5000, Building Construction and Safety Code. At the present time, this code has been adopted by only a few jurisdictions.

4. BUILDING USE CLASSIFICATIONS

Building use classifications are based on the nature of the occupancy or how the building will be used. Occupancy Categories are defined for purposes of applying wind, snow and earthquake provisions. When buildings or other structures have multiple uses (occupancies), the category selected shall be based on the highest classification. If a code uses a classification, the category must be listed on the Order Documents.

The following definitions were taken from ASCE 7 and are provided for general reference only.

Nature of Occupancy	Category
Buildings and other structures that represent a low hazard to human life in the event of failure including, but not limited to: • Agricultural facilities • Certain temporary facilities • Minor storage facilities	I
All buildings and other structures except those listed in Categories I, III, and IV	II
Buildings and other structures that represent a substantial hazard to human life in the event of failure including, but not limited to: • Buildings and other structures where more than 300 people congregate in one area • Buildings and other structures with day care facilities with capacity greater than 150 • Buildings and other structures with elementary school or secondary school facilities with capacity greater than 250 • Buildings and other structures with a capacity greater than 500 for colleges or adult education facilities • Health care facilities with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities • Jails and detention facilities • Power generating stations and other public utility facilities not included in Category IV • Buildings and other structures not included in Category IV (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing sufficient quantities of hazardous materials to be dangerous to the public if released.	III

Nature of Occupancy	Category
• Buildings and other structures containing hazardous materials shall be eligible for classification as Category II structures if it can be demonstrated to the satisfaction of the authority having jurisdiction by a hazard assessment that a release of the hazardous material does not pose a threat to the public	
Buildings and other structures designated as essential facilities including, but not limited to: • Hospitals and other health care facilities having surgery or emergency treatment facilities • Fire, rescue, ambulance, and police stations and emergency vehicle garages • Designated earthquake, hurricane, or other emergency shelters • Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response • Power generating stations and other public utility facilities required in an emergency • Ancillary structures (including, but not limited to, communication towers, fuel storage tanks, cooling towers, electrical substation structures, fire water storage tanks or other structures housing or supporting water, or other fire-suppression material or equipment) required for operation of Category IV structures during an emergency • Aviation control towers, air traffic control centers, and emergency aircraft hangars • Water storage facilities and pump structures required to maintain water pressure for fire suppression • Buildings and other structures having critical national defense functions • Buildings and other structures (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing extremely hazardous materials where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction. • Buildings and other structures containing extremely hazardous materials shall be eligible for classification as Category II structures if it can be demonstrated to the satisfaction of the authority having jurisdiction by a hazard assessment that a release of the extremely hazardous material does not pose a threat to the public. This reduced classification shall not be permitted if the buildings or other structures also function as essential facilities.	IV

Determination of classification shall be made by a design professional (Architect or Engineer as may be required by Code). The metal building designer/specialty engineer is not retained or obligated under the Contract Documents to make this determination. If the Buyer or End Customer determines the Occupancy Classification in lieu of a retained design professional, the Buyer or End Customer shall exempt and indemnify the building manufacturer and the metal building designer/specialty engineer from any claims of or related to improper classification.

5. DEFINITION OF LOADS

All Vulcan buildings are custom designed to meet the specific requirements of each project. Our engineers designed each structure in accordance with the required Building Code and design loads. The following is a brief description of design criteria.

Dead Load

The dead load is the weight of the building itself, and is comprised of the roof panels, trim, mastic, screws, purlins, eave struts, bolts and the structural frame.

DESIGN PRACTICES

Collateral Load

Collateral loads are additional dead loads hung from the building, such as sprinkler systems, drop ceilings, HVAC equipment, lighting etc. The MBMA Metal Building Systems Manual recommends the following collateral loads:

Sprinkler system - dry - wet	1.5 psf 3
Ceilings - Suspended Acoustical Fiber - Suspend Gypsum Board -1/2” - Suspend Gypsum Board - 5/8”	1 2 3
Lighting	0.1 to 1
HVAC Ducts	1

Roof Live Load

The roof live loads are produced (1) during maintenance by workers, equipment, and materials, and (2) during the life of the structure by movable objects such as planters and by people, but do not include wind, snow, seismic or dead loads. A clear distinction is made between “live” and “snow” loads. It is important that these two loads be treated separately because the probabilities or occurrence for snow loads are very different from those for roof live loads. Roof live load defined by the model codes is a reducible 20 pounds per square foot.

Ground Snow Load

The maps in the building codes for snow are for ground snow load, based on a 50-year mean recurrence interval.

Roof Snow Load

The roof snow load is almost always less than ground snow load based on the natural phenomenon that only a portion of the fallen snow would remain on the roof. Each building code has its own way of determining the roof snow load from the ground snow load.

Snow Exposure Factor

The roof exposure factor varies with the exposure category of the site. The roof snow load is higher for a site in a wooded area than it is for an adjacent site that is flat and open.

Terrain Category	**Exposure of Roof**		
	Fully Exposed	Partially Exposed	Sheltered
B (see Wind Exposure)	0.9	1.0	1.2
C (see Wind Exposure)	0.9	1.0	1.1
D (see Wind Exposure)	0.8	0.9	1.0
Above the tree line in windswept mountainous areas	0.7	0.8	N/A

The terrain category and roof exposure condition chosen shall be representative of the anticipated conditions during the life of the structure. An exposure factor shall be determined for each roof of a structure.

DESIGN PRACTICES

Partially Exposed. All roofs except as indicated below.

Fully Enclosed. Roofs exposed on all sides with no shelter** afforded by terrain, higher structures, or trees. Roofs that contain several large pieces of mechanical equipment, parapets that extend above the height of the balanced snow load, or other obstructions are not in this category.

Sheltered. Roofs located tight in among conifers that qualify as obstructions.

** Obstructions within a distance of 10h provide “shelter”, where h is the height of the obstruction above the roof level. If the only obstructions are a few deciduous trees that are leafless in winter, the “fully exposed” category shall be used except for terrain Category “A”. Note that these are heights above the roof. Heights used to establish the terrain category in Section 6.5.3 are heights above the ground.

Snow Thermal Factor

The thermal factor takes into account the heat that is transmitted from the interior of the structure and reduces the snow depth on the roof.

Thermal Condition*	Factor
All structures except as indicated below	1.0
Structures kept just above freezing and others with cold, ventilated roofs in which the thermal resistance (R-value) between the ventilated space and the heated space exceeds 25h · ft2 · °F/Btu	1.1
Unheated structures	1.2
* The thermal condition shall be representative of the anticipated conditions during winters for the life of the structure	

Snow Drifts

In areas where the ground snow load is 5 psf or greater, snow drifting caused by roof projections or multi-level roofs must be investigated by design. Drifts can also occur on separate, lower structures located within 20 feet of the new building. It is important, when applicable, to show all roof obstructions and lower adjacent structures within 20 feet of the new building on the order documents.

Wind Load

Almost all nationally recognized building codes in the United States, beginning in the early 1980’s, have adopted some form of wind design procedure based on extensive research on low-rise buildings conducted at the University of Western Ontario. That research project began in 1976 and has continued to present.

Wind Exposure Factor

An exposure category that adequately reflects the characteristics of ground surface irregularities shall be determined for the site at which the building or structure is to be constructed. For a site located in the transition zone between categories, the higher category shall apply.

Exposure B. Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger. Exposure B shall be assumed unless the site meets the definition of another type of exposure.

Exposure C. Open terrain with scattered obstructions, including surface undulations or other irregularities, having heights generally less than 30 feet extending more than 1,500 feet from the building site in any quadrant. This exposure shall also apply to any building located within Exposure B-type terrain where the building is directly adjacent to open areas of Exposure C-type terrain in any quadrant for a distance of more than 600 feet. This category includes flat open country, grasslands and shorelines in hurricane-prone regions.

Exposure D. Flat, unobstructed areas exposed to wind flowing over open water (excluding shorelines in hurricane-prone regions) for a distance of at least 1 mile. Shorelines in Exposure D include inland waterways, the Great Lakes and coastal areas of California, Oregon, Washington and Alaska. This exposure shall apply only to those buildings and other structures exposed to the wind coming from over the water. Exposure D extends inland from the shoreline a distance of 1,500 feet or 10 times the height of the building or structure, whichever is greater.

Floor Live Load

Floor live loads are based upon occupancy and usage. The Vulcan order form “Second Floor Information Sheet” has reprinted the minimum uniformly distributed and concentrated floor live load table from ASCE 7. Other building codes will have a similar, but possibly slightly different table. The floor will be designed to support safely the uniformly distributed or the concentrated live load, whichever produces the greater load effects.

Partition Load

In offices and other buildings where partitions will be erected, rearranged, or relocated, provisions must be made to support the actual weight of such partitions where the partitions occur, or for an equivalent uniform load, which may be assumed to be not less than 20 psf. Provisions for partition weight must be made whether or not partitions are shown on the construction documents, unless the specified live load exceeds 80 psf.

Seismic Load

The Building Seismic Safety Council (BSSC) under the sponsorship of the Federal Emergency Management Agency (FEMA) prepares the NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings and Other Structures. NEHRP stands for the National Earthquake Hazards Reduction Program. Since 1985, the NEHRP Provisions have been updated every 3 years. The latest edition utilizes spectral response design maps that reflect seismic hazards on the basis of contours. These maps were completed by the U.S. Geological Survey (USGS).

Every building is designed to resist seismic effects even though other loads, such as wind, produce greater demands on the building.

6. CRANE CLASSIFICATIONS

The Crane Manufactures Association of America (CMAA) has established various classifications of crane service depending on usage. These classes have been established so that the most economical crane for the installation may be specified. These classes are also used by Vulcan’s engineers to establish runway beam fatigue design criteria. These classes are reprinted on Vulcan’s order for: “Crane Information Sheet.