Postgraduate Certificate in Structural Steel Design

Steel Seismic Design

Base Shear Force (Vb): The total lateral force or shear force that a structure is designed to resist at its base due to seismic activity. It is calculated as the product of the seismic coefficient (defined by building codes), the weight of the building, and a reduction factor (R) that takes into account the ductility and energy absorption capacity of the structure.

Beam-Column Element: A type of structural member that functions as both a beam and a column, resisting both bending and axial forces. In steel structures, beam-column elements are often used in moment-resisting frames, where they are designed to resist both gravity loads and lateral forces due to earthquakes.

Capacity Design: A method of seismic design that aims to ensure that a structure has sufficient ductility and energy absorption capacity to withstand earthquake forces without collapsing. It involves designing critical members, such as beam-column elements, to yield before other less ductile members, thus ensuring that the structure can dissipate energy through controlled plastic deformations.

Damping Ratio: A measure of the energy dissipation capacity of a structure due to the internal friction and other non-linear behavior of the materials. In seismic design, a higher damping ratio implies that the structure will experience less lateral displacement and acceleration during an earthquake.

Diaphragm: A horizontal or sloping structural element that transfers lateral forces from the building's exterior to the interior frames or shear walls. Diaphragms are typically made of reinforced concrete or steel decking and are designed to resist shear and bending forces due to lateral loads.

Ductility: The ability of a material or structure to undergo large plastic deformations without losing its load-carrying capacity. In seismic design, ductility is a critical factor in ensuring that a structure can absorb energy and deform in a controlled manner during an earthquake.

Eccentric Bracing Frame (EBF): A type of steel frame that uses diagonal braces to resist lateral forces due to earthquakes. In an EBF, the braces are arranged in a chevron pattern and are connected to the beam-column joints with eccentric connections, which allow the braces to buckle and dissipate energy during an earthquake.

Elastic Behavior: The behavior of a structure under small loads or deformations, where the material remains in the linear-elastic range and the structure returns to its original shape and position when the load is removed. In seismic design, elastic behavior is used to calculate the base shear force and other seismic demands on a structure.

Equivalent Lateral Force (ELF) Method: A method of seismic design that calculates the lateral forces on a structure based on its mass, height, and period of vibration, as well as the seismic hazard level and site conditions. The ELF method is a simplified approach that is widely used in building codes and design guidelines for steel structures.

Force-Based Design (FBD): A method of seismic design that focuses on the distribution and magnitude of the forces that a structure is subjected to during an earthquake. FBD is based on the principles of static or dynamic analysis and is used to calculate the member forces, story drifts, and other seismic demands on a structure.

Inelastic Behavior: The behavior of a structure under large loads or deformations, where the material exhibits non-linear behavior and the structure may undergo significant plastic deformations. In seismic design, inelastic behavior is expected and is taken into account through capacity design and other methods that ensure that the structure can dissipate energy and deform in a controlled manner during an earthquake.

Inelastic Energy Demand: The amount of energy that a structure is expected to dissipate during an earthquake due to plastic deformations and other non-linear behavior. In seismic design, the inelastic energy demand is estimated based on the structure's mass, stiffness, and ductility, as well as the seismic hazard level and site conditions.

Interstory Drift: The relative lateral displacement between two adjacent stories of a building, expressed as a percentage of the story height. Interstory drift is a critical parameter in seismic design, as it affects the stability and serviceability of the structure.

Modal Analysis: A method of structural analysis that calculates the natural frequencies, modes of vibration, and other dynamic properties of a structure. In seismic design, modal analysis is used to determine the dominant modes of vibration of a structure and to calculate the seismic demands on the structure based on its dynamic response.

Modal Participation Factor: A measure of the contribution of a mode of vibration to the overall response of a structure under lateral loads. In seismic design, the modal participation factors are used to calculate the seismic demands on a structure based on its dynamic response.

Plastic Hinge: A region of a structural member where significant plastic deformations occur during an earthquake, leading to a loss of stiffness and load-carrying capacity. Plastic hinges are expected to form in ductile structures, and their formation is taken into account through capacity design and other methods that ensure that the structure can dissipate energy and deform in a controlled manner during an earthquake.

Redundancy: The ability of a structure to distribute loads and deformations among multiple members or paths, such that the failure of one member or path does not lead to the collapse of the entire structure. In seismic design, redundancy is an important factor in ensuring that a structure can withstand earthquake forces without collapsing.

Response Spectrum: A graphical representation of the maximum response of a structure to different levels of ground motion, expressed in terms of displacement, velocity, or acceleration. Response spectra are used in seismic design to calculate the seismic demands on a structure based on its dynamic response.

Seismic Coefficient (Cs): A dimensionless parameter that represents the lateral force or shear force that a structure is designed to resist due to seismic activity. The seismic coefficient is defined by building codes and is based on the seismic hazard level, site conditions, and other factors that affect the seismic response of the structure.

Seismic Design Force: The lateral force or shear force that a structural member is designed to resist due to seismic activity. The seismic design force is calculated based on the seismic coefficient, the weight of the structure, and other factors that affect the seismic response of the member.

Seismic Hazard: The likelihood and severity of earthquake ground motion at a given location, expressed in terms of peak ground acceleration (PGA), spectral acceleration (SA), or other parameters. Seismic hazard is an important factor in seismic design, as it affects the seismic demands on a structure and the level of protection that is required to ensure public safety and structural integrity.

Seismic Joint: A structural connection that allows for differential movement between adjacent parts of a structure due to earthquake forces. Seismic joints are used in steel structures to accommodate the relative displacements and rotations that occur during an earthquake, and to prevent the formation of brittle fractures and other types of damage.

Seismic Load: The lateral force or shear force that a structure is subjected to due to earthquake forces. Seismic load is calculated based on the seismic coefficient, the weight of the structure, and other factors that affect the seismic response of the structure.

Seismic Performance: The ability of a structure to withstand earthquake forces without collapsing or suffering significant damage. Seismic performance is an important factor in seismic design, as it affects the safety and serviceability of the structure, as well as the cost and feasibility of repair and reconstruction after an earthquake.

Seismic Risk: The likelihood and consequences of earthquake damage to a structure, expressed in terms of the probability of exceedance, the expected annual loss, or other parameters. Seismic risk is an important factor in seismic design, as it affects the level of protection that is required to ensure public safety and structural integrity, as well as the cost and feasibility of insurance and other risk management strategies.

Stiffness: The ability of a structure to resist deformation under lateral loads, expressed in terms of its lateral stiffness or flexural stiffness. Stiffness is an important factor in seismic design, as it affects the natural frequency, mode shape, and dynamic response of the structure, as well as the distribution and magnitude of the forces that the structure is subjected to during an earthquake.

Story Drift: The relative lateral displacement between two adjacent stories of a building, expressed as a percentage of the story height. Story drift is a critical parameter in seismic design, as it affects the stability