5.3 EQUIVALENT DESIGN LOADS WHEN THE STRUCTURE IS SUBJECTED TO EARTHQUAKE LOADING.

The seismic loads on the structure during an earthquake result from inertia forces which were created by ground accelerations. The magnitude of these loads is a function of the following factors: mass of the building, the dynamic properties of the building, the intensity, duration, and frequency content of the ground motion, and soil-structure interaction.

In recent years, a lot of achievements have been made to incorporate these influential factors into building codes accurately as well as practically. The basis for IBC 2000 seismic provisions is the 1997 NEHRP "Recommended Provisions for the Development of Seismic Regulations for New Buildings and Other Structures" (FEMA 302).

The National Earthquake Hazard Reduction Program (NEHRP) is managed by the Federal Emergency Management Agency (FEMA),In IBC 2000, the seismic loads are on a strength level limit state rather than on a service load level, which was used in UBC 94 and prior versions. The seismic limit state is based upon system performance, not member performance, and considerable energy dissipation through repeated cycles of inelastic straining is assumed.

Criteria Selection

In IBC 2000, the following basic information is required to determine the seismic loads:

I. Seismic Use Group According to the nature of Building Occupancy, each structure is assigned a Seismic Use Group (I, II, or III) and a corresponding Occupancy Importance (1) factor (1 E 1.0, 1.25, or 1.5).Seismic Use Group I structures are those not assigned to either Seismic Use Group H or III. Seismic Use Group 11 are structures whose- failure would result- in a substantial public hazard due to occupancy or use. Seismic Use Group III is assigned to structures for which failure would result in loss of essential facilities required liar post earthquake recovery and those containing substantial quantities of hazardous substances.

2. Site Class eased on the soil properties, the site of building is classified as A, B, C, D, E and F to reflect the soil-structure interaction. Refer to 113C 2000. for Site Class definition.

3. Spectral Response Accelerations SS and S1 The spectral response seismic design maps reflect seismic hazards on the basis of contours. They provide the maximum considered earthquake spectral response acceleration at short period SS and at 1-second period Sl. They are for Site Class B, with 5% of critical damping. Refer to the maps in IBC 2000.

4. Basic Seismic-Force-Resisting System Different types of structural system have different energy-absorbing characteristics. The response modification coefficient R in Table 5.9 is used to account for these characteristics. Systems with higher ductility have higher R values.

With the above basic parameters available, the following design and analysis criteria can be determined. Seismic Design Category. The Seismic Design Category is based on the seismic group and the design spectral response acceleration coefficients, SDS and SDI, which will be explained later.

The Seismic Design Category for a structure can be determined in accordance} Seismic Design Categories are used to determine the permissible structural systems, the limitations on height and irregularity of the structural components that must be designed for seismic resistance and the types of lateral force analysis that must be performed.

Seismic Use Groups I and II structures located on sites with mapped maximum considered earthquake spectral response acceleration at 3.-second period SI, equal to or greater than 0.75g, shall be assigned to Seismic Design Category E. Seismic Use Group IIl structures located on such sites shall be assigned to Seismic Design Category F. A structure assigned to Seismic Design Category E or F shall not be sited where there is the potential for an active Fault to cause rupture of the ground surface at the structure. Building Irregularity. Building with irregular shapes, changes in mass from floor to floor, variable stiffness with height, and unusual setbacks do not perform well during earthquakes.

Thus, for each type of these irregularities, additional design requirements shall be followed to maintain seismic-resisting capacity. IIIC 2000 requires that all buildings be classified as regular or irregular based on the plan and vertical configuration.

Structures assigned to Seismic Design Category A need only comply with the following:

Structure shall be provided With a complete lateral-force-resisting system designed to – resist the minimum lateral force, of 1% floor gravity load. The gravity load should include the total dead load and other loads listed below.

In areas used for storage, a minimum of 25% Of the reduced floor live load [floor live load in public garages and open parking structures need not be included)

Where an allowance for partition load is included in the floor load design, the actual partition weight or a minimum weight of 10 psf of floor area (whichever is greater)

Total operating weight of permanent equipment

= 20% of flat roof snow load where flat roof snow load exceeds 30 psf

The direction of application of seismic forces used in design shall be that which will produce the most critical load effect in each component. The design seismic forces are permitted to be applied separately in each of two orthogonal directions and orthogonal effects are permitted to be neglected.

The effect of this lateral force shall be taken as E in the load combinations.

Special seismic load combinations that include Em need not to be considered, The primary objective of earthquake resistant design is to prevent building collapse during earthquakes thus minimizing the risk of death or injury to people in or around those buildings. Because damaging earthquakes are care, economics dictate that damage to buildings !s expected and acceptable provided collapse is avoided.

Earthquake forces are generated by the inertia of buildings as they dynamically respond to ground motion. The dynamic liatuve of the response makes earthquake loadings markedly different from other building loads.