

1.5 Overview of Building Codes and Fire Standards

1.5.1 Building Codes

Building design and occupancy in the United States is governed by building codes that specify the minimum environmental, or external, loads that a building must have the strength to resist. They also prescribe requirements for internal challenges such as fire protection and timely egress for life safety. However, designers must consider project circumstances and owner requirements when determining building design loads. The primary external loads specified are:

- gravity
- wind
- earthquake

Other risks considered include the potential for fire, hazardous material leaks or explosion, and the need to promptly evacuate occupants to safety. These demands establish building code requirements for fire resistive construction, emergency egress, and fire protection systems.

National model building codes do not include requirements to design for loads that might be imposed due to acts of war or terrorism. It is usually considered unnecessary to provide the capacity to resist such loads in most buildings; however, these loads may be included at the discretion of building owners if they desire a higher level of protection (e.g., an embassy, bank, or military facility).

Gravity loads include both the weight of the building and its contents. The weight of the building is calculated based on building construction plans and material densities. The weight of the contents is not specifically known at the time of design because it will depend on the building user and will vary with time. Therefore, the codes specify minimum floor loads on a pounds per square foot basis. For instance, for a standard office occupancy, the codes typically specify a minimum live load of 50 pounds per square foot (psf) of floor area. It is the responsibility of the building owners to see that floors are not overloaded.

Wind loads specified by codes are based on maps of design wind speed for different regions of the country. As wind speed increases, the wind pressure on the building increases proportionally to the square of the wind velocity. The pressure on the building also varies with the height and degree of shielding provided by other buildings and geographic features. Although not usually required by building codes, engineers frequently use wind tunnel studies to more accurately determine wind loads on tall buildings, where standard calculations may not be adequate. WTC 1, 2, 4, 5, and 6 all had extensive wind tunnel studies performed as part of the design process. WTC 1 and WTC 2 were among the first structures that were designed using wind tunnel studies.

The hazard presented by earthquakes is also highly dependent on the geographic region. In all regions of the country, including the most severe seismic areas of California, the effects of earthquakes are relatively small for very tall buildings. The flexibility of a very tall building, say 100 stories, generally allows the building to respond as the ground moves back and forth without developing forces nearly as large as those produced by design wind loads. Therefore, even in a severe seismic area, tall building design is generally controlled by wind loads.

Engineers design buildings for gravity, wind, and earthquake loads. Architects, in concert with fire protection professionals, including fire protection engineers, oversee the selection and application of fire resistive construction elements and fire protection systems such as sprinklers, fire alarms, and special hazard protection.