Capacity Design

Capacity Design is a design process in which it is decided which objects within a structural system will be permitted to yield (ductile components) and which objects will remain elastic (brittle components).

Once ductile and brittle systems are decided upon, design proceeds according to the following guidelines:

- **Ductile components** are designed with sufficient deformation capacity such that they may satisfy displacement-based demand-capacity ratio.

- **Brittle components** are designed to achieve sufficient strength levels such that they may satisfy strength-based demand-capacity ratio.

It is best to implement Capacity Design because structural performance is then a deliberate intention of the designer, and not revealed in a secondary manner by computational tools. Further, because of the many sources of uncertainty inherent to structural modeling and analysis, unless ductile systems are predetermined, a computational tool may not accurately indicate which systems will achieve inelastic response. In summary, Capacity Design enables the creation of a more reliable computational model, which should lead to better structural design.

Capacity Design also comes to the relief of computational time. When an engineer knows which objects will behave elastically, and which will be permitted to yield, *material nonlinearity* need only be modeled for ductile components, while components which will not yield need only consider elastic stiffness properties. These relationships are linear, which provides for a more simple formulation of less computational demand. Brittle components are redesigned such that strength capacity exceeds that demanded. A level of complexity comes with the redesign of ductile components, however, in that ductile components may satisfy nonlinear demand-capacity criteria through a balance of both strength and deformation capacity.

While Capacity Design should lead to more reliable modeling and more accurate results, engineers should note that computational models only represent a mathematical simulation of physical phenomena, and cannot exactly predict structural behavior. Too many sources of uncertainty exist, and it is up to the designer to best characterize as many behavioral parameters as is practical.