The process by which vibration steadily diminishes in amplitude is called damping.

In damping the energy of the vibrating system is dissipated by various mechanisms, and often more than one mechanism may be present at the same time.

In simple “clean” systems such as laboratory models, most of the energy dissipation presumably arises from the thermal effect of repeated elastic straining of the material and from the internal friction when a solid is deformed.

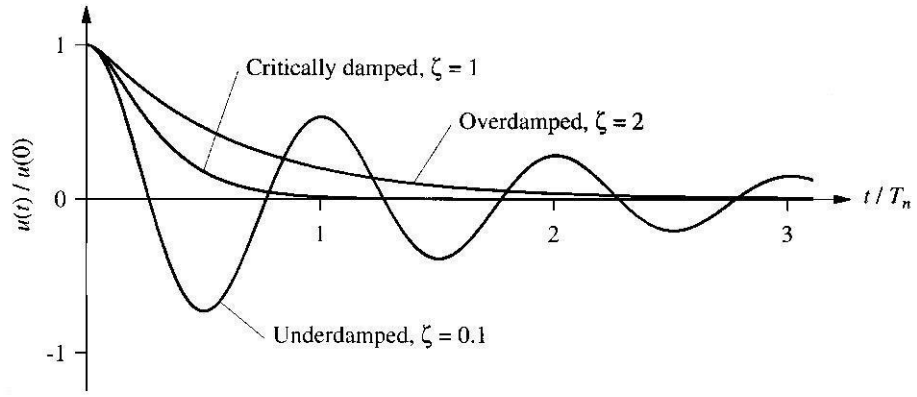
In actual structures many mechanisms contribute to the energy dissipation. In a vibrating building these may include such items as:

- Friction at steel connections
- Opening and closing of micro-cracks in concrete
- Friction between the structures itself and non-structural elements such as partition walls.

- If $c = c_{cr}$ or $\zeta = 1$, then the system returns to its equilibrium position without oscillating. This type of system is said to be *critically damped*.

- If $c > c_{cr}$ or $\zeta > 1$, the system does not oscillate and returns to ist equilibrium position, but at a slower rate than when $\zeta = 1$. This type of system is said to be *overdamped*.

- If $c < c_{cr}$ or $\zeta < 1$, the system oscillates about its equilibrium position with progressively decreasing amplitude. This type of system is said to be *underdamped*.



Free vibration of underdamped, critically damped, and overdamped systems.

The damping coefficient c_{cr} is called the *critical damping coefficient* because it is the smallest value of *c* that inhibits oscillation completely. It represents the dividing line between oscillatory and nonoscillatory motion.

As architects and structural engineers of we will only be considering *underdamped* systems since the most of the structures of interest to us – buildings, bridges, dams, nuclear power plants, offshore structures, etc. all fall into this category. Typically the damping ratio of the structures just mentioned is less than 0.10.

(Critically damped and overdamped systems do exist. For example, recoil mechanisms, such as the common automatic door closer, are overdamped. Instruments used to measure steady-state values, such as a scale measuring dead weight, are usually critically damped.)