



A FEW COMMONLY ASKED QUESTIONS CONCERNING SEISMIC ISOLATION OF HOSPITALS

1. Why does Taylor Devices, Inc. recommend base isolation for hospitals?

ANSWER: Because only base isolation protects the hospital building, and its personnel and its contents. Conventional "shock hardening" techniques with a fixed base design protects only the building. In the event of a severe earthquake, a conventional "hardened structure" will substantially damage delicate medical equipment. Even if only a single piece of equipment is damaged on a floor, all equipment on that floor cannot be used. This is due to the risk of possible hidden damage or calibration drift that could prove potentially life threatening to patients.

2. Why not just use base isolation bearings, without dampers. For example, what about a high damping rubber bearing?

ANSWER: The response of any damped bearing is essentially that of a spring, with a superimposed hysteretic (friction) damping output. During a seismic event, the step-function output of hysteretic dampers are extremely damaging to personnel and equipment. Fluid damping is non-hysteretic, its output is essentially out of phase with that of the spring force of the bearing. Thus, fluid damping is not damaging to personnel and equipment, plus it greatly reduces the required displacement of the base isolation bearings; reducing cost, complexity, and size of the bearings.

3. How much damping should be used?

ANSWER: Taylor Devices recommends that damping values of 25%+ are absolutely required, due to the high variance found in real world seismic transients. A real world distinction exists between a randomized time history (or a group thereof) and the possibility of a realistic transient that dwells at a specific frequency for even a few seconds. This so-called "quasi-resonance" effect has been noted in recent earthquake time histories. The classical solutions for transient response do not allow for quasi-resonance effects, because amplification under resonance is much more severe than amplification from a transient.



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For example, at 10% damping, the steady state resonance amplification factor is 5:1, producing severe structural damage. However, at 25% damping, amplification reduces to 2:1, a value that is usually considered acceptable for seismic design. The conventional seismic analysis using either design level spectra or transients does not take into account the quasi-resonance phenomena. The problem becomes even worse for fixed base structures with much less damping. If a design is to be truly earthquake resistant, then it must take into account all potential failure inducing mechanisms of the expected pulse field. If a minimum displacement isolation system is desired, then fluid damping levels as high as 50% of critical can be used before damping forces begin to dominate the response.

A good comparison can be made with an automobile suspension, a design subjected to truly random inputs with frequent dwelling at resonance. After nearly 100 years of design evolution, all automobiles use fluid damping, with the following values:

"Standard" Suspension = 20-30% Critical

"Heavy duty" Suspension = 30-40% Critical

"Off-road" Suspension = 40-50% Critical