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SOUND AND VIBRATION ISOLATION

SOUND ISOLATION

Airborne sound transmission is generally reduced by two methods. One is to increase the mass of the walls, floors, or ceilings separating spaces from each other and the other is to introduce an air gap between relatively airtight constructions.

According to the Law of Mass stating the limit of any solid material to reduce sound transmission sound through a material, a doubling of the mass will yield a 5 decibel increase in the sound transmission loss of a barrier. Within practical limits of construction materials, it becomes impractical to rely on mass alone for sound isolation.

Assuming a construction component weighing 5 pounds per square foot has a transmission loss of 30 decibels, doubling the weight to 10 pounds per square foot increases the transmission loss to 35 decibels. Again doubling the weight to 20 pounds per square foot results in a transmission loss of 40 decibels.

The doubling of mass to achieve sound isolation quickly develops a condition of diminishing return.

The introduction of an air gap between structural components tremendously improves the sound transmission class.

If a 6-inch concrete slab is increased to 10 inches by additional 4-inch concrete pour, the STC is increased from 54 to 57. The introduction of a 1-inch air gap between a 6-inch and a 4-inch slab raises the STC to 76, a dramatic increase of 19. Increasing the air gap to 4 inches raises the STC to 82.

The inclusion of a lightweight fiberglass in the air space between massive structural elements produces minimal results. In a test conducted at Riverbank Laboratories, the inclusion of 2 inches of fiberglass into the void increased the STC by 3 beyond the original [illegible].

There are two basic floating concrete floor systems. The jack-up or lift slab system utilizes plastic sheeting placed on the structural subfloor as a bond breaker, isolators are placed on the plastic sheeting, reinforcing steel is set, and the concrete floor is poured. After the concrete slab is cured, the floor is lifted by turning adjustment bolts built into the isolators. The slab can be lifted to provide any practical air gap between 1 inch and 4 inches. The isolators used in this system are bell-shaped metal castings with built-in jack screws and 2-inch thick neoprene pads.

The other method utilizes individual neoprene isolators, normally 2 inches thick, cemented to the structural slab to establish the air gap. The isolators are covered with plywood or metal forming. If plywood is used, the top surface is covered with polyethylene sheeting. Reinforcing is placed over the formwork and the concrete is poured.

Both types of systems are separated from the side walls with 1/2-inch of 10 pound fiberglass or neoprene sponge. The joint at the floor is caulked with non-hardening, non-drying, and non-bleeding sealant.

If floor drains are required, special floating floor drains must be used.

Some manufacturers of isolation systems, both jack-up and formwork types, recommend mounting heavy equipment on full-sized concrete pads that are supported directly on the structural floor and isolated from the floating slab by use of perimeter separators. This localized massive support raises the efficiency of the machinery isolators. These mounting pads are generally 4 or 5 inches thicker than the total structural/air gap/isolated floor combination, thereby minimizing the STC differential between the isolated floor system and the solid pad construction.

VIBRATION ISOLATION

Steel spring mountings are by far the most widely used equipment vibration isolators. Springs provide an easily variable design medium and are as permanent as the equipment itself when selections are made within proper stress values. Most isolators are simply steel springs with sufficiently large diameters to provide stability without the need for supplementary housing. They are generally manufactured with an adjustment bolt and a neoprene pad in series with the spring to attenuate high frequencies.

Mathematical efficiency charts for isolator selection assume great stiffness and mass under the isolators. This is not necessarily true in structurally supported floors. For any given operating speed there will be a need for a larger spring deflection when the equipment is located in areas with long unsupported spans because long spans have the potential of making the floors more flexible and vibration prone.

Isolated equipment should be made to move as freely as possible and restricted by connected piping or ductwork. Flexible neoprene connectors contribute to the reduction of noise and vibration.

Floating ceilings are another means of reducing sound transmission. Since ceiling construction is relatively light in weight as compared to floor construction, the STC ratings are comparably low. The ceiling system isolators consist of a neoprene isolation element at the top and a coil steel spring seated in a neoprene cup on the bottom. Both the element and the cup are molded with a bushing that passes through a steel frame connecting the two parts.

In cases where vibration or impact is more of a factor than noise, input frequencies lower than 20 hertz for instance, spring isolators should be used for isolated floor systems rather than the rigidly fixed or jack-up systems previously described for sound isolated floors. The specified deflection of the spring is a function of the input frequency.