Remote Monitoring Measures The Impact of Construction

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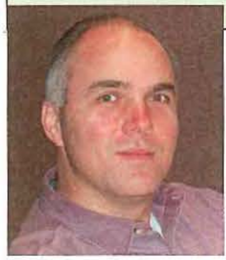
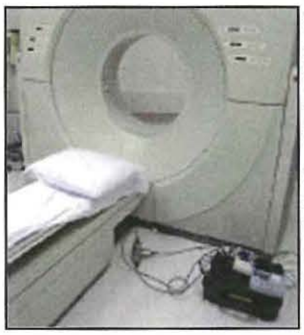


By Jeffrey A. Zapfe, Ph.D. President of Acentech, Inc.

Until recently, vibration sensitive equipment like MRIs and electron microscopes were typically located on grade-supported slabs, often in the hospital's basement. This type of equipment has been migrating upward, closer to patients, where it is on more flexible floors that are more prone to vibrations which may interfere with the equipment's efficient operation.

The suppliers of sensitive equipment generally specify specific limits on the vibrations of the floor on which the equipment is to be located.



Unfortunately, the exact equipment items to be placed in a facility are often not known early in the facility's design process. Because of this, a set of generic vibration criteria (shown, for example, in AISC Design Guide 11 "Floor Vibrations Due To Human Activity") has been developed to allow designers to classify the vibration sensitivity of a building's areas and thereby to enable the design of suitable structures.

These generic criteria are given in terms of "VC curves" that indicate limits on the floor vibration velocity. The 2010 Guidelines for Design and Construction of Health Care Facilities , published by the American Society for Healthcare Engineering, recommends that vibrations of floors in patient rooms/areas, ORs and treatment rooms be limited to 4,000 micro-inches per second (min/s, colloquially called "mips") and that floors in administrative and public circulation areas be limited to 8,000 mips. To provide some perspective, the threshold of perception of the most sensitive humans corresponds to 4,000 mips. Sensitive areas have limit below this perception threshold: for example, 2,000 mips is often specified for laboratory and animal research areas and limits as low as 500 mips are representative of MRI spaces. The key to a successful design is to identify the vibration sensitive areas in the building and to provide the structure necessary for obtaining

appropriate vibration environments.

One aspect of new construction that should not be overlooked is the potentially adverse effect of construction-related vibration on nearby facilities, particularly those that contain sensitive equipment or operations.

For example, the construction of a new 245,000 square foot, nine-story Ambulatory Care Center next to an existing hospital at Boston Medical Center raised concerns about interference of construction-related vibrations with ongoing hospital activities. Particularly severe vibrations are known to result from demolition, soil excavation, and pile driving. In situations like these, pre-construction testing with representative equipment is the best way to quantify the expected impact of construction activities. The results can be used to determine which areas may or may not be affected during construction and to develop mitigation strategies. These may involve scheduling, selection of construction methods and equipment, providing sensitive items with supplemental vibration isolation, and real -time monitoring of vibrations in critical areas.

In the aforementioned Boston Medical Center project, and in a similar project at the New England Baptist Hospital vibration measurements were carried out in sensitive areas of the hospital before and during a series of representative construction activities. The measured vibrations were compared to criteria for MRIs, CT scanners, and operating rooms, in order to evaluate the potential impacts. At Boston Medical Center, real-time vibration monitoring of the vibrations in the sensitive areas was then used continuously during the actual construction, with automatic alarms sent to project and hospital personnel if any pre-set vibration limits were exceeded. This allowed the hospital and construction personnel to anticipate complaints from staff and to mitigate the construction activity, if necessary.

At New England Baptist Hospital, the tests and data were used to educate the hospital staff and to devise strategies that permitted the hospital to continue carrying out its work during construction without continuous monitoring.

Remote monitoring, where measurement systems are installed in critical areas and their data are observed at other convenient locations, has been found to be especially useful not only for coping with construction, but also for evaluating the suitability of sites being considered for sensitive activities. As an example of the latter, remote monitoring is being used at the University of Connecticut Health Center to determine whether a selected location on a higher floor is suitable for relocation of its Center for Advanced Reproductive Services.

In cases such as the ones illustrated here, remote monitoring can be a cost-efficient tool in view of its capability to provide data and alarms in real-time and thus to protect hospital environments from undue vibrations – all without the need to have specialists on site for extended periods.

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