VIBRATION CONTROL DURING MUSEUM CONSTRUCTION PROJECTS

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As vibrations caused by heavy construction at museums are potentially harmful to museum buildings and artwork, the protection of museum objects calls for a reliable method of vibration control. This article provides background information on vibrations and their effects on humans, buildings, and artwork, along with recommending conservative limits for protection of buildings and artwork from construction vibrations. Humans can perceive low levels of vibration before damaging levels are reached, and typical ambient (background) vibrations in museums can approach recommended limits. Research also shows that during transit, art objects are exposed to vibration levels much higher than recommended limits and damage rarely occurs. The greatest risks for damage to art objects during construction are from light objects "walking" on smooth surfaces; from the resonance of objects with natural frequencies similar to construction vibrations; and from vibratory motion of extremely fragile objects or those with serious pre-existing weaknesses. On the basis of research and the authors' experience, a general methodology for vibration control during museum construction projects is introduced—a methodology that reliably protects the museum while not unduly constraining the construction. Two examples of large-scale implementations are described to illustrate this methodology.

KEYWORDS: *vibration, shock, construction, museums, artwork, monitoring, vibration limits*

1. INTRODUCTION

With virtually any kind of construction project, especially with the heavy construction such as selective demolition and foundation installation commonly associated with museum expansions, significant levels of vibrations will be transmitted into the existing buildings. Such vibrations can be damaging to irreplaceable collections as well as to adjacent galleries, which might themselves be aging structures, susceptible to transmitted vibrations.

Artwork left in place near the construction will likely be subjected to greater-than-background levels of vibrations. By their nature, aged and delicate art objects can be very sensitive to damage from vibrations and movement. But while the safety of the art is paramount and the elimination of risk imperative, relocation of artwork poses its own set of risks to collections and is disruptive to the operation of the museum.

Hence, among the difficult questions that museums must address before embarking on major construction projects, the following considerations must be taken into account: what are safe and acceptable vibration levels, what materials should be relocated, what, if any, protective measures should be employed for the artwork that remains in-place near the construction, and what protective measures should be taken to safeguard the museum buildings themselves?

Approaches taken in response to these difficult questions are:

1. A conservative approach, in which any and all artwork that could possibly be affected by the nearby construction is relocated in advance of the construction. This approach should avert construction-related damage, but it will most likely add unnecessary cost and be disruptive to the operation of the museum.
2. A judgment-based approach, in which the museum staff decides, based on their judgment and experience, what levels of vibration are safe, which artwork can remain, and which artwork must be proactively de-installed. If, based on the staff's judgment, objectionable vibrations occur during the construction, steps are taken to mitigate damage. This approach is not only subjective and risks short-term exposure of artwork to potentially damaging vibrations, but it also risks costly construction stoppages while artwork is relocated. In addition, it fails to provide clear, quantifiable operational limits to which the contractor can be held accountable and

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