Vibro-Acoustic Consultants Series on Vibration and Noise Control Issues – February 2011

Precast vs. Cast-in-Place

Some clients have extensive experience and preference for precast concrete structures. Design teams often ask if the vibration performance of precast structures can compete with that of cast-in-place structures. In this article, Ahmad Bayat argues that both structural systems can successfully meet high-end vibration criteria like VC-E.

When compared with traditional cast-in-place concrete structures, precast systems can offer significant benefits in cost and schedule. This is especially true for fast-track projects like vibration-sensitive semiconductor fabrication facilities. Assuming that environmental ground vibrations do not limit performance, there is no reason that precast concrete structures cannot meet high-end vibration criteria like VC-D and VC-E.

We have worked with a variety of precast systems over the years and have had success with the vibration performance of the finished facilities. Precast systems do require special consideration of lateral performance. On the other hand, they can in some respects perform *better* than cast-in-place systems due to the use of higher-strength concrete and the better quality control inherent to production in controlled environments.

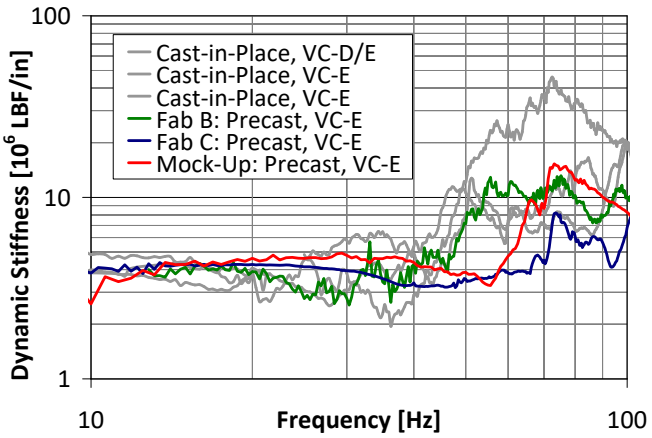
We have floor vibration performance data from a large set of semiconductor fabs in the USA, Asia, and Europe. Comparison of vibration data from these facilities reveals that precast structures can compare favorably. Below are specific examples of fabs for which precast waffle options were employed:

Fab A: a 300mm fab in Europe, this was a successful VC-D design. The lateral design concept utilized a moment frame created by inverted Ts at the column lines, with the waffle sections dropped in from above.

Fab B: a mask shop in USA, this was a successful VC-E design. The site is a seismic region, so shear transfer was handled via bridge plates between waffle sections.

Fab C: another mask shop in USA, this successful VC-E design also accommodated shear by bridge plates.

Data from three precast and three cast-in-place VC-E fabs are shown in the figure below. The plot includes test data from a mock-up of a hybrid "half-slab" precast concept developed by a contractor in Asia.



The plot relates resistance to imposed forces, so higher is better. Note the tight distribution at low frequencies, and modest amplification at resonances for all six. No final performance data are available for the mockup, but all five of the fabs successfully met their vibration criteria.

The data show that floor vibration performance does not preclude the use of precast waffle systems in VC-E and VC-D environments. Special attention to the horizontal performance is required, but lateral design is needed for seismic performance, anyway. Given the use of higher strength concrete and better quality control, it might even be feasible to design *leaner* structures.

Vibro-Acoustic Consultants specializes in vibration and noise design in demanding settings, serving clients around the world. Contact Ahmad Bayat by visiting www.va-consult.com

VACC, Inc. DBA
Vibro-Acoustic Consultants

490 Post St. #1427 • San Francisco 94102 • USA
(+1) 415-693-0424 • http://www.va-consult.com

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