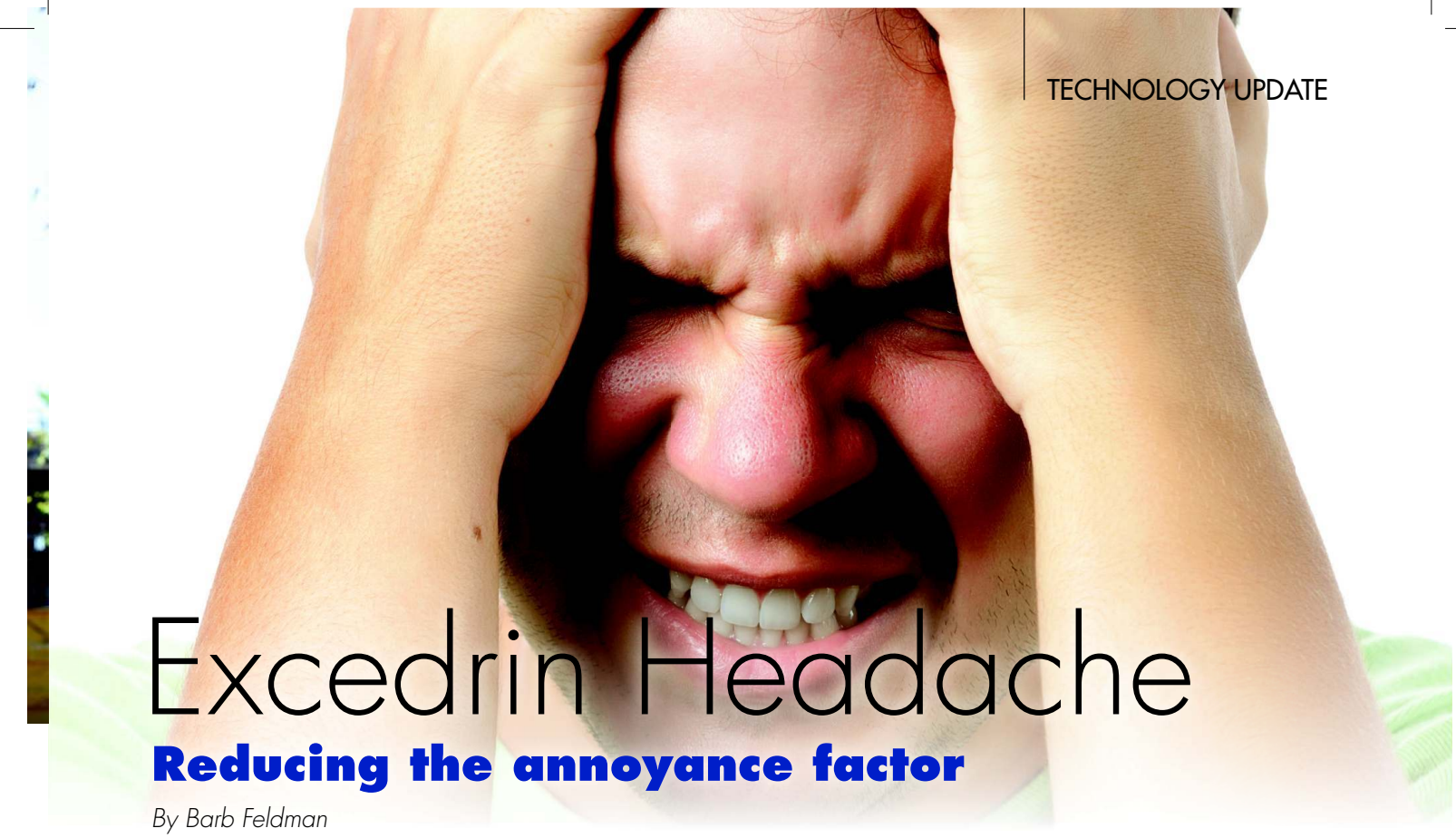


Excedrin Headache

Reducing the annoyance factor

By Barb Feldman

Months of all-day pounding were an "Excedrin headache" for the neighbourhood, and turned into a public relations headache for GO Transit, a division of Metrolinx, when West Toronto Diamond Community Group filed a complaint with the Canadian Transportation Agency (CTA), claiming that the noise and vibration of diesel explosion pile driving was unreasonable. In December of 2009 the CTA agreed.

The $277-million Toronto West Diamond project, a joint venture between Anchor Shoring and Bermingham Foundation Solutions, was a grade separation between a CP freight line and GO commuter rail service and additional support for other rail lines. It required 2,338 driven piles along three continuous one-kilometre walls, to form the structure for two depressed corridors. The ground was mostly silty sand, and piles were up to 82 feet long and 36 inches or 914 millimetres in diameter, with wall thickness from ½ inch or ⅝ inch to ¾ inch. It was "a massive job," recalls Project Manager Toben Jerry of Anchor Shoring & Caissons Ltd. "You couldn't really anticipate the noise, because there was no precedent." Pile driving took place over a period of about 16 months.

Zakim Bridge at night.

Noise mitigation measures introduced prior to the CTA decision included use of the Giken press-in machine from Japan and vibratory hammer from France. The CTA ruling required that GO restrict work to weekdays between 8 a.m. and 4 p.m., provide weekly noise and vibration measurements, develop a pile-driving activity website and update it daily, and use alternative pile driving technology and noise containment measures wherever possible. "We basically did a research and development program to fabricate noise shrouds," Jerry recalls. Encasing the hammers with sound-dampening curtains attenuated the sound by up to about 10 decibels, and the piling activity was completed as quickly as possible. The CTA ruling set a precedent for future upgrading projects involving piling in the Greater Toronto Area.

CAT Project Contracts map.

"The Big Dig was the largest construction noise-control laboratory in the world," says Erich Thalheimer, who managed the construction noise control program for the joint venture of

BRIDGE AND MAP PHOTOS COURTESY OF ERICH THALHEIMER. BACKGROUND IMAGE: PHOTOS.COM

Bechtel/Parsons Brinckerhoff at Boston's Big Dig. Officially the Central Artery/Tunnel Project, it was the most expensive highway megaproject in the U.S.A. By the time the Big Dig was completed in 2007, pile driving had been going on for 15 years, lasting weeks and even months in particular locations. "Because of the magnitude of the project, the resources available to it, and the duration of time it was going to be exposed to the public, we were free for the first time to experiment" with noise-control solutions and compare them," says Thalheimer.

"The best solution to pile driving noise is to not create it in the first place," he observes. The Big Dig used slurry walls or a pile-pusher system when the ground and type of piles allowed it, made use of pile cap cushions, and pre-augured or pre-trenched pile holes. "You still have to drive that pile to the point of ultimate resistance at the bottom, but it reduces noise by about 10 decibels."

"You've got to be very flexible in the field," says Thalheimer. If noise cannot be controlled at the source, pathway controls such as traditional wood or plastic barriers may be effective if they are close to the pile, break the line of sight between pile and listener, are massive and have a surface density of at least 4 pounds per square foot. "And a bellows that wraps around a pile and collapses to the ground as the pile is driven downward can reduce noise as much as 15 decibels," he says. "Receiver controls" can also be surprisingly effective, he notes. "A good outreach program, although it does not reduce noise by a single decibel, goes a long way in facilitating the work to be done and reducing the annoyance factor on the public."

David A. Towers.

The vast majority of the Big Dig was downtown and in close proximity to businesses and residences, he notes. Although pile driving was used in some locations where slurry walls were not feasible, "If we had had to rely on traditional pile driving we could not have done that job in the time we did–the noise would have had too much of an impact on the city of Boston."

But sonic or vibratory pile drivers which operate by vibrating the pile into the ground at a fixed frequency may be not be suitable in sensitive locations, says Dave Towers of Harris Miller Miller & Hanson Inc., who was the primary noise and vibration control support consultant for the Big Dig. "Continuous operation at a fixed frequency may be more noticeable to nearby residents, even at lower vibration levels. Furthermore, the steady-state excitation of the ground may induce a growth in the resonant response of building components, which may be unacceptable in cases of fragile buildings or vibration-sensitive manufacturing processes." Impact pile drivers, which generate a high vibration level for about a fifth of a second, allow time between impacts for any resonant response to decay, he explains.

"Pre-auguring to as great a depth as possible before driving the piles reduces the vibration levels by increasing the slant distance to nearby structures, and also reduces the duration of the disturbance," says Towers. Hydraulic pile pushers such as the Giken system, widely used in Japan and on a more limited basis in North America, are extremely effective in reducing noise and vibration, he notes, "but tend to be rather expensive."

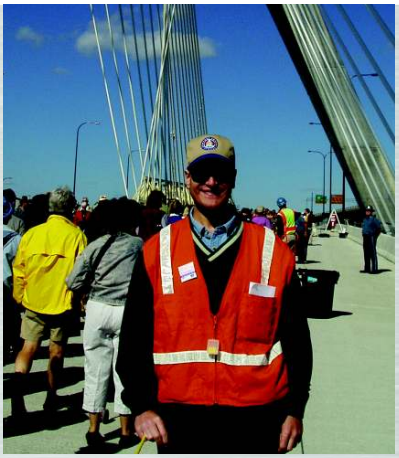
Newer and quieter technologies often are more expensive. But good noise and vibration control can reduce or eliminate an Excedrin headache not just for the neighbours, but for contractors as well. It may save money by enabling work to proceed for more hours of the week, reducing or eliminating lawsuits, or even reducing compensation claims for employees' hearing loss or other injuries.

"We do noise control not for the benefit of the project, but for the benefit of the public," says Thalheimer. "But we have seen from contractors' bid prices and actual production rates that work can proceed in a timely manner even with noise-control obligations put into the contract. It's always the tightrope that we must balance ourselves on as noise engineers and construction managers."

"The trick is to be economical and therefore competitive as a contractor while meeting the requirements of the specifications," says Jerry, "Your solutions have to be sustainable, because it's not just one job, it's a relationship. And to be a competitive contractor within this urban environment, you've got to respond and make people happy."

Database of noise

Erich Thalheimer assisted the US Department of Transportation Federal Highway Administration in developing a new handbook based on the construction noise control work done at the Central Artery/Tunnel Project in Boston. The FHWA Roadway Construction Noise Model (FHWA RCNM) is a Windows-based program available for use in predicting noise for highway construction projects of varying complexity. "Its database of all construction equipment makes it useful for any type of construction project–highway or transit or fixed site such as a power plant," says Thalheimer. "It's all measurements made at the Big Dig, so we have a very good knowledge base of how noisy modern equipment is."



Erich Thalheimer on Zakim Bridge public walk.

The Roadway Construction Noise Model and guide can be downloaded without cost or obligation at: www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/

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