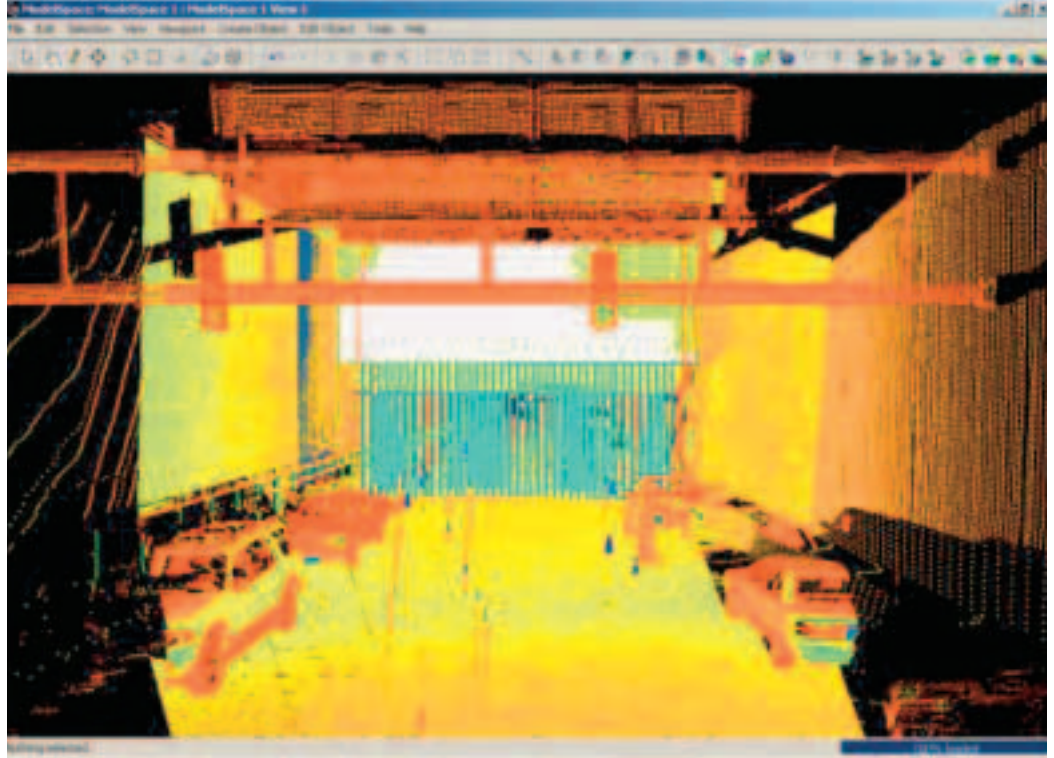


# "The BigDig" mines savings from high-definition surveying



**Boston's massive BigDig project has taken advantage of numerous technology innovations during its 15-year life. The latest technology success story is the project's use of Leica Geosystems' high-definition surveying (laser scanning) systems.**

The Massachusetts Turnpike Authority's Central Artery/Tunnel Project (or "The BigDig" as it is commonly known) is the largest, most complex, and technologically-challenging highway project ever attempted in American history ([www.bigdig.com](http://www.bigdig.com)). The \$15 billion project will dramatically reduce downtown traffic congestion and improve the quality of life in

one of America's oldest and most congested cities. The BigDig is also a geometrically-complex project that lends itself well to laser scanning.

### Project Agency bought two scanners

The Federal Highway Administration recommended to the Central Artery/Tunnel (CA/T) authority that they investigate the use of laser scanning on the project. In 2001, BSC/Cullinan, a subcontractor dedicated exclusively to provide surveying services for CA/T, investigated the potential benefits of applying laser scanning for contractually required "closeout" as-builts of the project's many complex intersections, roadways, bridges, tunnels, and support infrastructure. Closeout as-builts are final records of what was actually built on the project (as opposed to

design drawings). The investigation found that laser scanning (or high-definition surveying, as it is now called) could save \$2 million compared to traditional methods. Based on these projected savings and BSC/Cullinan's subsequent detailed analysis of all available laser scanning hardware and software solutions on the market, the Central Artery/Tunnel agency soon acquired from Leica Geosystems two Cyrax 2500 laser scanners, Cyclone software, and classroom training for BSC/Cullinan staff.

### Multiple uses

Although the laser scanning systems were acquired for the purpose of capturing and delivering closeout drawings, they were not used for this right away. Instead, as the project's construction engineers (or "resident engineers") became aware of the systems' capabilities, BSC/Cullinan quickly began to receive requests to use the scanners on "critical path" surveys that risked delaying scheduled road and tunnel openings.

**(Above): Portal clearances were checked along full width of the roadway**

**(Below): Scan data were used for annotating photo of tunnel portal clearance**



One of the most compelling needs was to accelerate the surveying of new road paving. Contractors had to determine if any areas of the road surface, which was applied in layers, required more paving material or if any areas required the most recent layer to be ground down to meet specs. For one such "roadway finish survey" - a section of I-93 - three conventional survey crews were scheduled to take three weeks to survey 3.5 lane-miles. When the project's resident engineer learned about the speed of laser scanning, he secured the subcontractor's laser scanning services. The result: fieldwork was completed in just three days with one scanner crew!

Another early BigDig application was BSC/Cullinan's surveying of "portal clearances" to determine minimum distances from the road surface to the tunnel opening. The benefit of laser scanning is that capturing complete data provided a higher confidence level as to where the absolute minimum clearance existed. A conventional survey would only have obtained clearances where shots were taken or where height poles were placed. This would not necessarily have determined the minimum.

Yet another BSC/Cullinan use of high-definition surveying was for geometric quality checks of a large, complex air intake structure. The goal was to ensure that key elements of the structure had been constructed within their geometric specifications. High-definition surveying was a big winner from a cost/productivity standpoint. The tall structure required only three days of laser scanning compared to an estimated three weeks had the as-built surveys been done traditionally. In addition, data capture was done remotely with scanning. This represented a safety advantage over

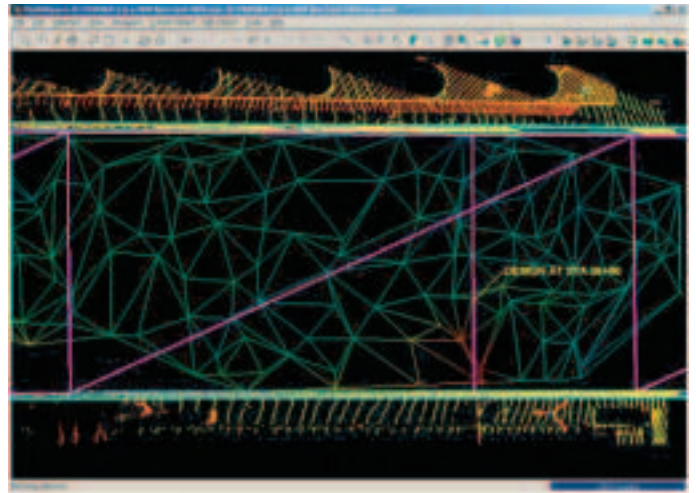
traditional methods that would have required surveyors to climb on the structure to achieve measurements with the necessary accuracy.

#### Taking advantage of the technology

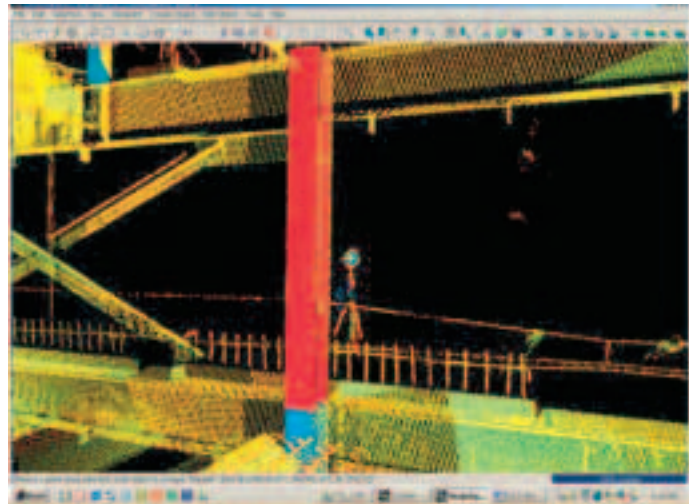
At the height of scanning activity, from November 2002 through to February 2004, both of BSC/Cullinan's Cyrax 2500's were used five days per week, sometimes on double shifts. Overall, BSC/Cullinan's main client, Bechtel/Parsons Brinkerhoff, was very happy with the results and continuously sought ways to take further advantage of the technology. Other local subcontractors in the Boston area, including Meridian Associates, Inc. and Digital Geographic Technologies (DGT), have also provided Cyrax-based laser scanning services to various portions of the BigDig project, also with great success. Meridian Associates, for example, scanned hundreds of overhead girders in a 5,000' tunnel section in just five nights, saving an estimated 75 nights of traditional surveying in the tunnel; this also saved their client up to \$100,000 in fees for additional lane closure services.

#### New HDS3000 Scanner for Project

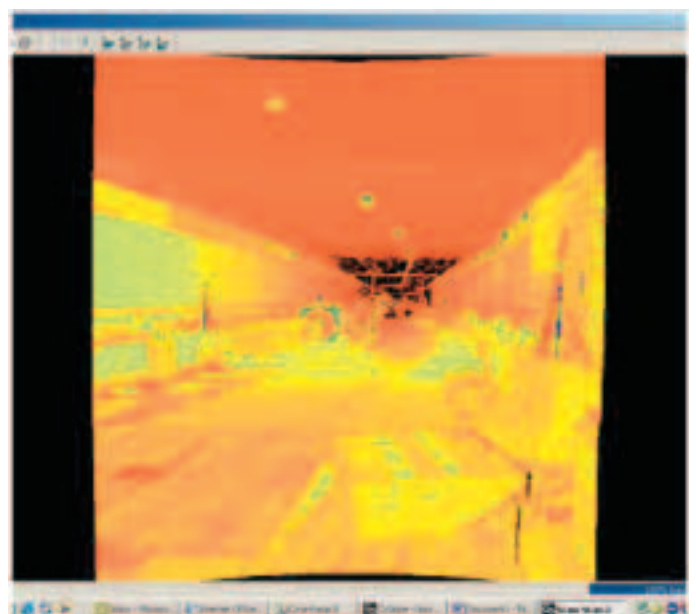
Recently, the Central Artery/Tunnel authority ordered and BSC/Cullinan took delivery of Leica Geosystems' new HDS3000 laser scanner as a third unit in their fleet of scanners for the BigDig. This acquisition was based on BSC/Cullinan's analysis of productivity gains for the HDS3000 (up to 50%) versus a Cyrax 2500 for the type of work needed. The new HDS3000 scanner has already been used on projects for the BigDig. BSC/Cullinan has reported publicly that the scanner is living up to their expectations in terms of significant productivity gains.



(Above): Plan view deliverable of pavement QA was created in Cyclone from scan data



(Below): Laser scan of complex air intake structure



(Below): High-definition survey of recently paved roadway within tunnel