

3D / 4D Digital Modeling for Construction Management — Innovation Description

The Connecticut Department of Transportation (CTDOT) is using 3D / 4D modeling techniques to provide construction management support to the I-95 New Haven Harbor Crossing Corridor Improvement Program (“Program”). As the largest transportation project in the state’s history, the Program replaces the Pearl Harbor Memorial Bridge and the entire I-95 / I-91 / Route 34 Interchange, while maintaining traffic and coordinating activities with the Port of New Haven, one of the top five ports in the U.S. for moving domestic petroleum products. The 3D / 4D digital model and its visualizations help stakeholders manage the risk associated with such a complex project and better understand, identify, and plan for improved construction performance. The model is comprised of 3D elements developed from 2D CADD drawings linked with the contractor’s critical path method construction schedules to create the fourth ‘D’ – time. In addition to generating 4D simulations of construction activities, 3D model components are used to create visualizations including photo-realistic images, animations and driver’s perspective videos. The model and visualizations are innovative tools to validate design and schedule assumptions and evaluate critical construction operations and corridor-wide traffic coordination in advance of the actual work.

The complexity of the \$2B multi-modal transportation program is significant, requiring overlapping construction contracts to implement 12 construction stages, 11 corridor-wide traffic shifts and more than a dozen sub-phase traffic shifts, while maintaining traffic flows, a commercial navigation channel and coordinating Port of New Haven activities. CTDOT implemented 3D / 4D modeling to improve efficiency and manage risk by providing construction managers and contractors with a powerful tool to proactively analyze the work, achieve time / cost savings and coordinate shared work areas. The model was made available to contractors prior to bid of the of interchange reconstruction project to assist bidders with schedule analysis and coordination of work. It is used extensively during coordination meetings to foster collaboration among project partners. This tool helps the project team move from a descriptive discussion to a predictive discussion. Digital model updates are published to I-95 New Haven’s cloud based document control system for use by all contractors, CE&I consultants, designers, and federal / state agencies.

Use of the digital modeling has provided significant benefits to the Program by allowing the team to evaluate critical construction activities and milestones. Important examples include:

- Modeling of critical contract interfaces allowed construction activities between contractors to be coordinated. This opened the northbound structure of the new Pearl Harbor Memorial Bridge three months early, advancing remaining work.

- Modeling of structural steel erection allowed the contractor and CTDOT inspection personnel to ‘practice’ the pre-assembly, transport, staging and erection of 9 ft-deep curved box girders over I-91 southbound and I-95 northbound and southbound. The modeled work was a virtual duplicate of the actual construction. This resulted in limiting traffic stoppages to approximately 30 minutes for the erection sequence.

- Driver’s perspective videos are used in advance of traffic shifts to identify areas that may cause confusion for motorists, allowing CTDOT to proactively add additional signage and pavement markings.

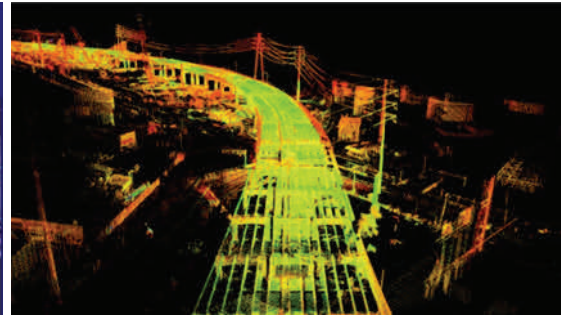
- The model is currently being used to plan the demolition of existing 9.5 ft-deep box girders 13 inches away from a historic manufacturing building in a busy neighborhood, verifying equipment access, crane pick radii, material lay down areas and roadway closures.

Model animations and graphic ‘stills’ are also powerful public information tools, used to educate and alert the public of impending traffic shifts, detours, alternate routes, and effectively communicate what the finished project will look like. Photo-realistic images and driver’s perspective videos allow viewers to virtually experience new roadway alignments before actually driving them. The stills and videos are published to the I95newhaven.com website, distributed by e-mail in ‘Construction News’ bulletins, broadcast on local television stations and distributed door-to-door. Feedback from community groups indicates that this approach improves public perception of the Program, provides the public a sense of ownership and most importantly, facilitates informed decision making during construction operations.

Led by federal initiatives like Every Day Counts and MAP-21, a paradigm shift is underway to incorporate digital modeling as a standard tool in federally funded projects. As it moved from hand drafting to CADD years ago, the industry is now transitioning from 2D CADD to 3D / 4D digital modeling and the I-95 New Haven Harbor Crossing Corridor Improvement Program is at the forefront of this change, testing and advancing important new ways to improve project quality and delivery.

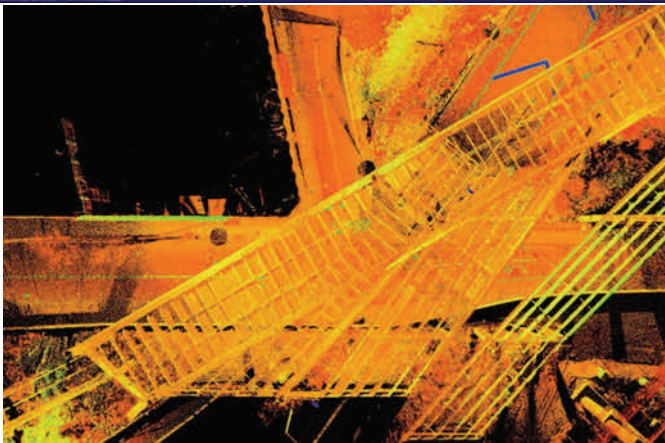


(Above) Photo-realistic visualizations showing change in alignment before (left) and after (right) traffic shift for public outreach.



(Left) An image of 4D model shows maintenance and protection of traffic technical information for public outreach.

(Above) Visualization of bridge girders in laser scan model.



(Left) Visualization of existing box girder bridge less than 18 in. away from his-toric building in raw laser scan model.

(Below) Demolition sequence in red of existing box girder bridge in 3D/4D model, also shown in laser scan to left.

