

3D Engineered Models: Schedule, Cost and Post-Construction



Three-dimensional (3D) engineered models are widely used by the highway community to more effectively connect a project's design and construction phases. These models and the as-found, digital geospatial data that supports them can also be applied to other phases in the project delivery cycle to positively affect safety, project costs, contracting, maintenance and asset management.

The Federal Highway Administration (FHWA) emphasized 3D engineered models for design and construction in the second round of the Every Day Counts initiative (EDC-2), and is continuing this support under EDC-3 to further advance additional application areas. Propagating the as-found data used to build 3D models into nontraditional functions such as roadway inventory, asset management, surveys, and records maximizes the technology's potential to create a complete, high-quality, digital footprint of the nation's roadways.



The EDC-3 effort is focused on three practices: using the as-found data from which the model is created (for example, LiDAR-based data) for roadway inventory and asset management purposes, incorporating schedule (4D) and cost (5D) information into models, and using post-construction survey data to correct the design model and create an accurate as-built record drawing (including subsurface utilities).

The 4D and 5D modeling efforts facilitate communication between multiple stakeholders and allow contractors to streamline construction schedules, which can produce major cost and schedule advantages.

Using a 4D engineered model that incorporates scheduling information, contractors can gauge how individual tasks such as utility installation, grading, or paving can impact the schedule for the next project phase. It also provides construction crews with productivity information and installation rates for various operations.

5D engineered modeling uses the scheduling component of 4D modeling and links that information to cost data associated with each aspect of the project. The major benefit of 5D is that stakeholders can see how changes or revisions can affect the overall project cost and schedule.

Post-construction survey data can be used to create accurate, as-built record drawings. It can also update asset management systems such as pavement management software, potentially providing owners with administrative cost savings.

Some of the first 4D models used on highway projects were on the Central Artery/Tunnel Project in Boston, Massachusetts, in the 1990s. Since then, many states have successfully employed them in delivering both large and small projects.

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The California and Washington State Departments of Transportation (DOTs) used 4D models for the San Francisco-Oakland Bay Bridge East Span and the Alaskan Way Viaduct and Seawall Replacement projects, respectively, and the Connecticut DOT implemented 4D modeling techniques to support its I-95 New Haven Harbor Crossing Corridor Improvement project.

BENEFITS

- ▶ **Improved project management.** With 4D modeling, stakeholders can visualize construction over the project duration and identify potential conflicts.
- ▶ **More accurate cost estimates.** 5D engineered models allow stakeholders to evaluate costs and model cash flows for each phase of construction.
- ▶ **A living record throughout the project life cycle.** Once the 3D model is built, it can be used for continuing maintenance, management and future planning.

CURRENT STATE OF THE PRACTICE

More than half of the country's state DOTs are exploring the use of 3D engineered models in construction, and several have developed mature practices. As a result, the tools and techniques used to collect and process data to build 3D models during various stages of the project — planning, surveying, design, construction and asset management — are rapidly maturing.

More than half of the DOTs also use LiDAR technology for field data collection, from which they extract models for various uses. The Tennessee and New York

State DOTs use LiDAR for collecting geospatial data and creating base maps for ground features and infrastructure assets. The Utah DOT engaged eight of its departments, including Planning, Maintenance, Information Technology, Geographic Information Systems and Pavements, in its bid to use LiDAR data well beyond construction.

SUPPORT AND AVAILABLE TOOLS

- ▶ The FHWA Office of Infrastructure Construction Management Team's 3D Engineered Models Web page provides links to the Technical Services Support Center, new Web-based training modules, a webinar series, upcoming workshops, and other resources.
<http://www.fhwa.dot.gov/construction/3d/>
- ▶ Every Day Counts 3D Engineered Models: Schedule, Cost and Post-Construction web page
<http://www.fhwa.dot.gov/innovation/everydaycounts/edc-3/3d.cfm>
- ▶ FHWA TechBrief: 3D, 4D, and 5D Engineered Models for Construction
<http://www.fhwa.dot.gov/construction/pubs/hif13048.pdf>



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Every Day Counts (EDC), a State-based initiative of FHWA's Center for Accelerating Innovation, works with State, local and private sector partners to encourage the adoption of proven technologies and innovations aimed at shortening and enhancing project delivery

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