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Integrating 3D Visualization into Transportation Engineering

Webster's Dictionary defines visualization as "any technique for creating images to represent abstract data," and these techniques can be employed in a variety of ways.

Transportation engineering uses three types of visualization: two dimensional (2D), three dimensional (3D), and four dimensional (4D). 2D Visualization is the simple display of CAD drawings. 3D Visualization uses 3D data generated during the design process to communcate the project's potential appearance. 3D Visualization can range from a basic shaded 3D model identifying slope impacts to a complete photo-realistic before-and-after rendering that highlights the project's completed design, aesthetics, and relation to the existing environment. A highly detailed 3D rendering shows not only the proposed improvements but also the intended aesthetics and landscape architecture. 4D Visualization, on the other hand, uses the 3D data in a dynamic display as in a fly-thru or a drive-thru of the project. It shows not only what the project might look like but also how the project might operate.

3D Visualization is primarily used for communication purposes. In the federal surface transportation funding bill (SAFETEA-LU reauthorization of 2005), visualization techniques are used as part of the transportation plan and transportation improvement program development. To determine the desired level of effort/detail, the audience must first be identified. Agencies are always looking for ways to improve communication with the public on proposed improvements in its area. Many public stakeholders may not understand traditional 2D engineering plans/layouts, and though aerial photography has enhanced the 2D means of communication, it doesn't give the public a clear picture. 3D Visualization gives the viewer a sense of what the project will look like when completed, and hopefully obtains the stakeholder's buy in on the improvements.

The public is not the only audience faced. Effective communication must

Aerial view of an existing intersection.

Aerial view of a proposed directional interchange.

exist between agencies and engineers to make design-related decisions. Today, engineers use FHWA's Context Sensitive Solutions practices, which FHWA defines as "a collaborative, interdisciplinary, approach that involves all stakeholders in developing a transportation facility that compliments its physical setting and preserves scenic, aesthetic, and historic and environmental resources while maintaining safety and mobility." 3D Visualization allows engineers to design, quickly evaluate, and modify the rendering to better meet the principles of Context Sensitive Solutions. Some quick 3D evaluations can be as simple as using an oblique aerial rendering to evaluate the associated cuts and fills of a proposed roadway and the impacts to adjacent resources. 3D Visualizations are also useful in evaluating different alternatives and choosing the one that best serves the needs of the project.

Roadway structures, for example, are excellent candidates. 3D Visualization is great for evaluating and making decisions on different types of bridge piers, retaining walls, noise walls, bridge fencing, and lighting, as well as their associated aesthetics in a side-by-side manner.

The costs associated with creating 3D deliverables have decreased over the years. Most of the necessary tools for 3D and 4D come pre-loaded in standard CAD software programs such as Bentley's MicroStation. Some additional software, such as Adobe Photoshop, is also necessary to provide post-process support for final 3D images.

3D Visualization is a cost-effective way to utilize existing data to add value to a project while enhancing communication between agencies, engineers, and most importantly, the public on transportation engineering projects.

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Mr. Davis has nine years of management and technical experience as a Transportation Engineer, working in planning and final design for Federal, State, and local governments. He has performed the work of and prepared environmental documentation through final design plans.

At-grade view of an existing intersection.

At-grade view of a proposed directional interchange.

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