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SH 130 Project Wrap-Up: A Summary of Tools Utilized & Lessons Learned

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As the second largest transportation project in the United States comes to a close, the $1.1 billion Texas State Highway 130 project provides a number of lessons learned that can be applied to other design-build ventures. As the program manager for SH 130, HDR acted as the owner's representative and verified that contractual requirements were being fulfilled by the design-builder (developer). This article discusses some of the knowledge gained during project startup, preconstruction, construction and project closeout.

SH 130 is an 87-mile controlled access tollway just east of Austin. The first 49 miles, segments 1 through 4, were constructed under an exclusive development agreement, which is an expanded concept of a design-build contract that incorporates right-of-way acquisition and utility relocation, among other things. This phase of the tollway included four mainlane toll plazas, three major river and three railroad crossings, seven major and 31 minor interchanges and 123 bridges. The final portion of this phase opened to traffic April 30, 2008, after nearly nine years of planning, design and construction.

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The remaining 38 miles, segments 5 and 6, are a separate project and will be constructed as the first-ever concession project in Texas. In this model, a developer will design, build, maintain and operate the tollway for 50 years.

Project Startup

One of the advantages of design-build is the ability to bring in a large design staff to quickly and concurrently work on various portions of the project. The SH 130 team, referred to herein as the turnpike team, comprised the Texas Department of Transportation (TxDOT), HDR and several sub-consultants. At its peak, the turnpike team and developer staff totaled more than 1,000 people working toward a common goal of constructing a roadway. Close interaction, open communication and partnering were key to successfully delivering this project.

A key decision made early in the project was co-location; the turnpike team and developer staff were to be located in the same building complex. Co-location fostered a team atmosphere and helped speed up decision-making.

Another challenge of having a large team is coordination and consistency of design. Compounding the issue is the performance-based nature of the design-build contract, which leaves numerous design aspects open to interpretation. To address this challenge, the developer and the turnpike team collaboratively developed design task protocols. These protocols helped everyone stay on the same page and reduced conflicts between contractual and design preference issues.

Another design aspect that had to be dealt with early on was the development of the design quality control/quality assurance plan (DQC/QAP). An independent quality assurance firm was required as part of the contract to provide some assurance that the developer was adhering to contractual requirements. As another layer of protection, the turnpike team also provided oversight of the design process. Creating the DQC/QAP was a collaborative effort and became an essential tool in laying out the processes that would be followed by all parties during the review process.

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SH 130 is an 87-mile controlled access tollway just east of Austin.

For SH 130, the developer was responsible for performing acceptance inspection and materials testing. The turnpike team was responsible for inspection oversight and materials testing verification. An organization chart mirrored the developer's organization and staffing, but at a much reduced level. As the project ramped up, staff levels increased to accommodate the workload. Developing the organization chart in such a manner allowed for a clear line of responsibility and helped developer and turnpike team members develop a rapport with their counterparts.

Tom Kessler Photography

Segments 1-4 total 49 miles and include four toll plazas, seven major and 31 minor interchanges, and 123 bridges.

Regarding document management, TxDOT wanted to have a fully electronic project to reduce costs and comply with the agency's environmental concerns. An initial system captured the basic needs of the procurement processes, but it was quickly realized that more robust file transfer and sharing capabilities were needed. A second, more comprehensive development effort produced a document management system designed around the collaboration protocols amongst all groups and built around an established filing system. In the years since the SH 130 project began, off-the-shelf solutions have improved and now offer broader storage capacities, wider bandwidth availability and more fully customizable process definitions. A similar project effort today may achieve equal success with document management without embarking on such a significant development effort.

The SH 130 request for proposals included ultimate schematics as a basis for bid preparation. The schematics were conceptual in nature and the developer was responsible for ensuring that they satisfy requirements of the contract documents. However, when the turnpike team wanted to enforce an element on the schematics, the team pointed to the schematics and said it needed to be done accordingly. Providing contractual language to clear up this discrepancy would be beneficial on future design-build projects.

Preconstruction

The bulk of design for SH 130 took place during the preconstruction phase. Design review proved to be a challenging process, with the number of comments going into the thousands. The method in which to track comments was discussed early on in the process, and Microsoft Excel was chosen rather than a database due to cost concerns with the development of a database. However, tracking comments as they went through the comment closeout process turned out to be difficult, and the only way to find previous comments was to use the search function in each of the various spreadsheets. In hindsight, the cost to develop a database most likely would have been offset by the functionality and ease of use it would have provided. Having a more user-friendly tool might have helped ensure that comments logged and resolved in one section were carried forward into other sections.

The construction team knew early on that one of the challenges of the project would be meeting federal requirements for owner verification testing. The Code of Federal Regulations requires that in cases where the contractor pays the laboratory making the materials acceptance decision, the owner's representative must validate the quality of materials accepted by performing verification sampling and testing. While many tools and documents existed to maintain this second set of test results electronically, no tool existed to perform the associated statistical analysis without significant clerical preparation.

Furthermore, the turnpike team utilized a proactive materials management approach by reporting to the Federal Highway Administration quarterly as construction progressed, thus repeatedly requiring validation and subsequent engineering assessment of the results to "sell the project as we go" rather than attempting to close out the project after a five-year construction period. The last quarterly report will, in effect, be the close-out document for the project. As a result, the Inspection and Materials Management System (I2MS) was built in two phases, the first allowing lab and field staff to begin work and the second to more fully capture all testing and inspection needs. The current version imports the contractor's test results automatically, eliminating data entry error and establishing better controls. The system utilizes both Web site and personal data assistant interfaces for data entry, thus deploying scores of inspectors and testers to perform work without being constrained to lab notes, diaries and clipboards.

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One of the more critical construction-related developer deliverables was the construction quality control/quality assurance plan (CQC/QAP). The contract required the developer to produce a CQC/QAP that addressed every facet of construction inspection and testing. The contract was specific with regards to the minimum content of the CQC/QAP, including items such as formal procedures, identification of hold points in the construction process, reporting forms and other detailed processes that would form the backbone of the contractor's quality program. The review and approval of this submittal was an iterative process that required several meetings and submissions. The final document was two volumes and required three to four months to complete. It is important to note that once completed, this document did not sit on project shelves. It was used daily by project staff in both camps. The CQC/QAP was also considered a "living document" as it was revised many times throughout the five-year duration of the project. Once the CQC/QAP was approved, the turnpike team authored an owner verification testing and inspection manual for internal use. This manual defined the turnpike team's procedures for performing oversight functions as they related to the approved CQC/QAP.

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The turnpike team utilized a proactive materials management approach by reporting to FHWA quarterly.

Construction

Being a design-build project, TxDOT had the flexibility to modify the design and incorporate changes. Approximately $90 million worth of change orders have been executed on the project to date. These were changes that TxDOT determined would be beneficial to the project, including approximately $37 million in an interchange improvement and approximately $15 million to reconstruct an adjacent facility. Properly analyzing the impacts of the changes with respect to cost and schedule is extremely important, as is documenting all of the decisions. From a stakeholder point of view, this flexibility created a collaborative atmosphere between TxDOT and surrounding public agencies since TxDOT was typically able to incorporate their requests with minimal project impact.

As discussed earlier, many decisions and agreements were made during the review process. As the developer gets closer to finishing construction, it proposed changes related to decisions made earlier in the project. Resolving this issue takes time and effort to find documentation on what decisions were made and why. To minimize these situations, it is important to get the construction personnel involved early during the design review process and clearly document everything.

When construction commenced, it quickly became apparent for the need to define "the engineer." TxDOT standard specifications reference the engineer as the approving authority, as well as addressing requirements

as "defined by the engineer." TxDOT was willing to let the developer's quality assurance staff act in the role of the engineer in some instances, but wanted to retain it for others. Ultimately, if decisions affected cost, schedule or contractual changes or had corridor-wide implications, TxDOT retained the role of the engineer. It made sense to delegate engineering authority to the developer's quality assurance staff for some operational issues. However, it was done in a formal, documented process and was monitored. There were occasions throughout the life of the project where previously delegated authority was rescinded based upon a review of how it was being exercised.

The schedule was set up on a cost-loaded basis for purposes of providing payment to the contractor by paying percentages of the overall budget, i.e., "earned value." Instead of counting bid item quantities and manpower hours, inspectors make notes on progress made to resource-loaded schedule activities, which are distinctly tied into I2MS from the Primavera schedule. As a result, the I2MS-stored daily reports can be reviewed on a monthly basis and used to denote progress. Furthermore, as a claim avoidance mechanism, the entire track record of the contractor's performance is tied to specific schedule activities to provide any essential backup in cases where claimed delay may have been self-imposed. No delay claims have been submitted to the project to date.

Project Closeout

While the tollway recently opened, there are numerous project closeout tasks the turnpike team is still working on. Punch lists need to be completed, as-builts need to be turned over, and all outstanding construction deficiencies and non-compliances must be closed. The majority of construction inspection and testing documentation has been turned over electronically during the course of the project. Because of the large amount of electronic data produced on this project and the various applications used to manage it, the turnpike team is in discussions with TxDOT regarding the final deliverable. A number of questions need to be addressed, such as whether to transfer just the databases or install local instances of the applications on the client's networks. Additionally, HDR must determine what information and in what format the company retains.

After nearly nine years of planning, design and construction, the first phase of the SH 130 tollway is operational.

Ongoing, proactive efforts to align project requirements with federal required documentation at closeout have positioned the turnpike team to quickly, accurately and comprehensively provide all information as needed. In addition to meeting legal requirements, the turnpike team has diligently engaged TxDOT for its preferences and formats regarding final deliverables.

Wrap-up

It is a rare opportunity to work on such a large project with so many team members for such a long time. On the day of the opening, a TxDOT team member refused to go to the opening ceremony because he was sad that the project was coming to a close and the team was going to be breaking up. It is rare to find someone who did not enjoy their experience on the SH 130 turnpike team. This can also be seen by looking at the extremely low turnover percentage on the project. Many attribute this attitude to the feeling of camaraderie and partnership on the project. While there were difficulties, the team learned what tools and processes could be utilized to reduce negative effects from these challenges.

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