The First Caltrans Design-Build Project:
A Case Study

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Design-Build is as an alternative project delivery method that often promises great advantages over the traditional design-bid-build method. Although many states have been using the method for decades, California just recently authorized a demonstration program that will be used to determine the effectiveness of design-build on Caltrans projects. This paper will examine the first design-build project that was completed under the demonstration program, a pavement rehabilitation project on California’s State Route 99 in Madera, CA. This paper will outline the current design-build trends in the industry; the process that led to the selection of design-build for the project; the project specifics; the goals that were met or un-met by the project; the challenges and benefits of design-build; lessons learned; and recommendations for future design-build projects. The project met the goal of schedule acceleration and innovation; however, the goals of risk transfer and cost certainty were not met for various reasons. The project encountered unique challenges, such as the difficulty transitioning to the new mindset, a lack of full commitment to the method, difficulty adjusting to the QA/QC process, and a complicated change order process. However, there were also advantages such as a more collaborative design process, an efficient jobsite documentation process, and a close contractor-designer relationship. These characteristics provided valuable lessons learned which included the importance of early preparation, the necessity for full commitment to the process, the need for a modified QA/QC process, and the importance of selecting the right project with a clear scope.

Key Words: Caltrans, Design-Build, Transportation, Lessons Learned

Introduction

The state of California’s Department of Transportation (Caltrans) has been around for over 100 years, and has rapidly grown over time to serve the transportation needs of the nation’s most populous state. According to the agency’s website, Caltrans currently manages over 50,000 miles of highways and freeways that serve almost 40 million residents. Originally created in the early 1900’s as an agency in charge of building the state’s first highways, today Caltrans often finds itself updating and expanding them. One of those original routes being expanded and upgraded today is State Route 99, which slices through the central valley as a major connection of Northern and Southern California.

In recent years, Caltrans has invested millions of taxpayer dollars towards upgrading major portions of Route 99. In particular, the agency has focused vast resources on a stretch that runs through the state’s central valley. This work has consisted of lane additions, bridge expansions/replacements, drainage system upgrades, and pavement rehabilitation, among other things. Some of these projects have been limited in size and scope, while others have been major projects that took many years to complete. The ever-increasing population has made reduction in construction time an important goal for many projects along the route, as more and more commuters are affected each time there are traffic delays due to construction. Although these projects are on the same route, they are each unique in their own ways. In addition to increasing construction complexities, the state also often deals with limited budgets and manpower. However, these challenges are not unique to California, and the majority of other states have already taken steps to help cope with them. Many states have realized the inefficiencies of the traditional design-bid-build method of project delivery have made operation increasingly difficult and have looked to design-build as an answer to the new challenges. Design-Build is essentially “a project delivery method under which a project owner executes a single contract for both architectural/engineering services and construction. The design-builder may be a single firm, a consortium, joint venture, or other organization. However, the fundamental element
of design-build delivery remains that one entity assumes primary responsibility for design and construction of the project.” (Transportation Design-Build Users Group 2009).

**Design-Build in the Industry**

Design-Build started primarily in the private sector as an alternative project delivery method that promised to bring great advantages to a project in comparison to the traditional design-bid-build method. (DBIA 2012). The use of the method expanded rapidly as more and more private owners, designers, and contractors realized the benefits. Although slower to catch on, the public sector eventually became aware of this new trend in project delivery. Beginning with the federal government, design-build was introduced to the transportation sector in 1988 (DBIA 2012). The Federal Highway Administration established guidelines that would allow state transportation agencies to experiment with design-build in order to determine if the same benefits realized in the private sector would hold true in the public transportation sector (DBIA 2012). Over time, more and more states tested out the method and by 2003, “more than 20 states had design-build authority” (DBIA 2012). Today, transportation is “the fastest-growing design-build sector in the United States” (DBIA 2012) and is currently authorized in 44 states. Sixteen of those 44 state departments of transportation currently only have limited design-build authority (see Figure 1).

![Design-Build State Laws for Transportation Procurement](image)

**Figure 1: 2013 Design-Build State Laws for Transportation Procurement**

*Source: DBIA 2013*

**Design-Build in California**

Some public transportation agencies in California (such as the Orange County Transportation Authority) have had design-build authority for over 13 years thanks to the state’s Design-Build Transit Law passed in 2000 (Smith & Jimenez 2011). Since Caltrans was not included in the law, the agency continued to use the traditional method of project delivery. However, in recent years the state has made efforts to test design-build on a limited basis. In early 2009, the state authorized a demonstration program of up to 15 state-funded design-build transportation projects as a way of testing and analyzing the effectiveness of design-build as a means of delivering Caltrans projects (Smith & Jimenez 2011). The results of the demonstration program will play a large role in determining Caltrans’ future use of design-build. Currently, there are 10 design-build projects that are either underway or completed as part of the demonstration program (See Figure 2). This paper will focus primarily on the first project selected for the program, known as Madera 99 Road Rehab.
The Madera 99 Road Rehab design-build project was selected as part of the demonstration program in early 2010. As one of the many projects along State Route 99, it presented unique circumstances that would benefit from the cost certainty, accelerated construction timeline, and collaborative nature often promised by the promoters of design-build. According to the project’s Authorization Request (Design-Build Demonstration Program 2010), the leaders of the demonstration program decided it was best to start with smaller projects like the Madera 99 project with the intention of applying the lessons learned from those to larger design-build projects later on. It was put out for bid in early 2011 and awarded to the design-builder in May of 2011. Fast forward two years, and the project is just wrapping up, and it provides a unique opportunity to analyze what could be the start of a major shift for one of the nation’s largest DOTs. Through use of a case study, this paper primarily focuses on the lessons learned from the Madera 99 project, along with the primary goals, challenges, and benefits as they relate to design-build.

**Lessons Learned From the Industry**

Since California is fairly late in adopting design-build for transportation projects, there is an abundance of information available from other states that have experience with the method. A comprehensive study conducted in 2009 (Transportation Design-Build Users Group 2009) highlighted the following lessons learned as they relate to design-build from 19 departments of transportation around the United States:

- Select the appropriate project. The traditional design-bid-build method may still be the most appropriate for many projects. It is important to consider the goals of the project and how they can best be achieved.
- Clearly define the scope of work in the RFP in order to avoid the risk of significant cost overruns.
- Consider risk allocation, which depends heavily on the project’s size, complexity, and location.
- Set aside traditional relationships. The agency must realize they are no longer the designer of record and should re-focus their efforts from strict specification compliance to verifying compliance with the RFP.
- Select the best design-builder. This is best done by taking other factors into account besides price alone.
- Select the agency’s best design-build team. Selecting a team that can handle the challenges brought on by a fast-paced design-build environment is critical.
• Consider warranties or operational requirements. This will encourage proposers to consider life-cycle costs in their quality control plans.

Methodology

The objectives of this case study are as follows:

• To report whether the design-build goals of the project were met.
• To highlight the challenges and transitional difficulties to a design-build mindset.
• To highlight the benefits of using design-build in comparison to design-bid-build.
• To highlight the lessons learned from the project as they relate to design-build.
• To provide a recommendation to Caltrans regarding the use of design-build on future projects.

The methodology chosen for the study was primarily qualitative. The qualitative study was done through interviews of key individuals from the management teams of the two primary contractual parties. The interviews focused on the perception of the project from each individual’s point of view. The interviews took place when the project was at least 90% complete. The interview results were then analyzed by the researcher in order to identify and highlight the main similarities and differences. The key issues, good or bad, were then organized into the following categories: goals, challenges, benefits, and lessons learned. This information was then be used to make a suggestion to Caltrans regarding the use of design-build on future projects.

Case Study

The primary purpose of the Madera 99 Road Rehab Project is to rehabilitate the pavement in a short stretch that passes through Madera County. According to the project’s Authorization Request (Design-Build Demonstration Program 2010), the pavement rehabilitation consisted of replacing failed concrete panels with full-depth asphalt concrete and an overlay to full reconstruction of all lanes and shoulders. The rehab was needed because the underlying Portland Cement Concrete (PCC) continued to fail after several previous replacements and it was determined that a full reconstruction was needed. As one of the primary connections for vehicular traffic between Madera and Fresno, as well as a common trucking route between Northern and Southern California, the stretch within the project limits is consistently exposed to heavy traffic. The traffic can make routine tasks for a highway project much more complex, especially when it comes to phasing and sequencing of activities.

Project Specifics

Following are additional key details of the project as they relate to this case study:

• Projected Cost: $37.4 million
• Projected Timeline: 16 months.
• Delivery Method: Design-build with a low-bid means of procurement.
• Project Limits: On State Route 99, in Madera County, from South Gateway Overcrossing to Avenue 16 Overcrossing (approximately 3.6 miles) in both the Northbound and Southbound Directions.
• Project Scope: Highway reconstruction, guard railing and signage upgrades, electrical modifications, and minor storm drain improvements.
• Design-Build Goals:
  1. Schedule acceleration. It was anticipated that the use of design-build would accelerate the project schedule by 12 months in comparison to design-bid-build.
  2. Innovation. Bringing the contractor into the project at an early stage, as well as the contractor’s close relationship to the designer, would likely provide creative engineering and construction solutions as well as possible innovation in the staging of construction.
3. Risk transfer. Design-build would allow Caltrans to transfer cost escalation and schedule delay risks to the contractor.
4. Cost certainty. The agency anticipated that design-build would bring greater cost certainty early on under the assumption that the contractor submits a fixed-price early in the design, and then works with the design team to stay within budget.

**Contractual Obligations**

As a design-build project, there were two main contractual parties involved: the owner (Caltrans) and the contractor-led design-builder. As the owner, Caltrans was tasked with, among other things, general project oversight, scope identification and clarification, contract procurement, and quality oversight (20% of normal quality assurance tasks). Caltrans assigned a single Resident Engineer (RE) as the individual responsible for assuring that the agency carried out its obligations. Under the RE, there were 2 or 3 people tasked with general administrative purposes and 1 part-time inspector to oversee the implementation of the contractor’s quality management program. In addition, approximately 20 Caltrans employees performed review or correction work at some point in the project. The design-builder was primarily tasked with creating a design & bid using the owner’s criteria set out in the RFP, updating the design throughout the project, construction, testing & inspection, public relations, and jobsite management. The design-build team was organized under the leadership a single Project Manager (PM) employed by the contractor. Additionally on the contractor’s project management team; there were approximately 2 project engineers, 1 superintendent, 1 intern, and 1 QC/QA manager. It is estimated that approximately 10 additional employees were at least somewhat involved, along with many field and subcontractor personnel. The design team consisted mainly of two engineers, both of which were not located on-site with the contractor.

**Results and Discussion**

The following information was gathered through interviews with key members of the two contractual parties upon completion of the project. It was the goal of this study to simply gather and present the information as objectively as possible. In addition to information relating to the specific project goals set out by the owner, the project also experienced unique benefits and challenges through the use of design-build that provide valuable lessons learned for the future.

**Design-Build Project Goals**

As mentioned previously, the owner set out specific goals for the project, some of which were met, others of which were not. While the project benefitted from innovation and some risk transfer, it did not meet the goals of schedule acceleration or cost certainty. The reasons for these outcomes are highlighted below:

1. Schedule Acceleration: The project did not meet the goal of accelerating the schedule by 12 months through use of design-build. The project suffered from costly owner-initiated change orders. In fact, the project was completed in 28 months, which was exactly how long the project was estimated to take using the design-bid-build method. However, that’s not to say that the project did not benefit from the close contractor-designer relationship, ease of design changes, or overlapping of the design and construction phases. If there were no change orders, it is likely that the project would have been completed at or near the original anticipated date. As discussed below, the changes resulted in large part from the lack of a clearly defined scope.

2. Innovation: The contractor’s early involvement in the project, as well as the close relationship to the designer, greatly improved the design process. The project also benefitted from early involvement of Caltrans construction management personnel, which would not be typical on a Caltrans design-bid-build project. On traditional Caltrans projects, the agency’s own engineering department creates the plans and specifications with limited input from the construction management side. These aspects were critical in producing construction and staging plans that were both buildable and practical.
3. **Risk Transfer:** Most risk was fairly easily transferred to the design-builder. Any schedule delays, material and labor escalations, and any errors or omissions in the design were the responsibility of the contractor and therefore greatly reduced the number of small change orders.

4. **Cost Certainty:** Unfortunately, the project did not provide cost certainty early on. This can be mainly attributed to the lack of a clearly defined scope. By the time the project was completed, there was almost $6 million in change orders, which primarily covered additional overhead signs, revised pavement cross slopes and profiles, electrical lighting scope corrections, and PCCP panel removal/replacement.

### Design-Build Challenges

As the agency’s first design-build project, there were many challenges that were addressed by the project team:

1. There was an obvious lack of full commitment to the design-build method from the owner’s side. Design-build seems to have been pushed by upper management at Caltrans, but the project-level employees appeared to be highly skeptical of the process from the view of other individuals. This is not surprising, as people in general are resistant to change if they’ve been doing something one way for many years and don’t fully understand an entirely new process right away.

2. The project showed that transitioning from the traditional way of thinking to a design-build mindset is not easy. While most of the individuals interviewed did not believe they personally had difficulty transitioning to the new way of thinking, they each thought that some of the others did. There was some confusion as to what each individual’s role was, and the expectations of each party to another. Although it was stated that the contractor is the district’s contractor of choice, there was an obvious lack of trust between the parties on this project. This appeared to be a result of not understanding each other’s expectations and not embracing a collaborative atmosphere. Both the owner’s representatives and the design-builder were doing their best to fulfill their obligations, but could have done better according to the other.

3. The QA/QC process caused many issues during the project. The contractor felt as though they were benefitting the owner by over-testing and producing very high quality work. However, the owner was not satisfied and felt as though the contractor consistently chose profit/schedule over quality. This is an understandable challenge, as it can be difficult for even the most ethical contractor with the best intentions to “police” themselves and for any owner to initially trust a process like that.

4. The change order process, although easier for the contractor, was much more complicated for Caltrans. The changes were unusually large and more complex than usual. In addition to the Caltrans review process, these factors triggered external reviews by other government agencies such as the Federal Highway Administration. Also, auditing the designer’s fees for change order work was difficult for Caltrans to do. This frustrated them as they realized the design fees were approximately 40% more expensive than doing it internally, as they would on a traditional project.

### Design-Build Benefits

The project demonstrated many of the advantages that often occur as a result of design-build:

1. The project benefitted from the close contractor-designer relationship. Design changes were made easier and completed faster than if they were done using the traditional method. The ability for the contractor to communicate directly with the designer allowed them to have better control over the project schedule.

2. The involvement of all parties in the design process, including Caltrans construction personnel, greatly improved the design’s constructability. While there was nothing extremely unique or new about the project’s design, the finished designs and staging plans were no doubt easier and more cost-effective to construct.
3. The jobsite documentation process was much easier, especially for Caltrans. The design-builder was responsible for coordinating the project records and ensuring completeness, which eliminated many of the back-and-forth document exchanges and owner oversight duties found on a traditional project.

4. Although the quality inspection process caused some problems, it was much easier when it was implemented effectively. Caltrans benefitted from having less inspection obligations and the contractor benefitted from catching themselves doing something incorrectly and taking corrective action quickly to minimize cost impacts.

**Design-Build Lessons Learned**

The project provided valuable insight for future design-build project teams to take into account:

1. It is important to ensure adequate preparation early on so that all parties clearly understand their roles and responsibilities. Doing so will allow for greater trust, understanding, and communication between the different contractual parties. Establishing expectations early on is critical.

2. Success depends on a full commitment from all parties to the design-build process and mindset. It is important that individuals are open to change, and willing to step out of their comfort zone. The owner needs to trust but verify, allow the contractor to think outside of the box, and not be afraid to lose a little power over the project. The contractor needs to clearly understand the owner’s expectations and has to be willing to stop themselves if quality goals are un-met. Both parties need to realize that all discrepancies will eventually be solved, so it is important to not lose trust in each other over a few events.

3. Better implementation and/or modification of the quality control procedures is needed. The difficulties regarding the QA/QC process resulted in large part from the fact that the contractor hired their own inspector. The contractor needs to be effective at self-policing and the owner needs to have faith in the entire process. To improve the process, perhaps it would be best for the owner to select the QA inspector.

4. There needs to be a careful selection and implementation process for projects to be delivered using design-build. This project confirmed that not all types are appropriate for design-build. The project was fairly small in size and not complicated, but had many unknowns due to the nature of the rehabilitation work. Also, the lack of a clearly defined scope resulted in multiple costly change orders. In order to increase cost certainty, it is likely best to choose projects that allow for a clearly defined scope. Perhaps larger, more complex projects that have fewer unknowns would be better candidates for the method.

**Conclusions and Future Research**

As the first design-build project ever completed by Caltrans, the Madera 99 Road Rehab project has provided the agency with valuable information. The other projects in the demonstration program, along with any design-build projects beyond that, shall now know more about the realistic goals to set, the challenges to expect, potential advantages, and should apply the lessons learned to ensure greater project successes. This case study has found that there can be advantages to using design-build if done properly. The accelerated schedule, increased collaboration, innovation, and other advantages of using design-build will be more likely as the agency and contractors alike become more experienced with the method. According to the majority of interviews conducted for this case study, Caltrans should pursue design-build on future projects that are the right fit for the method. Many projects, like the Madera 99 Road Rehab, are still likely to benefit more from the traditional method. If Caltrans decides to pursue design-build in the future, it will be important that the agency selects larger, more complicated jobs that allow for clearly defined scopes. Also, this case study has shown the importance of early preparation, full commitment to the process, and proper implementation of the QA/QC process.
As more of the demonstration projects are completed, it may be beneficial for future researchers to complete additional case studies similar to this one. This will provide a much more accurate and well-rounded understanding of the advantages and disadvantages of design-build on Caltrans projects. These subsequent case study results can then be combined into a single study that analyzes and presents the key information from all of them. The results can then be used to determine the future of design-build use for Caltrans and how best to approach the projects.

References


