

## Practical Design Case Study

An In-House study by Organizational Results in cooperation with the Central District

### MoDOT Summary Statement

*Practical Design has been a resounding success at MoDOT in delivering projects to meet specific location needs while saving millions of dollars. In just its first two years, Practical Design saved Missouri taxpayers \$400 million. Even when faced with increased construction costs, Practical Design helped the Central District deliver a critical transportation project by reducing project costs by more than 15 percent.*

### Background

Missouri voters passed Amendment 3 in November of 2004. The Missouri Department of Transportation had the opportunity not only to improve Missouri's roadways, but also to prove to Missourians that they could be good stewards of their tax dollars. The Amendment 3 funds were used for three different elements.

- Element 1, called Smooth Roads Initiative, improved the condition and safety along 2,200 miles of existing roads.
- Element 2 involved accelerating projects that already had a funding source.
- Element 3 funds were used to construct projects that had no funding source such as the 4-lane expansion of Route 50 from St. Martins to California.

#### Original Route 50 Project

The original Route 50 project involved making a two-lane road into a four-lane road from Jefferson City to Sedalia. The original project had been through a preliminary design phase, but due to the \$343 million price tag, no funding had been available. The Practical Design process began and the Route 50 project eliminated \$30 million from the initial budget. When Amendment 3 passed, district leaders knew that the Route 50 project was of great importance, but the \$313 million project was not likely to receive full funding. The decision was made to split the job into 3 separate projects.

#### Amendment 3 Element 3

In December of 2004, MoDOT's Transportation Planning Division requested each district to identify projects of high need that currently were not funded. They received over 200 projects. The districts were then asked to limit the list of projects to those of high need for both the district and the state.

The Central District worked with the five Regional Planning Commissions (RPCs) and the two Metropolitan Planning Organizations (MPOs) within the district to determine the highest need projects. Central District staff took a unique approach by asking the RPCs and MPOs to present the projects they felt should be included. Not only did this provide more local input into the process, it also allowed the local and regional leaders to provide ways the counties could partner with the state. One of the selling points for the



### **Background (cont'd.)**

St. Martins to California Route 50 segment was that the local counties agreed to take over the old Highway 50 and the new outer roads. With the counties agreeing to maintain all but the new 4-lanes of Highway 50, MoDOT will save money in maintenance and snow removal costs for those roadways. With the local-state partnership on the project, the counties were able to get a new four-lane roadway and the state was able to turn over the existing roadway instead of increasing the miles of road it maintained.

Through the Planning Framework process, MoDOT formed a “Major Project Task Force” to help select the final projects that would receive funding from Amendment 3 element 3. The task force had one member from each district, the director of System Management, the director of Program Delivery, and the director of Transportation Planning. The available funding was broken into two groups: rural major transportation projects and urban major transportation projects.

The district engineer from each district presented their list of projects to the Major Project Task Force and explained why each particular project was important to Missouri. The first round of presentations was held on February 15, 2005. Those projects that made the cut were again presented at an April 13 meeting. From that meeting a final prioritized list of projects and recommendations were sent to the Missouri Highways and Transportation Commission. The Route 50 Project from St. Martins to California was third in priority for rural major transportation projects.

### **The Project**

In recent years, MoDOT has made public involvement a priority in planning and constructing projects. The Route 50 project is a good example of how MoDOT and the public can come together to make a project more successful. In June of 2005, public hearings were held in

St. Martins and California. Over 500 people attended generating 87 comments; opposition was minimal.

The Route 50 project relocates the highway and provides four new lanes near St. Martins to just west of California, Missouri. The design team worked hard to accelerate the project. They knew if they completed the project plans early enough, it would not go out to bid at the same time as other Amendment 3 projects. When there are fewer projects in a bid letting there is more competition among contractors and the lowest bids are received. The project required over 500 plan sheets and was let nine months ahead of schedule.

The Route 50 project was 11 miles long and required the acquisition of 68 parcels of right of way. With the accelerated schedule, the Right of Way Division worked hard and was able to acquire all the property in 11 months. Only two parcels were condemned.

Concurrent to the planning stages, Hurricane Katrina hit and construction prices skyrocketed. The bid for another District 5 job, Highway 5 in Camdenton, came in several million above the estimate. Central Office required updates on estimates of all big projects. Despite being faced with a crisis, Practical Design enabled the district to deliver a project that met the needs of the public in the budget they were given.

### **Practical Design**

Before Practical Design, most projects followed strict guidelines on the parameters of a project. All roadways with the same classification type and traffic volume would have the same depth of pavement, same shoulder type, etc. The concept of Practical Design was initiated in 2005, which required designers to start looking at projects on a case-by-case basis instead of strictly adhering to standards. Another aspect of Practical Design was that the road would be built to meet the

### Practical Design (cont'd.)

needs, not necessarily to the highest of standards used if there was an unlimited budget. Although it should be noted that one of the fundamental principles of Practical Design is that safety will never be compromised. While the concept of Practical Design was in place prior to Hurricane Katrina, the increased construction costs amplified the need to locate cost-saving measures wherever possible.

MoDOT projects are initiated at the state level and the district level, and there are separate funds for each. Prior to Practical Design, when a state level project went over or under budget, the excess money was taken from, or returned to the statewide pool of money. An added incentive for districts to institute Practical Design was that all the money saved when a project came in under budget would be returned to the district for future projects in that district. Concurrently, if a project goes over budget, the money is taken from the district budget. The only exception is for major river bridges where the economies of scale make it impractical.

The design team for the Route 50 project was in a constant state of cutting costs and applying Practical Design concepts while still satisfying the needs of the project. One area that allowed significant cost savings was with the pavement thickness. In the past, concrete roads for this type of roadway were designed to be 12" to 14" thick. With Practical Design many concrete roadway thicknesses have decreased to 10." However, when looking at the specific site conditions, it was determined the roadway thickness for Route 50 would further decrease to 8". A couple factors led to this decision. Most importantly, the roadway was on a solid rock base. Unlike most roadways in Missouri, the Route 50 project has a very stiff fill below the roadway. Another factor was that MoDOT's Pavement Engineering staff was using a new design method, the Mechanistic-Empirical (M-E) approach. MoDOT is the first DOT in the United States to adopt this new

method because it more realistically characterizes in-service pavements and improves the reliability of designs.

The St. Martins to California stretch of Route 50 does not have a large volume of truck traffic. The projected number of trucks for this section of Route 50 in 2008 was around 1,500 per day compared to the 10,000 or more trucks per day on Interstate 70 through the region. The limited truck traffic added to the decision to decrease the pavement thickness and also allowed several other areas of the project to be scaled back. The pavement slab narrowed from 28 feet to 26 feet, and the shoulder thickness was reduced from 5 ¾" to either 3 ¾" asphalt or 4" of concrete (alternate bid).

Providing alternates was another way the project team decreased the project costs. Mainline and outer road pavements and shoulders could be bid as asphalt or concrete or a combination. The winning contractor chose to use concrete for Route 50 and asphalt for the outer roads. Prospective bidders were also allowed to choose alternates to the traditional materials and construction for the drainage pipes and structures.

Other Practical Design elements included eliminating 2,000 feet of outer road. The original project called for outer roads along the entire route. Outer roads were eliminated in areas where existing roads provided adequate access, and the grade was increased where the outer road could not be eliminated. Instead of using the standards set for the four lanes of Route 50, the outer roads and connections were designed to match the existing conditions as long as a minimum 5 ¾" roadway thickness was maintained. In some areas ditches were narrowed to reduce excavation costs.

Some non-design related factors played a part in decreasing the construction costs as well. The Smooth Roads Initiative, element 1 of

### **Practical Design (cont'd.)**

Amendment 3, was completed on December 8, 2006 a full year ahead of schedule. With the successful completion of SRI projects there was more competition in the bidding environment. The roadway was relocated which decreased the impact on traffic; therefore during the bidding process, contractors did not have to plan for traffic control and mobility costs during the project. The terrain for the project was fairly mild which decreased structures and provided an excellent base for the roadway. The passage of HB 1944, eminent domain legislation, right-of-way costs increased over \$220,000, however the utility relocation costs were under budget, which offset the right-of-way overruns.

A condensed list of project information and Practical Design components can be found in Appendix A.

### **Results**

The construction budget was \$35.3 million. Illinois Valley Paving came in with the low bid of \$29.9 million. The result, \$5.4 million under construction budget! This cost savings goes back to District 5, allowing them to take care of other needs and projects within their district. The Route 50 job is an excellent example of the cost savings that can be achieved by applying the Practical Design concept to each component of a project.

## Appendix A

# *Fast Projects That Are of Great Value*



**Route 50**  
**St. Martins to California, Cole and Moniteau Counties**  
**J5P0632A**  
**Bid Opening - December 15, 2006**  
**Budget = \$35.3 million (Amendment 3 funds)**

### **Project Description**

- 11 mile 4 – lanes on relocation.
- Project accelerated **9 months** (originally September 2007)
- 68 R/W parcels required, 2 condemned (**11 months acquisition**)
- Moniteau and Cole Counties have agreed to take over existing Route 50 and new outer roads.
- In-house design with over 500 plan sheets. (**12 months for final design**).

### **Practical Design Components**

- 12' driving lanes with 4' inside and 10' outside shoulders.
- Pavement slab narrowed from 28' to 26'.
- Mainline pavement thickness reduced from 13" asphalt or 10" concrete to 8" asphalt or 8" concrete.
- Shoulder pavement reduced from 5 ¾" asphalt or concrete to 3 ¾" asphalt or 4" concrete.
- Mainline and outer road pavements and shoulders could be bid as asphalt or concrete or combination. (Bidders choice)
- Eliminated a 2000' outer road and increased grades on all outer roads.
- Matched existing pavement thicknesses and widths on all outer roads or roads being tied into.
- Narrowed ditches, which reduced excavation cost in some areas.
- Allowed drainage pipes and structures bid as traditional materials and construction or alternative.

### **Other factors**

- Bidding environment (SRI finished, contractors not carrying work, fuel prices)
- Mild terrain, minimal impact to traffic due to relocation, minimal structures, etc.
- R/W cost have overrun due to HB 1944 but utility relocation costs are under budget enough to offset.

**Low Bid = \$29.87 million** (*Illinois Valley Paving*)

**Practical Design Results = \$5.4 million under construction budget**

**That's \$5.4 million to meet other district needs!**