The Ohio Department of Transportation Office of Research & Development Executive Summary Report

Evaluation of the Effectiveness of the Strategic Initiative 9 Pilot Bridge Concepts

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Problem

The Ohio Department of Transportation adopted Strategic Initiative #9 – Building Bridges Faster, Smarter and Better. Bridges are usually the bottleneck in road repair. The purpose of SI-9 was to find methods of constructing bridges faster and with better quality. The term "faster" did not necessarily mean a reduction in total construction time, but rather a reduction in the time the bridge was closed or under traffic restriction.

Initially, ODOT identified six concepts:

1) Stay-in-place steel forms;
2) Prestressed concrete bridge decks which are post-tensioned and ground to final profile;
3) Concrete filled steel grid decks;
4) Precast sub-structure units;
5) High performance concrete materials which have shorter curing times;
6) Transversely post-tensioned adjacent box beams with integral wearing surfaces.

In the end, ODOT decided to concentrate on transversely post-tensioned adjacent box beams with integral wearing surfaces and prestressed concrete decks. Another concept, the continuous for live load steel bridge with prefabricated substructure elements, was added.

Objectives

The goal of this project was to answer three questions:

1) Did the use of these concepts reduce the time the bridge was closed or under traffic restriction?
2) What other factors influence bridge closure time?
3) Did these concepts result in better quality bridges?

Description

The study looked at six bridges, broken down as follows:

PIC-22-17.03 is a six span steel girder bridge. This was designed as continuous for live load steel bridge. The structure also used prefabricated substructure elements.

HAN-75-15.99 is a single span steel girder bridge with prestressed, precast concrete deck panels.

CLI-730-11.13, MOT-70-14.74 and FAI-22-15.85 are single span, precast, longitudinally pre-tensioned, laterally post-tensioned box girder bridges.

GUE-513-1.80 is a two span, laterally and longitudinally post-tensioned, precast slab bridge.

Conclusions & Recommendations

CONCLUSIONS

1) The barriers to building bridges faster, better and more efficiently are not technological, but are largely human factors. Bridges can be built faster, better and more efficiently when the following principles are applied:
    a. Effective pre-project planning.
    b. Designing the project for fast and efficient construction.
    c. Aligning all project personnel to the same goal.
    d. Creating and maintaining an effective partnering strategy.
    e. Creating and maintaining an effective change management system.
    f. Use of an experienced, low turnover workforce.
2) From a technological standpoint, bridge construction can be accelerated by:
    a. Use prefabricated elements.
    b. Order necessary materials early and store so they are available when needed.
    c. If possible, do as much assembly of these elements as possible before closing the existing bridge.
    d. For elements to be assembled on site, use a mock-up to check the fit beforehand.
    e. Create streamlined procedures for acceptance of field work.
    f. Close the bridge and use a detour rather and using phased construction.
3) Incentives and disincentives have only a marginal effect, if any at all, on time to completion.
    a. Incentives: Incentives are only effective if they cause the contractor to fundamentally alter the construction process (e.g. work overtime, add second shifts, use innovative construction techniques and materials). Data from benchmarking and post-construction evaluations show that only the largest jobs have enough incentive to cause this change in the construction process. For a typical job, the incentives are usually not large enough. This does not mean that the incentives should be abandoned. Data suggest that, while the contractor may not make large changes to collect the incentive, the presence of the incentive might cause some small changes in behavior.
    b. Disincentives/penalties: Benchmarking data suggest that these penalties are rarely enforced. The presence of penalties may prevent egregious violations of the contract, but in most cases the contractors can justify the delays well enough to avoid penalty.
    c. There was some suggestion in post-construction meetings that contractors include incentives/disincentives in the bid. If the contractor feels the job requirements are unrealistic, they will increase their bid to account for the risk of a penalty. If they feel they have a good chance of getting the incentive, they may decrease the bid to win the job and use the incentive to make up the difference.
    d. Incentives/disincentives are not usually passed on subcontractors. This can create a

problem as the subcontractor has no reason to worry about the schedule.

4) Use of lateral post-tensioning improved the performance of adjacent box girder bridges. However, these systems need to be carefully designed and constructed to avoid problems. ODOT uses less post-tensioning than required by AASHTO LRFD, but it appears adequate and is consistent with values published in literature.
5) The precast concrete deck panels used on HAN-75 preformed very well. The use of precast deck panels did not increase the speed of construction on this project. ODOT District personnel thought that use of the panels had the potential to speed up construction if a better construction methodology were found.

8.3 RECOMMENDATIONS

1) To judge the effectiveness of bridge projects, ODOT needs to develop a benchmarking system. It is recommended that:
   a. ODOT form a benchmarking team to determine what data is needed and a collection method.
   b. There needs to be a consistent way to define "where items go." For example, under the current system, an approach slab might be part of the bridge in one project and part of the pavement in another.
   c. Create an improved and consistent format for construction diaries. Frequently, the causes and durations of delays and important dates (like date of bridge closing) are missing. This information is necessary for benchmarking.
   d. Develop a consistent method for tracking contractor progress.
2) ODOT currently has a partnering program. To improve this program and to add alignment, it is recommended that everyone involved with the project have training and information on partnering. There should be formal reviews of the partnering process on each project to be sure it being done properly.
3) ODOT currently reviews plans for constructability, but every effort should be made to be sure that this is done and done properly as constructability reviews are extremely important. ODOT should review its current training in this area to be sure it is adequate.
4) It is recommended that formal pre-project planning strategies be adopted. ODOT should consider:
   a. Involving the engineer of record in the planning process so that the design reflects not only good, technical engineering, but also good planning for fast and effective construction.
   b. Use of the pre-bid meeting. This is essential to flag out any odd or unusual details, materials and processes. Pre-bid meetings can provide feedback which might improve the planning process.
   c. Use of preconstruction meetings for planning. Currently, preconstruction meetings tend to be informational. The successful projects in this research used the pre-construction meetings for planning.
5) ODOT may wish review its change management system. Fast and effective change management is a key factor in project success.
6) Data suggest that the presence of incentive and penalties have little effect on performance, except for the largest jobs. ODOT may wish to evaluate the effectiveness of this program.
7) ODOT should consider working with the State Highway Patrol on permit issues. In two cases (MOT-70 and PIC-22), shipments of vital components were delayed because of permitting issues. In both cases, the problem was a "technical" violation not a safety issue; e.g. in one case a truck broke down and the existing permit could not be used with the replacement truck. The first priority should be keeping Ohio's roads safe, but some provision should be

made to allow shipment of vital components if the violation is not a safety issue.

8) In every project, the use of grout was a problem. It is recommended that ODOT review the grouting materials list and grouting standards. Specifically, the review should consider:
   a. The development of a "ready-mixed" grout as an alternative to bagged material.
   b. Creating a procedure to allow the use of special purpose grouts which are not on the currently approved list.
   c. Creation of detail for grouting full depth shear keys in adjacent box girder bridges.
   d. Examining the property variability and problems with grout installation. Perhaps a change in specifications or procedures is needed.

Implementation Potential

All of the recommendations can be easily implemented by ODOT. In some cases, implementation is as simple setting a uniform standard and being consistent from project to project with things ODOT is already doing (partnering, data collection, classification of items in bid documents, etc.). In other cases, all that is required are minor changes in ODOT policies and procedures.