Prefabricated Elements Case Study

tech transfer summary

Researchers compared the use of prefabricated concrete panels versus traditional construction methods for a Minnesota case study.

Objective

The purpose of this case study is to provide an example of an analysis of the use of prefabricated elements to reduce the duration of closed lanes during highway reconstruction. The objective of this study was to show a process to determine the benefits and costs of using prefabricated elements versus traditional replacement. This specific project compared prefabricated concrete panels versus traditional concrete replacement for both a 218 ft. construction project and a single panel replacement project.

Problem Statement

This project is a case study of a small panel replacement project, conducted by the Minnesota Department of Transportation, involving the installation of precast concrete pavement panels. The installation segment consisted of a 218 ft. continuous stretch of 12 ft. wide pavement on Trunk Highway 62 in Minneapolis.

Prefabricated elements have the opportunity to reduce the duration of closed lanes during highway reconstruction. Prefabricated concrete panels are cast off-site and are ready for installation once the base is prepared. Using prefabricated panels eliminates the curing time required when cast-in-place panels are used. Since the concrete panels are already cured, the section can be opened for traffic immediately following placement of the panel and sealing, thus minimizing the disruption and congestion of traffic. However, the precast panels are significantly more expensive than traditional cast-in-place panels, meaning that reduced user costs (work zone delays) are achieved at the expense of increased construction costs.

Cost of traditional repair for 218 ft. segment of Trunk Highway 62

Item	Qty	Unit	Unit price	Cost
Full depth contraction joint repair	12	lf	$45.55	$546.60
Full depth panel replacement	283	sy	$69.20	$19,583.60
Reinforcement bars	90	lb	$6.00	$540.00
Dowel bars	96	ea	$5.00	$480.00
Seal concrete pavement joints	60	lb	$3.80	$67.00
Joint repair	336	lf	$1.30	$436.80
Total traditional repair				**$21,644.00**

Cost of precast panel replacement for 218 ft. segment of Trunk Highway 62

Item	Qty	Unit	Unit price	Cost
Remove concrete pavement	2593	sf	$1.00	$2,593.00
Precast concrete panel	18	ea	$9,040.00	$162,720.00
Seal concrete pavement joints	60	lb	$3.80	$67.00
Joint repair	336	lf	$1.30	$436.00
Total precast replacement				**$165,805.80**

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RESEARCH PROJECT TITLE
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Research Description

To determine when it is appropriate to use higher construction cost prefabricated panels instead of lower cost cast-in-place panels, benefit-to-cost ratios were calculated for different project lengths and different construction schedules. The results of these analyses were used to form a sensitivity analysis to determine the conditions under which it would be cost-beneficial to use prefabricated panels.

To conduct the sensitivity analysis, the researchers investigated the user costs and construction costs of varying the length of panels from 1 panel to 18 panels. From this range of panels, researchers then determined a specific number of panels for which it was beneficial to use prefabricated elements as opposed to traditional repair methods.

With the B/C ratio, many of the inputs used are unique to a specific location, which hinders the ability of an analysis at one location to form the basis for determining whether prefabricated panel construction should be used for a separate location. Traffic and network configurations are unique to each location and are the basis for calculating potential road user cost-reduction benefits.

Because prefabricated panels provide for a shorter lane closure time, the benefits are greater if the facility is already congested and traffic is not easily diverted to parallel facilities.

Key Findings

The results of this analysis show that on Trunk Highway 62 in the Twin Cities (a grade-separated roadway), the use of prefabricated panels for short sections was cost-effective because prefabricated panels could be placed more quickly and required a shorter lane closure than traditional methods. In this case, when reconstruction involved seven or fewer panels, prefabricated panels were found to be cost-effective. Because of the high cost of prefabricated panels, when reconstruction involved more than seven panels, the use of prefabricated panels was not found to be cost-effective.

Implementation Benefits

The greatest benefit of prefabricated panel use is realized when a facility has high traffic volumes. The combination of a reduction in schedule and the opportunity to open the closed travel lane(s) during the last stages of the construction process after sealing reduces the total road user costs when compared to traditional methods.

Implementation Recommendations

The end result of the analysis is not necessarily intended to show that precast concrete panels should or should not be used for all locations; rather, the intent is to show that this method has advantages in certain types of projects and locations and that the benefit-to-cost analysis should be conducted on a case-by-case basis for each specific project. The case study included in this project provides an example of one such analysis.

Prefabricated concrete panel installation (photo courtesy of Dave K. Merritt, The Transtec Group, Inc.)