Flexible Start/Fixed Duration Contracting for Construction of Transportation Projects: A Case Study of the Paseo Bridge Maintenance Project

MTC
MIDWEST TRANSPORTATION CONSORTIUM

SWZDI
Smart Work Zone Deployment Initiative

Final Report
July 2007

Sponsored by
the Smart Work Zone Deployment Initiative
a Federal Highway Administration pooled fund study
and
the Midwest Transportation Consortium
the U.S. DOT University Transportation Center for Federal Region 7

ctre
Center for Transportation Research and Education

IOWA STATE UNIVERSITY

About the MTC

The mission of the University Transportation Centers (UTC) program is to advance U.S. technology and expertise in the many disciplines comprising transportation through the mechanisms of education, research, and technology transfer at university-based centers of excellence. The Midwest Transportation Consortium (MTC) is the UTC program regional center for Iowa, Kansas, Missouri, and Nebraska. Iowa State University, through its Center for Transportation Research and Education (CTRE), is the MTC's lead institution.

Disclaimer Notice

Non-discrimination Statement

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date
Flexible Start/Fixed Duration Contracting for Construction of Transportation Projects: A Case Study of the Paseo Bridge Maintenance Project	July 2007
	6. Performing Organization Code
7. Author(s)	**8. Performing Organization Report No.**
Kelly Strong, Amr Kandil, and T.H. Maze	
9. Performing Organization Name and Address	**10. Work Unit No. (TRAIS)**
Center for Transportation Research and Education Iowa State University 2711 South Loop Drive, Suite 4700 Ames, IA 50010-8664	**11. Contract or Grant No.**
12. Sponsoring Organization Name and Address	**13. Type of Report and Period Covered**
Federal Highway Administration U.S. Department of Transportation 400 7th Street SW Washington, D.C. 20590 Midwest Transportation Consortium 2711 South Loop Drive, Suite 4700 Ames, IA 50010-8664	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

Visit www.ctre.iastate.edu for color PDF files of this and other research reports.

16. Abstract

Innovative contracting methods are being constantly refined to meet the challenges facing state departments of transportation (DOTs) in their efforts to rehabilitate the nation's infrastructure. These contracting methods emphasize best value practices and attempt to minimize construction cost and service disruptions to the traveling public. The importance of innovative contracting methods stems from the flexibility they offer to state DOTs in the procurement and delivery of construction. One innovative contracting method that appears to be underutilized is flexible start date contracts which allow contractors to schedule their work during dates that optimize schedules and minimize the public impact of their projects. The present paper describes an exploratory investigation of flexible start/fixed duration contracting. The paper presents the current practices of a number of state DOTs along with a case study of the Paseo Bridge rehabilitation project in Kansas City, Missouri. The results of this investigation demonstrated the advantages of flexible start/fixed duration contracting and its potential benefits in large transportation projects in urban settings.

17. Key Words	18. Distribution Statement
fixed duration—flexible start—incentive/disincentive	No restrictions.

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
Unclassified.	Unclassified.	24	NA

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

FLEXIBLE START/FIXED DURATION CONTRACTING FOR CONSTRUCTION OF TRANSPORTATION PROJECTS: A CASE STUDY OF THE PASEO BRIDGE MAINTENANCE PROJECT

Final Report
July 2007

Principal Investigator
T.H. Maze
Professor, Department of Civil, Construction, and Environmental Engineering
Iowa State University

Principal Authors
Kelly Strong
Associate Professor, Department of Civil, Construction, and Environmental Engineering
Iowa State University

Amr Kandil
Assistant Professor, Department of Civil, Construction, and Environmental Engineering
Iowa State University

Research Assistant
Jonathan Wiegand

Sponsored by
the Smart Work Zone Deployment Initiative
a Federal Highway Administration pooled fund study
and
the Midwest Transportation Consortium
the U.S. DOT University Transportation Center for Federal Region 7

A report from
Center for Transportation Research and Education
Iowa State University
2711 South Loop Drive, Suite 4700
Ames, IA 50010-8664
Phone: 515-294-8103
Fax: 515-294-0467
www.ctre.iastate.edu

TABLE OF CONTENTS

LIST OF FIGURES

ACKNOWLEDGMENTS

The authors gratefully acknowledge the financial support provided by the Federal Highway Administration and the Midwest Transportation Consortium. The authors also acknowledge the support of the Minnesota Department of Transportation's Office of Innovative Contracting through Mr. Tom Ravn, the director of the office, and the following Minnesota Department of Transportation resident engineers: Mr. James Roberts, Mr. Ted Sexton, and Mr. Jeffrey Perkins. The authors also acknowledge the support of MoDOT's resident engineer, Mr. Matt Killion. The authors finally would like to acknowledge the support of the Center of Transportation Research and Education (CTRE) at Iowa State University and the Smart Work Zone Deployment Initiative.

1. INTRODUCTION AND BACKGROUND

In recent years, construction procurement has witnessed a rapid increase in volume, due to the need to maintain a rapidly decaying transportation infrastructure (*1*). This increase in procurement volume is also paralleled with significant changes in contracting methods for transportation projects, which can be attributed to (1) the need to improve project performance in cost, time, and quality and (2) the downsizing and restructuring of State Highway Agencies (SHAs) (*2*). These changes led to the development of a number of innovative contracting methods that are being utilized in an increasing number of highway projects in the United States. One of these innovative contracting methods, called A+B contracting, places emphasis on project duration by giving project time a monetary value. Although this method was initially employed with some hesitation, it gained greater acceptance after the Federal Highway Agency (FHWA) recommended its use in the bidding of highway construction projects (*3*). The A (cost) parameter represents the project cost estimate, similar to conventional contracting methods. The B (time) parameter, on the other hand, represents the monetary value of the project duration (*4*).

The A+B contracting method is sometimes used in conjunction with another innovative contracting method called incentive/disincentive (I/D) contract clauses (*5*). I/D clauses motivate contractors to decrease project durations and deter them from exceeding estimated contractual completion dates. The method motivates the reduction of project duration through a bonus amount, called the incentive fee, paid to the contractor per unit of time reduced from the estimated project duration. The deterrence, on the other hand, is achieved through a penalty amount, called the disincentive fee, which is deducted from contractor payments. This penalty is a value deducted per unit of time in excess of the contractual project duration (*6*).

Although A+B contracting with incentive/disincentive clauses can be credited for attempting to minimize project durations, it does not explicitly offer contractors the flexibility to determine their project start times. This limitation can, in some cases, defy the purpose of these innovative contracting methods, since it decreases the contractor's ability to better manage and optimize project schedules and minimize disruption of service. Allowing flexible start dates may also create a more competitive bidding environment. If contractors are allowed to schedule their start dates in a manner that allows for optimal or near optimal resource utilization, they should be able to pursue more work. In addition, the risk of disincentive should be reduced if contractors can choose their date. Reduction of risk should be accompanied by a corresponding reduction in fees.

A number of studies emphasized the importance of providing contractors with the flexibility to schedule projects at times that decrease service disruption and analyzed methods to optimize transportation project scheduling (*7,8,9,10*). An FHWA study in 1998 listed the use of variable start date, or "window," specifications as one method for reducing the length of time that work zones are in place. This time reduction is a key to successful traffic management, which also includes improvements in safety and reductions in congestion within the work zone (*11*). A recent study by Dunston et al. (2005) demonstrated the importance of flexible scheduling by highlighting the fact that when input is received from construction and contracting professionals as part of an overall constructability review, process efficiencies result in cost and schedule reductions (*12*).

Another study that highlighted the importance of flexible project scheduling was conducted by Lee and Ibbs (2004), leading to the development of the Construction Analysis for Pavement Rehabilitation Strategies (CA4PRS) model (*13*). The CA4PRS model was designed to perform a constructability analysis of highway rehabilitation projects and to assist in deciding on optimum construction start times and durations. The model was developed to assist in implementing California DOT (Caltrans) Long-Life Pavement Rehabilitation Strategies (LLPRS) to rebuild 2800lane/km of deteriorated urban freeways over a period of 10 years. CA4PRS was used by Lee et al. (2005) to compare several scheduling alternatives for a number of transportation projects in California based on project completion, road user cost, maximum delay per closure, construction costs, and traffic handling costs (*14*). Results of the analysis demonstrated that project start times and scheduling alternatives had a strong impact on the outcomes of the project (including project cost, duration, and quality), and on minimizing service disruption. The study also illustrated that flexible starts can potentially impact the optimality of incentive/disincentive schemes based on road user costs derived from traffic analyses. This illustrates that the use of flexible start/fixed duration contracts for construction of transportation projects represents another valuable technique for incorporating greater efficiency and speed into the construction process.

Although the importance of allowing contractors flexibility in scheduling their projects has been established in the aforementioned studies, a review of academic literature reveals very little research about the issues involved in flexible start/fixed duration contracting, including the risks, benefits, and drawbacks of this type of contracting. Therefore, this paper will present the results from a search of legal cases involving construction start dates to identify the risks associated with firm schedule start dates, as well as the role project commencement plays in construction disputes. The paper then presents an exploratory investigation of current practices in flexible start contracting, including a detailed account of a case study project where this contracting method has been applied. The paper concludes with recommendations for future practice and research.

2. ROLE OF THE COMMENCEMENT DATE IN CONSTRUCTION DISPUTES

The date of commencement of a project plays an important role in the outcome of many construction disputes. For example, in *Gibbs Construction Company, Inc. v. A.C. Thomas* (1987) No. 86-C-1208 [500 So. 2d 764], the commencement date as defined in the contract was used by the court to determine whether or not a contract actually existed between the parties, and, hence, whether or not the plaintiff was entitled to damages. Specifically, a contract was signed on July 8, 1983, but commencement of the work was delayed until January 1984 due to delays in construction. A.C. Thomas rescinded their contract in November 1983, so the question before the court was whether or not a contract existed, since several months had elapsed between the execution of the contract and the start of work. Although the details of the case exceed the scope of this paper, the court ruled (on appeal) that if a contract is conditioned on an event occurring within an established period (such as a notice to proceed or the issuance of debt financing), and that conditional event does not occur within the stipulated time, the contact is voidable. Therefore, a contractually-fixed start date may put the owner at risk if permitting or financing problems delay the start of construction well past the contractual start date. Use of flexible start date language may help mitigate this risk.

Two issues widely encountered in construction disputes are delays and liquidated damages. The start date of the project will typically be an important factor in determining the outcome of such disputes, since it is used, along with the project's duration, to determine the date after which the project is considered in delay and liquidated damages become applicable. In *P.T.& L. Company, Inc. v. State of New York* (1992) 179 A.D.2d 850 [578 N.Y.S.2d 921], the contractor was in delay for almost two years. The notice to proceed was issued on July 20, 1973 and the contractual completion date was December 24, 1975. Liquidated damages were set in the contract at the rate of $500 per day of delay beyond the contract completion date. Liquidated damages were applied by the state, in addition to back charges for additional engineering expenses incurred by the state during the period of delay, which prompted legal action by the contractor. At trial, the contractor contended that the state delayed the issuance of the notice to proceed for three weeks. In a pre-construction meeting, the contractor submitted a tentative schedule of the work with a start date of July 1, while the notice to proceed was issued July 20. The Court of Claims rendered its judgment in favor of the state, noting that the contractor failed to demonstrate that the initial delay was due to the state's delay in issuing the notice to proceed and that the cause of the initial delay was the contractor's failure to properly mobilize its resources because it had too many other projects in progress. The finding of fact regarding the contractor's backlog of work is relevant to flexible start date scheduling. If contractors are given some choice in when to start the project, they can better balance their resources, thereby avoiding the situation discovered in *PT & L v. State of New York*.

In *Howard Contracting Inc. v. G.A. MacDonald Construction Co., Inc.* (1998) 71 Cal App. 4th 38 [83 Cal. Rptr. 2d 590], the city of Los Angeles, although aware of the federal agencies' intentions to impose restrictions prohibiting construction activities that disturb the nesting season (which extends between April 1 and September 30) of the least tern migratory bird, failed to inform the bidding contractors of such restrictions during the bidding stage. Furthermore, the city issued the notice to proceed to the successful contractor on February 14, a month and a half before the period when the construction work had to be suspended. Despite a "no damage for delay" clause in the contract between the city and the general contractor, the trial court found that the city was in breach of the contract and awarded the general contractor and his subcontractors damages and interest. On appeal, the Court of Appeal of California affirmed the trial court's decision. This case affirms the risk assumed by owners when they decide upon a fixed start date, either contractually or conditionally.

In some cases, the parties may agree that the date of commencement will coincide with the date of occurrence of a certain event. For example, in *Armstrong Construction Company Inc. v. Ralph E. Thomson* (1964) 64 Wn. 2d 191[390 P.2d 976], the construction contract stated that commencement of the work would be "on or before 10 days after receiving the building permit." The contractor chose to proceed with excavation and foundation work before the building permit was issued. Later on, the county building inspector suspended the work because the design violated both the zoning code and the building permit. Upon the owners' refusal to accept corrective design changes, the contractor commenced litigation to perfect a lien for the value of the work performed and the costs incurred for issuing the building permit. The trial court ruled in favor of the contractor regarding the building permit's expenses, but did not allow recovery of the work expenses because such expenses would have been avoided had the contractor abided by the terms of the contract with regard to commencement. The judgment was affirmed by the

Supreme Court of Washington. In this case, the contractor assumed the risks associated with choosing when to start work.

While early commencement by the contractor has its associated risks, as demonstrated in the previous case, late commencement can also be a source of construction disputes. One of the issues under litigation in *Superior Gunite v. Ralph Mitzel Inc.* (2004) 117 Cal App. 4th 301 [12 Cal. Rptr. 3d 423] was the subcontractor's claim for additional expenses due to late commencement. The subcontractor of the structural works expected to commence work in February and mobilized its resources accordingly. However, the general contractor did not allow the subcontractor to start the work until June or July. The main finding of this case that is germane to flexible versus fixed start date is a judgment against the contractor for the false start claim, including interest and attorney fees. In the case of general contractor and subcontractor, the legal precedence remains: whichever party establishes the start date assumes much of the scheduling risk.

The legal risk associated with commencement date is reflected in various standard forms of contracts. The American Institute of Architects' General Conditions of the Contract for Construction (AIA Document A201 TM – 1997) defines the date of commencement of the work in Article 8, Section 8.1.2 as the date established in the Agreement. However, the document does not fail to realize the possibility that the parties may agree to commence on a previously agreed date, or that the decision to commence be left to the contractor. Section 8.2.2 provides that in cases where the commencement date is neither specified by the contract documents nor by a notice to proceed given by the owner, the contractor must give sufficient notice to the owner, usually within a contractually stipulated The language of Section 8.2.2 allows for flexible scheduling with little modification of the extent contract.

The aforementioned cases highlight the significant role project start dates play in project success. Therefore, allowing contractors the flexibility to start projects at times that allow them to better utilize their resources can potentially mitigate some of the scheduling risks and resultant disputes relating to project commencement and can also enhance project success. The following section illustrates some of the current practices in flexible start contracting.

3. FLEXIBLE START CONTRACTING CURRENT PRACTICES

Although little academic research has been done regarding flexible start/fixed duration scheduling, a number of federal and state transportation agencies have been using flexible start clauses in their construction contracts. For the present exploratory study, state departments of transportation in Washington (WsDOT), Minnesota (MnDOT), and Missouri (MoDOT) were selected because of their experience with flexible start/fixed duration contracting. A variety of methods was used to collect information from these three states, including an archival data search, personal telephone interviews, and email questionnaires.

3.1 WsDOT Flexible Start Date Provisions

The state of Washington has a flexible start date provision to allow contractors flexibility, within limits, in selecting starting dates for construction projects. WsDOT determines the contractual completion date, but no longer specifies the start date (*15*). The flexible start date provision is intended to be used when it is determined that the contractor can use resources more efficiently if allowed some latitude in starting the work. More efficient use of resources is thought to provide public benefit through lowered construction costs. It is suggested that the flexible start date provision be used when delaying the project's start date results in no significant impact to the public and when the state benefits by allowing flexibility in start dates, such as when material and labor supplies are constrained by overlapping projects (*15*). Figure 1 illustrates a sample of the flexible start date provision used by WsDOT.

(January XX, 2001)

Section 1-08.4 is modified as follows:

*The Contractor shall begin onsite work on or before *** $$1$$, *** and shall notify the Engineer in writing a minimum of 10 calendar days in advance of the date on which the Contractor intends to begin work. The Contractor shall diligently pursue the work to completion within the time specified in the contract. Voluntary shutdown or slowing of operations by the Contractor shall not relieve the Contractor of the responsibility to complete the work within the time specified in the contract.*

**** $$ 1 $$ *** - Latest allowable Start Date*

Figure 1. WsDOT flexible date provision (*15*)

Flexible start date provisions are also beneficial for projects with large amounts of offsite preparatory work, for which the construction start date and associated traffic delays can be postponed until all necessary pre-construction work is completed. WsDOT recommends that projects with fast track construction schedules not use the flexible start date provision (*15*). WsDOT also recommends the careful consideration of a number of factors before making the decision to use the flexible start provision. These factors include (1) the potential to lose control over the construction project schedule, (2) the ability of WsDOT staff to accommodate the contractor's schedule, (3) the potential for increased impacts to the traveling public, and (4) the potential public and media impacts (*15*).

3.2 MnDOT Resident Engineer Exploratory Survey

The Minnesota Department of Transportation (MnDOT) has made use of flexible start/fixed duration scheduling on several recent projects. MnDOT was contacted to survey their experience in this contracting method. The Innovative Contracting office at MnDOT recommended that a number of resident engineers with project experience using flexible start/fixed duration

contracting be contacted for this exploratory survey. E-mail surveys were sent to these MnDOT resident engineers, asking the questions shown in Figure 2.

The resident engineers drew on their experience from a variety of flexible start/fixed duration projects over the last ten years, including both rural and urban locations. The predominant project types were bituminous mill and overlay rehabilitation projects, but flexible start/fixed duration contracts have been used on projects ranging from small, very simple projects to projects of moderate complexity. The contract letting dates have varied from late winter through late summer, but the predominant letting dates were late May through early August.

The primary reason given for using flexible start/fixed duration contracts was the ability to attract more bidders if projects were scheduled according to contractor needs rather than MnDOT needs. By attracting more bidders and allowing the contractors flexibility in the start date, all three resident engineers believed they received lower bids because of the added competition and increased flexibility.

1)Please provide the project name(s) where flexible schedule contracts were used.

2)Please provide brief project description(s), including letting date and contract amount.

3)Please discuss the primary reason flexible start/fixed duration schedule was used on these project(s).

4)In your opinion, did the use of flexible start/fixed duration have any impact on traffic congestion during construction compared to traditional contracting methods? If so, what was that impact, and did it improve or worsen congestion?

5)In your opinion, did the use of flexible start/fixed duration have any impact on worker safety during construction compared to traditional contracting methods? If so, what was that impact, and did it improve or worsen worker safety?

6)In your opinion, did the use of flexible start/fixed duration have any impact on public perceptions or convenience during construction compared to traditional contracting methods? If so, what was that impact, and did it improve or worsen public perception?

7)In your opinion, what are the primary benefits of using flexible start/fixed duration contracts?

8)In your opinion, what are the primary drawbacks of using flexible start/fixed duration contracts?

Figure 2. MnDOT exploratory email survey

None of the resident engineers stated that the use of flexible start/fixed duration contracting impacted traffic congestion differently than traditional phasing approaches, although two of the respondents did state that it would be a good idea to consider trip-generating events (e.g., state fair, fall color tours) when specifying the construction window. None of the resident engineers believed the use of flexible start/fixed duration scheduling had any impact on work zone safety.

Similarly, none of the respondents expressed any impact, negative or positive, on public perception for projects using flexible start/fixed duration contracts. One resident engineer stated that projects requiring long advance notice periods for notifying local businesses and residents are not good candidates for such contracts. Another stated that road sections needing emergency repair are also not good candidates for flexible start/fixed duration contracts.

The primary drawback to the use of flexible start/fixed duration contracting is the pressure it places on local agency staff, particularly inspectors. If the contractor has flexibility, the local agency personnel must have flexible schedules as well. This can be problematic, given the budget constraints faced by many transportation agencies. Two resident engineers stated that an effective communication plan must be developed prior to contract letting. Specifically, a minimum one-month notification period prior to the start of work should be required of the contractor. In addition, a plan for informing the public and other affected agencies should be worked out in advance.

3.3 MoDOT Experience

The Missouri Department of Transportation (MoDOT) has recently completed two projects utilizing flexible start/fixed duration contracting. The MoDOT resident engineer responsible for both of these projects was interviewed to gather more in-depth information regarding the benefits and drawbacks of flexible start/fixed duration contracting. These two projects were a $2.5 million project involving the rehabilitation of the West Pennway overpass across I-35 and a $21 million project involving the rehabilitation of the Paseo Bridge, which will be discussed in detail in the following section. Many of the issues encountered in the two projects were similar. However, for the West Pennway project there were other access points close to the ramp closures required to complete the project, so the overall impact on the traveling public as well as traffic disruption and congestion on alternate routes were not significant issues. For this reason, the reduction in impact on the overpass project may not have been as dramatic as it was on the Paseo Bridge project, but the overall benefits of using flexible start/fixed duration contracting were still positive.

4. PASEO BRIDGE PROJECT

The Paseo Bridge is a major river crossing over the Missouri River that carries I-29 and I-35 traffic north of Kansas City. The Paseo Bridge is a suspension bridge serving as the primary connector from Kansas City’s central business district to the north metro and northern suburbs. The bridge provides access to a number of businesses in the area, including a number of river front Casinos, as shown in Figure 3. At approximately 100,000 vehicles per day, it is the busiest river crossing in the Kansas City metropolitan area. The renovation project involved painting; replacement of barrier rails, lighting fixtures, and bearings; installation of weatherproofing for the bridge's cables; cleaning of the flexure pin housings; and rehabilitation of the bridge deck. Clarkson Construction Co. was the general contractor for the project. The bid called for both cost and schedule bids from the contractors. Clarkson Construction bid approximately $20.9 million in costs and 170 days for bridge closure. The following section presents an analysis of the construction contract of this project.

Figure 3. Arial photo of the Paseo Bridge

4.1 Contract Analysis

A main objective of MoDOT in this project was to minimize disruption and inconvenience to highway traffic on I-29/35 resulting from road closure. This objective was reflected in various contract provisions, including the following:

- The contract defines the Average Daily Road-User Cost (RUC) as the amount of money that the parties to the contract agree is a reasonable quantification of the cost incurred by the road users due to interference and inconvenience to highway traffic resulting from road closure. Each bidder is to specify the closure time required to complete the work and the product of the multiplication of the specified closure time by the RUC is added to the bid price of each bidder. Using this method, the closure time specified by each bidder plays an important role in determining whether their bid was the lowest responsive and responsible bid.
- The contract limits the closure time specified by the bidder to a maximum of 170 days and stipulates that under no circumstances will the road closure extend beyond a specified date, namely November 10, 2005.
- Deductions in the form of liquidated damages will be applied to the contractor's payments at a rate equal to the RUC for each day of work in excess of the closure time specified by the contractor in the bid. The same deductions will be applied for each day of work extending beyond November 10, 2005, regardless of the closure time specified by the contractor.
- If the contractor completes all the work required for opening the road to traffic and has the road opened to traffic in less than the specified closure time, the contractor's payments shall be credited an amount equal to the product of the multiplication of the RUC by the number of days saved by the contractor. The maximum credit the

contractor may receive under this provision is $1.5 million, equivalent to a period of 90 days less than the specified closure time.

- Under the contract, I-29/35 will only be closed and reopened to traffic one time during the duration of the project. Temporary closure will not be allowed. Accordingly, road closure will not be approved until all pre-closure activities are complete and all materials necessary to carry out the work during the closure are procured to allow for continuous work during the closure.

It is apparent that the contract treats the work performed during road closure as a separate section of the project, with a duration equal to the closure time specified by the contractor and a maximum completion date of November 10, 2005. The contractor is free to choose when to close the road and commence such work, as long as all pre-closure activities are complete and as long as I-29/35 is open for traffic by the end of the specified closure time or by November 10, 2005, whichever is earlier. The contract also recognizes the fact that overall completion of the project entails the completion of work that does not require road closure. Any delay in such work beyond the overall completion date of the project makes the contractor liable to liquidated damages, regardless of the contractor's performance during the road closure work. Accordingly, incentives earned by the contractor during the road closure portion of the work are not paid until overall completion is achieved and liquidated damages, if applicable, can be evaluated.

4.2 Project Outcomes

The contractor completed the project in 110 days, opening the bridge two months early and earning the maximum bonus of $1.5 million. The project's resident engineer believed that the use of flexible start/fixed duration contracting, along with early completion incentives and the inclusion of schedule information in the bid, minimized disruption to the public. Traffic congestion on alternate routes increased during the bridge closure, but not beyond expected levels. This is illustrated in Figures 4 and 5, which show the volume to capacity ratios of diversion routes before and during construction, respectively. Traffic disruption and congestion were neither increased nor decreased by the use of flexible start/fixed duration contracting, but the duration of the disruption was minimized. The major work zone disruption time was six months, and the resident engineer believes the disruption could have been in place for as long as two years using traditional contracting.

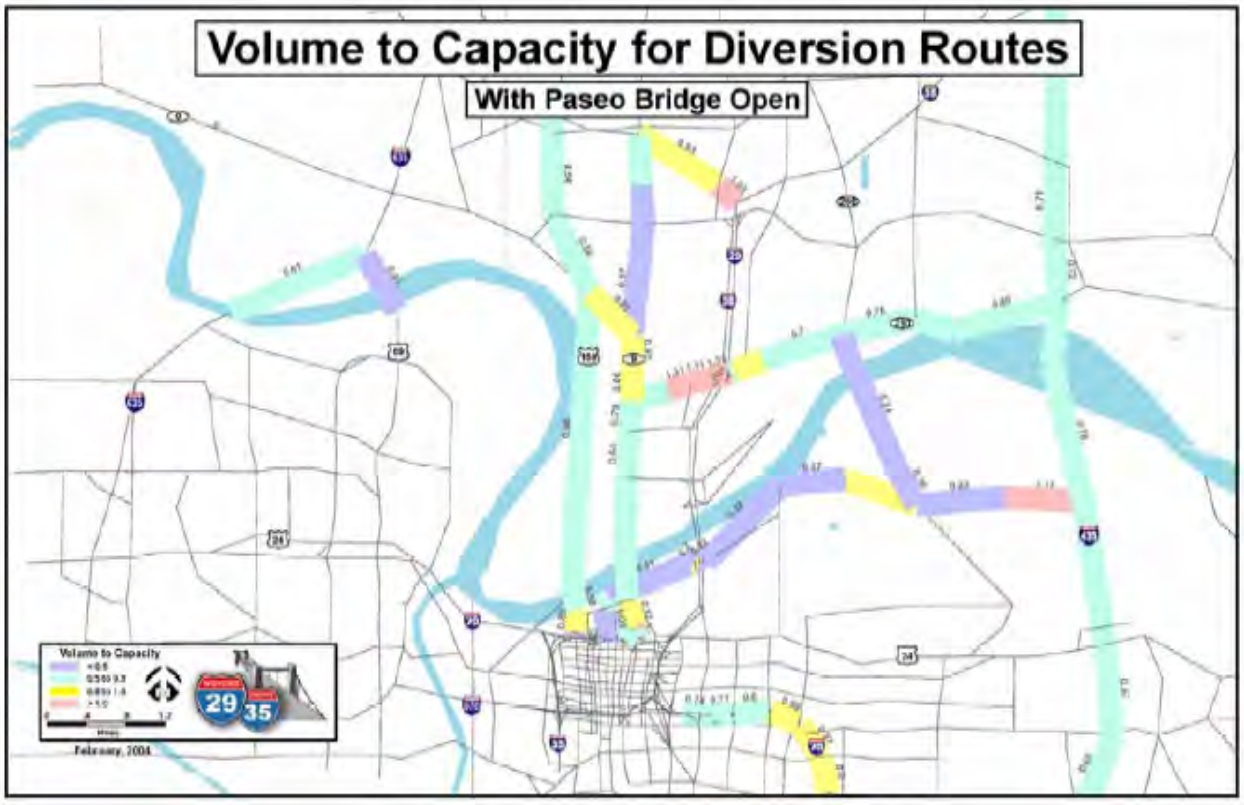

Figure 4. Volume to capacity ratios of diversion routes before construction

The project's resident engineer did not believe that worker safety was compromised by the use of flexible start/fixed duration contracting with incentive language. He stated that worker safety is actually dependent on the project type and the attitude of the contractor and subcontractors toward safety. He did note that the use of flexible start/fixed duration contracts with incentive clauses puts pressure on critical path activities. In other words, the ability of the contractor and subcontractors to earn the early incentive bonus may depend on the performance of a small number of subcontractors; therefore, these construction activities should probably be monitored closely for safety. On the Paseo Bridge project, for instance, the painter was on the critical path. The MoDOT onsite engineer did need to note some safety concerns that were promptly corrected by the subcontractor. It is not certain that the safety concerns were related to the accelerated schedule, but the pressure to earn the early completion bonus warrants increased diligence in reviewing critical path activities.

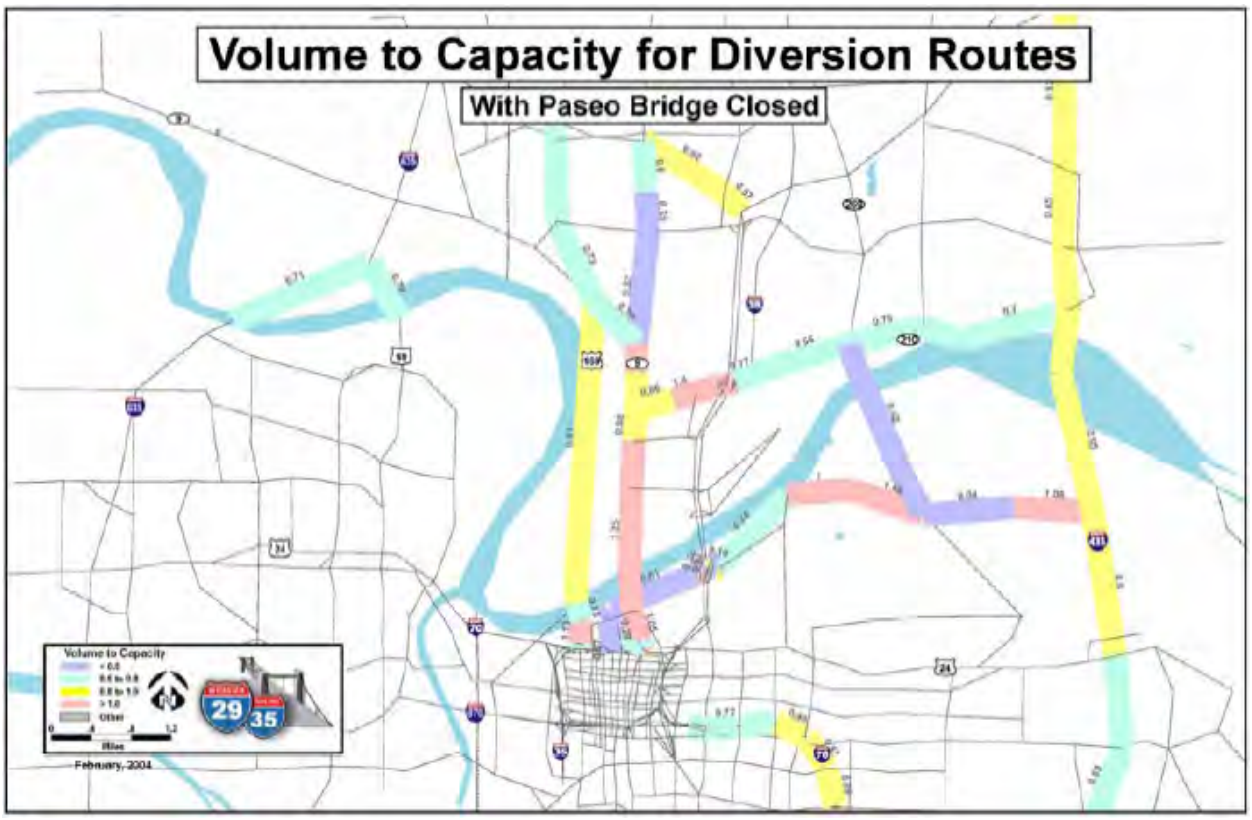

Figure 5. Volume to capacity ratios of diversion routes during construction

Public perception appeared to be favorable, as the traveling public saw the work progressing rapidly. One of the main issues in work zone traffic management is the adverse public reaction to seeing closed roadways or road sections when work is not underway within the work zone (*11*). Casinos along the riverfront were negatively impacted by the closure of the Paseo Bridge, but they were kept informed of impending closure and reopening dates. The total duration of the negative impact was reduced through the use of flexible start/fixed duration contracts with early completion incentives. In addition, the ability to convey accurate and timely information to affected businesses was generally improved under this form of contracting. Since the contract called for completion of all preparatory work, confirmation of all material orders, and secure delivery dates for critical items, the schedule given to local businesses has much less uncertainty than might be found on traditionally contracted jobs. In addition, the flexible start provision eliminated the need for contractors to set up the workzone before they were ready to begin. The public becomes frustrated when they see several miles of closed road or lanes with no activity underway. Flexible start/fixed duration contracting should help reduce or eliminate this type of misinformation.

5. SUMMARY AND FUTURE WORK

In summary, this paper presented an exploratory investigation of the flexible start/fixed duration method of contracting, and described a case study project that utilized this contracting method.

The use of flexible start/fixed duration contracting appears to provide for better risk allocation, increased competition among bidders, lower bid costs, and shorter duration of work zone traffic disruption. Reduction in the amount of time a work zone is in place results in shortened periods of disruption to the traveling public and reduced exposure for workers in the construction zone. Flexible start/fixed duration contracting can also provide benefits in situations where labor and material supplies are constrained because it allows contractors to begin work at the most effective time in relation to other work underway in the region.

Flexible start/fixed duration contracting could be considered for almost any job, but is ideally suited for projects in which roads or road sections will be closed, causing major disruptions in traffic patterns. Projects with substantial preparatory work and post-closure work are also good candidates. Projects for which flexible starts would cause major inconvenience to local businesses or the traveling public should not be considered. For instance, banks, emergency service providers, or hospitals may need more than 30 days notice if traffic is to be rerouted in the area in which they are located. If a major trip-generating event is to occur during the potential construction period, this should be taken into consideration when planning projects.

Flexible start/fixed duration projects should include a start window and a latest allowable completion date, along with a minimum period in which the contractor must notify the agency prior to the start of work. It should be noted that the use of flexible start/fixed duration contracting may also strain local agency resources, particularly onsite inspectors. Safety does not appear to be compromised through the use of flexible start/fixed duration contracting, but onsite agency personnel should focus their attention on critical path activities, especially if there is an early completion bonus in the contract.

As innovative contracting continues to gain popularity, it will be important to consider hybrid types of contracting. For instance, the Paseo Bridge project in Kansas City effectively combined A+B contracting, I/D clauses, and flexible start/fixed duration specifications. Research into innovative contracting and project administration has typically treated contract types as discrete choices, when in actuality it appears that hybrid forms of contracting are quite effective in tailoring contract language to fit project needs. Future research should attempt to examine innovative contracting and administration techniques that can be combined for optimum resource allocation. Use of more sophisticated multi-attribute decision models can assist this effort.

The results of this exploratory investigation and the case study demonstrate the strong potential of the flexible start/fixed duration contracting method. Therefore, the authors envision continuing to investigate this contracting method by designing a more comprehensive survey of this practice that will target all state departments of transportation in the United States. This study will be designed based on the observations made in the present exploratory study, and its results will be analyzed for statistical relevance.

6. REFERENCES

1. American Society of Civil Engineers (ASCE) (2006) “Report Card: Reports and Statistics.” http://www.asce.org/reportcard/index.cfm?reaction=reports.

2. Anderson, A. and Russell, J. (2001) “Guidelines for Warranty, Multi-Parameter, and Best Value Contracting.” *NCHRP Report No. 451*, National Cooperative Highway Research Program. Washington, D.C.

3. Herbsman, Z. (1995) “A + B Bidding Method–Hidden Success Story for Highway Construction.” *J. Constr. Engrg. Mgmt.*, ASCE, 121(4), 430-437.

4. El-Rayes, K. (2001) "Optimum Planning of Highway Construction Under the A + B Bidding Method.” *J. Constr. Engrg. Mgmt.*, ASCE, 127(4), 261-269.

5. Herbsman, Z., Chen, W., and Epstien, W. (1995) “Time is Money: Innovative Contracting Methods in Highway Construction.” *J. Constr. Engrg. Mgmt.*, ASCE, 121(3), 273-281.

6. Jaraiedi, M., Plummer, R., and Aber, M. (1995) “Incentive/Disincentive Guidelines for Highway Construction Contracts.” *J. Constr. Engrg. Mgmt.*, ASCE, 121(1), 112-120.

7. Chien, S., Tang, Y., and Schonfeld, P. (2002) “Optimizing Work Zones for Two- Lane Highway Maintenance Projects.” *J. Transp. Eng.*, 128(2), 145-155.

8. Chien, S. and Schonfeld, P. (2001) “Optimal Work Zone Lengths for Four-Lane Highways.” *J. Transp. Eng.*, 127(2), 124-131.

9. Ma, W., Cheu, R. L., and Lee, D. (2004) “Scheduling Of Lane Closures Using Genetic Algorithms with Traffic Assignments and Distributed Simulations.” *J. Transp. Eng.*,130(3), 322-329.

10. Jiang, X., and Adeli, H. (2003) “Freeway work zone traffic delay and cost optimization model.” *J. Transp. Eng.*, 129 (3), 230-241.

11. Federal Highway Administration (FHWA) (1998) “Meeting the customer’s needs for mobility and safety during construction and maintenance operations.” *Publication No. FHWA-PR-98-01-A.*, Washington, D.C.

12. Dunston, P.S., Gambatese, J.A., and McManus, J.F. (2005) “Assessing state transportation agency constructability implementation.” *J. Constr. Engrg. Mgmt.*, Vol. 31, No. 5, pp. 569-578.

13. Lee. E., and Ibbs. C. W (2004) “Computer Simulation Model: Construction Analysis for Pavement Rehabilitation Strategies.” *J. Constr. Engrg. Mgmt.*, 131 (4), 449-458.

14. Lee, E. B., Thomas, D., and Bloomberg, L. (2005) “Planning Urban Highway Reconstruction with Traffic Demand Affected by Construction Schedule.” *J. Transp. Eng.*, 131(10), 752-761.

15. Washington Department of Transportation (WsDOT) (2006) “Flexible Start Date.” http://www.wsdot.wa.gov/Projects/delivery/alternative/FlexibleStart.htm.