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Criteria and Guidelines for Innovative Contracting

Study SD95-07
Final Report

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16. Abstract

To minimize the impacts of highway construction on road users, U.S. Highway Agencies are increasingly using innovative contracting methods designed to reduce the time of highway construction. Three time-based methods - incentive/disincentive provisions for Contract time, A+B bidding, and lane rental - have been successfully implemented for selected projects in many states to reduce the duration of highway construction projects. This research project investigates the use of these contracting practices in other states, and assesses the potential impacts that time-based innovative contracting methods would have on the South Dakota Department of Transportation and the contracting community in terms of costs, time, quality, safety, and effects on existing practices. This report also reviews the calculation of road user costs in several states and recommends enhancements to the existing calculation of road user costs in South Dakota. The report concludes that the use of time-based innovative contracting is feasible for selected projects in South Dakota's five year construction program, and provides recommended criteria for project selection, guidelines for implementation, and sample specifications.

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EXECUTIVE SUMMARY

A trend in the U.S. highway construction industry is towards 3-R (Rehabilitation, Reconstruction, and Restoration) projects on existing alignments. These highway construction projects maintain or detour existing traffic, causing inconveniences to the traveling public, impacts to adjacent businesses and property owners, and increased safety concerns. Highway projects constructed under these conditions are potentially more costly and time consuming. In addition to the direct construction costs, these projects generate indirect costs to the road user due to traffic delays, increased gasoline consumption, and accident costs. Given the fundamental premise that time is money, State highway agencies have increasingly turned to contracting methods designed to reduce the time of construction. Based on recent surveys conducted by the Federal Highway Administration, the use of innovative procedures to reduce contract time has become more widespread in highway construction contracting.

South Dakota Department of Transportation (SDDOT) selected Trauner Consulting Services Inc. (TCS) to conduct Research Project No. SD95-07 to assess the feasibility and potential for using time-based innovative contracting methods in South Dakota to expedite project completions for selected projects. The time-based innovative procedures investigated in this study are defined as follows:

Incentive and Disincentive (I/D) Provisions for Early Completion are provisions which compensate the Contractor a daily amount for completing the work ahead of the I/D completion date or assess a daily amount for finishing later than the I/D completion date.

A+B bidding, a cost-plus-time bidding procedure, selects the low bidder based on a monetary combination of the Contract bid items (A) and the time (B) needed to complete the project or a critical portion of the project.

Lane Rental provisions assess the Contractor daily or hourly rental fees for each lane, shoulder, or combination of lanes and shoulders taken out-of-service during a project to minimize the time that roadway restrictions impact traffic flow.

Incentive/disincentive (I/D), cost-plus-time or A+B, and lane rental approaches have been successfully implemented in many states to expedite the time duration of highway construction projects. SDDOT has implemented I/D provisions with some success, but without

comparative data, the potential benefits of innovative contracting procedures were difficult to determine.

TCS visited with SDDOT personnel and contractors working in South Dakota to gain insight into the current contracting practices in the State, conducted a literature search, and surveyed innovative practices and road user cost (RUC) calculations in South Dakota and other states. This report details TCS's research findings related to I/D provisions for early completion, A+B bidding, lane rental, and RUC calculations. It assesses the potential impacts of time-based innovative contracting on SDDOT and the contracting community, and provides recommended criteria to select candidate projects and choose a specific innovative contracting approach. The report also includes recommended enhancements to RUC calculations, and guidelines and sample specifications for each innovative contracting method.

FINDINGS/CONCLUSIONS

I/D provisions, A+B bidding, and lane rental have all been demonstrated to save construction time. The costs to the SHA and the Contractor may increase due to the greater demands on resources resulting from expediting the project. Contracting agencies implementing these methods have not detected any decrease in the quality of the work. In fact, some practitioners report that quality may improve. The data suggests that A+B bidding is the least risk to the SHA of the three because time reductions are primarily achieved through competitive bidding rather than the payment of an incentive or lane rental fees.

Some SHAs have reduced or eliminated the use of pure I/D provisions for early completion in favor of a combination of A+B bidding and I/D provisions. These SHAs expressed that the I/D time was difficult to accurately estimate and contractors may earn incentives without extra effort. Through A+B bidding, the SHA shifts the responsibility to estimate a time savings to the Contractor. This method shifts more risk to the Contractor in terms of bidding the optimum combination of time and cost, and efficiently planning and managing the work. Lane rental also relies on the Contractor to minimize construction time for projects involving lane or roadway closures with high ADTs.

After evaluating SDDOT's five-year highway construction program, current highway use, road user costs, and assessing the potential impacts of innovative methods on SDDOT and the contracting community, TCS concluded that South Dakota will benefit from the selected use of innovative methods to reduce highway construction time and improved methods of calculating RUC in its five-year highway construction program. Figure 1 in the Recommendations section illustrates

when and how SDDOT should evaluate a project as a candidate for innovative contracting in its Pre-Construction Engineering Management System (PCEMS) and provides criteria to select innovative contracting methods.

RECOMMENDATIONS

1. **Update methods for calculating RUC in South Dakota.**

   SDDOT currently does not use accident costs, a vehicle occupancy factor, and operating costs due to speed changes in the construction zone. Integrate these elements into SDDOT's current RUC calculations and review and update these costs annually based on the consumer price index.

2. **SDDOT should continue to use I/D provisions to expedite project time.**

   - Assess the cost/benefit of using an I/D provision. If the daily estimated savings in RUC equals or exceeds the Department's estimate of a Contractor's daily cost to accelerate, then the use of an I/D provision is cost effective for the project.

   - To limit the exposure of the Department if its estimate of I/D time is such that the Contractor can earn incentives without extra effort, cap the incentive at five percent of the Contract amount.

3. **Implement A+B bidding for selected projects in SDDOT's five year construction program.**

   - The Contractor's estimate of the "B" time is the primary basis of time savings for A+B bidding without an I/D provision. Establish a maximum "B" duration for the project. If reducing the time of construction is critical, use I/D provisions in conjunction with A+B bidding to further motivate contractors to shorten the construction time.

4. **Use a window or closure period for short projects with flexible schedules. Use in conjunction with A+B bidding, I/D provisions, or A+B bidding with an I/D provision to expedite the project completion.**

- The window is typically the construction season. The Contractor may start at any time as long as the project is completed within the construction season and the Contractor provides sufficient notice to the Department.

- Since the project does not have a definite completion date, a working day or a calendar day schedule may be used.

5. Implement lane rental for selected highway projects in South Dakota.

- Use a lane rental bid item. Do not include the lane rental bid item in the bonded amount to reduce the amount of the bond required from contractors.

- Keep a monthly tally of the rental charges and deduct these from the lane rental bid item but do not deduct from the Contractor's pay requisitions. At the completion of the lane rental work, if funds are left in the lane rental bid, pay these unused fees as an incentive to the Contractor to a limit of 20 percent of the lane rental bid item. If the rental charges exceed the bid amount, deduct these excess charges from the final Contract amounts due to the Contractor.

- To conserve the Department's funds, allocate 20 percent of the lane rental bid item for the project budget.

6. Evaluate potential project and select time-based innovative contracting methods in SDDOT's PCEMS in two phases (See Figure 1).

Phase 1 - Identify potential projects during or as soon as possible after the preliminary design is complete.

Phase 2 - Re-evaluate the project between final design and plan reviews, and if feasible, select a specific innovative contracting method based on the criteria provided in Recommendation No. 7.

7. Use criteria for the evaluation and selection of time-based innovative contracting methods (See Figure 1).

(1) Identify a project as a candidate for expedited completion during or as soon as possible after the preliminary design is complete based on:

- High traffic volumes, traffic restrictions, or lane closures on interstates or principal arterials with RUC estimates in excess of $1500.00 per day or greater than the liquidated damages for the project,
- long detours causing delay in excess of 10 minutes,
- high accident rates or safety concerns during construction,
- potentially significant impacts to the local community or economy, or
- projects coordinated with special events.

Identify if right-of-way acquisition, utilities, other contractors, or other factors affect the project performance. Begin to coordinate information with utilities.

(2) Re-evaluate the candidate project between issuance of the final design and the completion of plan reviews. Refine the estimate of RUC and estimate the Contract duration. If right-of-way acquisition, utility relocation, design uncertainties, material or manpower shortages, coordination with adjacent contracts, or other factors do not severely impact the bid letting date or the critical project schedule, select an innovative contracting method as follows.

use A+B if:

- the project does not require to be completed by a specific completion date,
- RUC is relatively low but other factors warrant expediting the project, and
- the Department seeks contractor expertise to estimate contract time.

use an I/D provision if:

- RUC is high, and the monetary benefit equals or exceeds the incentives paid to the contractor to finish early,
- it is in the public interest to complete the project as soon as possible, or by a specific completion date, and
- the Department can estimate contract time based on similar projects or CPM scheduling.

use A+B bidding with an I/D provision if:

- RUC is high, and the monetary benefit equals or exceeds the incentives paid to the contractor to finish early,
- it is in the public interest to finish the project as soon as possible.
- the Department seeks contractor expertise to estimate contract time.

use lane rental provisions if:

- the use of detours or alternate routes is impractical,
- the work requires the closure of a lane or lanes, or a combination of lanes and shoulders, while maintaining traffic on the remaining lanes and shoulders.
- RUC is relatively high, and the monetary benefit to finish early equals or exceeds the incentives paid to the contractor in the form of rental fees,
- the Department seeks contractor expertise to minimize the time that the roadway or a portion of the roadway is out of service.

8. **If utility work is needed for the project, coordinate with utility companies as early as possible (See Figure 1).**

9. **Ensure that the plans and specifications are complete, accurate, and well coordinated prior to bid.**

10. **Use Partnering in conjunction with innovative contracting methods.**

- All innovative contracting methods increase risks to the Department and the contractor. Partnering is an effective tool to identify and resolve problems during the project before they become disputes and is worth the added effort and cost for higher risk projects.

11. **Use CPM scheduling for projects using innovative contracting methods.**

- Without an approved CPM schedule and monthly or periodic updates, it is difficult to verify the completeness and logic of a contractors plan, and to monitor the actual progress of construction. The same consideration would apply to projects not using innovative methods.

12. **To aid in resolving weather related delays, use a working day weather chart.**

- The chart provides the average number of working days per month for highway projects in each geographic region of the State.

13. **Develop and implement training programs.**

- SDDOT is proceeding with CPM training.

- Develop and conduct internal training for implementation of innovative contracting procedures.

- Invite contractors to a pre-bid meeting or special meeting to introduce and discuss a new innovative contracting method. Review the proposed special provisions and solicit comments and suggestions from contractors.

- Conduct Partnering training. A one or two day training course in Partnering concepts and Partnering facilitation is offered through the National Highway Institute.

1.0 INTRODUCTION

As major U.S. highway construction projects on new alignments diminish following the completion of the last remaining components of the interstate highway system, the trend in the industry is towards 3-R (Rehabilitation, Reconstruction, and Restoration) projects on existing alignments.[1] These projects maintain or detour existing traffic, inconveniencing the traveling public, impacting adjacent businesses and property Owners, and increasing safety concerns. Highway projects constructed under these conditions are more costly than those on new alignments and require significant time to complete. In addition to the direct construction costs, these projects generate indirect costs to the road user due to traffic delays, increased gasoline consumption, and accidents. Given the fundamental premise that time is money, State Highway Agencies (SHAs) are increasingly turning to contracting methods designed to reduce the time of construction. Based on recent surveys conducted by the Federal Highway Administration (FHWA), the use of innovative procedures to reduce contract time is becoming more widespread in highway construction contracting.[2]

Though the state of South Dakota has not experienced the traffic volumes found within congested urban areas in other parts of the country, the South Dakota Department of Transportation's (SDDOT) five year Statewide Transportation Improvement Program (STIP) for 1995-1999 shows that, consistent with national trends, the majority of the planned construction projects involve rebuilding existing highways and bridges, resurfacing pavements, or rehabilitating existing roadways and structures in or near the urban areas of the state. Based on the 1995 SDDOT STIP map, most of the major reconstruction improvements, comprising 69 percent of the planned expenditures for fiscal year 1995, are concentrated in or near Souix Falls in the southeastern part of the state, and the Rapid City, Sturgis, and Deadwood areas in the west. Furthermore, 88 percent of the interstate system in South Dakota is at least 20 years old. The 3-R program on the interstate system includes bridge replacements and redecking, pavement overlays and resurfacing, interchange reconstruction, and joint-and-spall repairs.[3] These project types may necessitate lane closures in the construction zone or detours causing impacts to the highway user.

Given these facts, SDDOT selected Trauner Consulting Services, Inc. (TCS) to conduct Research project No. SD95-07 to develop criteria and guidelines for using innovative contracting. The term innovative contracting in the context of this study refers only to time-based contracting procedures. These contracting procedures, Incentive/disincentive (I/D), cost-plus-time or A+B bidding, and lane rental have been successfully implemented in other states to reduce the duration

of highway construction projects. SDDOT has implemented I/D provisions with some success, but without comparative data, the potential benefits of innovative contracting procedures have been difficult to determine.

As part of this research project, TCS has met with SDDOT personnel and South Dakota Contractors to gain insight into the current contracting practices in the state. TCS also conducted a literature search, and surveyed innovative practices in South Dakota and other states. This report details TCS's research findings and recommendations related to selection, use, and implementation of innovative contracting in South Dakota.

2.0 RESEARCH OBJECTIVES AND METHODOLOGY

The objectives of this research project are as follows:

1. Assess the feasibility and potential for using or continuing to use innovative contracting procedures in South Dakota.

2. Further develop and refine the estimating of road user costs (RUCs) in South Dakota.

3. Assess impacts of innovative contracting on SDDOT and South Dakota Contractors in terms of costs, safety, quality, and existing practices and procedures.

4. Given that innovative contracting is determined to be feasible, develop or refine criteria for selection, and guidelines and sample specifications for use of innovative contracting procedures in South Dakota.

The approach to this research project was first to obtain information from SDDOT and South Dakota Contractors regarding highway contracting and the use of time-based innovative methods in South Dakota. TCS also obtained information from the Federal Highway Administration (FHWA) and findings from other states regarding the use and implementation of time-based innovative contracting methods.

The goal of this research process was to develop criteria for project selection, recommended guidelines and specifications for innovative contracting in South Dakota which take into account the existing contracting practices in SDDOT.

The tasks undertaken for this research project are listed below in the order they were performed.

1. Hold meetings with the project technical panel, the executive committee, South Dakota contractors, and SDDOT personnel to discuss the project scope, and acquire information on prior experience with innovative contracting and current contracting practices in South Dakota.

2. Search the existing literature to acquire information and reports pertaining to the use of time-based incentives and disincentives (I/D), cost-plus-time (A+B) bidding, lane rental, and road user costs.

3. Interview several State highway departments to assess past experiences and findings regarding the methods described above, and obtain examples of criteria, work sheets for road user costs, and specifications.

4. Survey contractors to determine their prior experience with I/D provisions, A+B bidding, lane rental, and CPM Scheduling, and ask for suggestions and concerns.

5. Evaluate methods, including those used in the Department's Division of Planning, for estimating road user costs associated with construction activity.

6. Evaluate the existing use of I/D methods and potential for future use of other time-based innovative methods in SDDOT's recent five year construction program. Identify the number and types of projects amenable to innovative contracting.

7. Determine quantitative or qualitative impacts to the Department and to the contracting community in terms of costs, risks, and quality.

8. Define criteria for project selection - considering traffic levels, construction type, economic disruption, utilities, safety, risk, potential impact on other projects, and other relevant factors - and develop a set of procedural guidelines for using each of the innovative methods deemed to be feasible to use in South Dakota. Recommend modifications or additions to existing SDDOT policies and procedures to adopt time-based innovative contracting methods.

9. Prepare sample specifications for the innovative method or methods.

3.0 STATUS OF INNOVATIVE CONTRACTING IN SOUTH DAKOTA

Status

SDDOT is currently using time-based I/D provisions for selected projects in the three or four areas in the State with the highest population densities and Average Daily Traffic volume (ADT). At the present time, a draft policy exists for Area Engineers to select and implement I/D contracts and calculate I/D rates. [4] No procedures exist for other time-based innovative methods such as A+B and lane rental.

The draft policy states that contract time may be based on calendar days, working days, or a specific completion date. The policy states that contract time must be reasonable and based on SDDOT's estimation of efficient and properly coordinated contractor operations.

I/D dates for SDDOT contracts are commonly tied to a milestone, such as the end of the construction season, the start of a holiday, or a special event, without a rigorous estimation of the I/D time. If an I/D project extends for more than one construction season, SDDOT will establish an I/D milestone at the end of the first construction season to motivate the Contractor to complete the first phase of the work prior to the winter shutdown, though the work may actually take less time to complete. This approach allows flexibility for both contractors and SDDOT to manage and schedule projects during the construction season. Contractors with limited manpower and multiple contracts can use the entire construction season, shifting resources from one job to the next.

Contractors have reported that they earn incentives on most of their I/D projects. This indicates that the Department may be able to reduce the I/D time without additional costs. To use an I/D, a more structured approach to the assessment of I/D time in South Dakota with input from the contracting industry is needed to equitably share the risk between SDDOT and the contractors.

An alternative approach to implementing an I/D contract within a construction season is used by Local Government Assistance (LGA) within the SDDOT Division of Planning. LGA limits the contractor to a closure period sometime during the construction season. For example, if the closure period contract time is 60 days, the Contractor may schedule this work at any time as long as the work is performed in a 60-day period within the eight month construction season. This approach appears to be a good solution to implementing an I/D project while still allowing the Contractor the flexibility to schedule the work at any time during the construction season. LGA pointed out, however, that for this method to succeed, the contractor must notify SDDOT sufficiently in advance

of the start of work so that SDDOT can plan to have people available to administer and inspect the work.

Other Factors

During TCS's meetings, SDDOT and the Contractors at the Associated General Contractor's (AGC) office expressed specific considerations or concerns related to innovative contracting in South Dakota. These included:

- The impact of innovative contracts using I/D provisions on other contracts held by the same contractor in the same construction season - The SDDOT has found that because manpower resources in South Dakota are limited, contractors will allocate those resources to complete an I/D project on or ahead of schedule, thus earning the incentive, while postponing other projects with liquidated damages (LD) provisions. Because LDs in South Dakota are based solely on construction engineering costs and are relatively low compared to I/D rates, Contractors can absorb the LD's on these jobs and still obtain a profit by earning the maximum incentive on the I/D project.

- Incorporating innovative contracting into the Preconstruction Engineering Management System (PCEMS) - SDDOT uses a project management system to guide and control its overall design, construction, and maintenance programs throughout the State. SDDOT wants to integrate innovative contracting criteria and procedures into the PCEMS flowchart.

- Utility coordination - SDDOT contracts directly with utilities to perform new work or relocations on private easements. On existing public right-of-way, a State statute requires utilities to perform work within 90 days of written notice by the State. Utilities are typically large companies based in other states requiring long lead times, sometimes as long as 13 months to plan, schedule, and perform work in South Dakota. The 90-day notice is not sufficient for some projects. Furthermore, utilities may not be able to perform utility relocations until the Contractor has commenced work and opened up the roadway exposing or providing access to the utilities. SDDOT relies on its clause in its standard specifications, or incorporates special notes on plans, or incorporates special provisions in the Contract to coordinate the work of the Contractor with utilities. SDDOT does not have criteria for scheduling utility work and subsequently setting bid letting dates. The SDDOT utility coordinator, suggested an approach discussed at a recent National Quality Initiative (NQI) conference where utilities would be invited to participate in design meetings and share information in order to minimize utility conflicts.

- Factors affecting bid letting - Many factors affect bid letting. These include design changes, plan reviews, and utility coordination. Once plans are complete, the right-of-way acquisition process begins. Landowners are afforded a minimum of six months for due process. Unless the right-of-way acquisition can be expeditiously purchased, the full six month period is needed to obtain the land. Furthermore, should SDDOT

plan to relocate utilities from the existing right-of-way onto property that must be acquired, third party utilities must wait for the property acquisition prior to performing any utility relocation. In some cases, I/D contracts have been used as an after thought on projects with delayed letting dates to motivate the Contractor to meet a completion date at the end of the construction season. Potential third party delays caused by utilities which could have been relocated prior to bid letting increase the State's risks associated with I/D contracts.

- Use of CPM Scheduling - Critical Path Method (CPM) scheduling is used for selected projects. The current scheduling specification was taken from North Dakota. This specification does not require monthly updates. SDDOT may request that the Contractor update the schedule to show how lost time will be recovered if delays have occurred or the Contractor may submit an updated schedule to justify a time extension request. SDDOT does not require that CPM scheduling be used for all I/D projects or that I/D time be estimated using a CPM. SDDOT is in the process of providing training to Area Engineers in CPM scheduling.

- Weather related delays - The determination of excusable non-compensable delays caused by weather is a major concern to SDDOT and Contractors. In the 1995 construction season, grading projects let in the eastern half of the State did not start until the standing water had subsided. SDDOT will issue time extensions for these contracts. South Dakota Contractors prefer working day contracts because they do not have to estimate weather delays in their bid and can challenge the Engineer's decision on non-work days due to inclement weather. For I/D or other time-based innovative contracts, FHWA recommends using calendar day contracts. This approach needs to be reconciled with conditions in South Dakota.

- Time Extensions - SDDOT Contract time extensions for extra work or increased quantities are computed by multiplying the ratio of the dollar value of the extra work and the contract value by the original contract duration. If the Contractor decides that this calculation results in insufficient number of days, it may submit information to justify additional time. For delays beyond the Contractor's control, the Contractor must file a written request to the Transportation Commission, an independent body that rules on extensions of time. The commission rules on a time extension based on evidence presented by the Contractor and SDDOT.

4.0 LITERATURE REVIEW

To supplement its existing literature on innovative contracting, TCS searched computer-based data bases including the Transportation Research Board Information Services (TRIS) data base, visited libraries, reviewed publications related to the highway construction industry, and reviewed FHWA files concerning Special Experimental Project No. 14 - Innovative Contracting Practices. Several very useful studies and reports concerning the use of time-based innovative contracting methods were obtained during this search. These documents are referenced in the succeeding sections of this report and included with the reference list.

Additionally, TCS conducted surveys of SHA transportation departments with extensive experience in time-based innovative contracting methods and SHA agencies similar to South Dakota in geography and demography to obtain findings, policies, guidelines, road user cost calculations, and specifications related to I/D, A+B, and lane rental procedures. These SHA agencies included Arizona, California, Colorado, Iowa, Kentucky, Maine, Maryland, Missouri, Nebraska, New Jersey, New York, North Carolina, North Dakota, and Wyoming. The significant findings from the literature search and survey of the SHA highway departments for each of these methods is presented in the Sections 6 and 7 that follow.

5.0 DEVELOPMENT OF SURVEY INSTRUMENTS AND INTERVIEWS

Survey Instrument

The survey instrument used for this research project was a questionnaire to contractors who bid SDDOT contracts. The questionnaire was designed after TCS completed its initial interview with SDDOT and Contractors at the AGC's office. The questionnaire had 33 questions covering the following topics:

TOPIC	No. of QUES.
General	7
I/D	15
A+B	2
Lane rental	2
Scheduling	6
Summary	1
Total Questions	33

Because both A+B and Lane rental procedures have never been used by SDDOT, the questionnaire included an explanation of these innovative procedures just prior to the questions concerning these topics.

The questionnaire was mailed to 70 contractors listed on the AGC Directory of South Dakota. The Contractors on the mailing list included both in-state and out-of-state prime contractors and at least one subcontractor. TCS chose contractors who specialize in highway construction and reconstruction.

In the cover letter, the Contractors were told that TCS was conducting a study for SDDOT regarding innovative contracting methods which may be implemented in South Dakota in the future. The respondents were assured that their identity would remain confidential. The mailing was designed to make responding as easy as possible. A pre-addressed stamped envelope was provided. The TCS mailing address was also on the cover letter in the event the preaddressed envelope was misplaced. A copy of the questionnaire and cover letter are included in Appendix 1.

Of the 70 questionnaires mailed, a total of 14 were completed and returned. Thus, the overall rate of return was 20 percent.

A summary of the questionnaire data is included in Section 6.0 of this report. Appendix 2 contains the compilation of the data for each question along with specific responses to the various questions.

Interviews

Two sets of interviews were used to collect data for this report. Initially, meetings were held with SDDOT's Executive Committee and other SDDOT personnel, the FHWA, and AGC Contractors from May 16 through 18, 1995. TCS learned of SDDOT's objectives for the research, the position of the FHWA, the concerns of South Dakota Contractors regarding innovative contracting, and the existing DOT management plans, policies, and procedures for traditional and innovative contracting.

The second set of interviews was conducted via telephone. TCS interviewed SHA personnel most familiar with the SHA's innovative contracting experiences. A total of 14 telephone interviews were conducted. The SHAs contacted were: Arizona, California, Delaware, Indiana, Iowa, Kentucky, Maryland, Missouri, Montana, Nebraska, New York, North Carolina, Washington, and Wyoming. The personnel were asked:

- the success/failure of the innovative contracting methods
- how the SHA calculates road user costs
- the effect the methods have on bid prices
- quality of work performed on contracts with innovative procedures
- effects on SHA resources
- project costs
- safety
- project duration, and
- the risks and rewards of using innovative contracting methods for both the SHA and the Contractor

6.0 PRESENTATION AND EVALUATION OF THE COLLECTED DATA

In presenting the findings on TCS's data collection activities, TCS has segregated the presentation for each type of Innovative Contracting (IC) procedure, starting with Incentive/Disincentives (I/D), followed by Cost-Plus-Time (A+B) Bidding and lane rental. Within each of these sections, TCS has summarized the significant data and presented an evaluation of this data in summary fashion as well.

Where possible, TCS has evaluated each IC procedure by four critical elements:

- Project Selection
- IC Time
- IC Rate
- Other findings/impacts

6.1 INCENTIVES/DISINCENTIVES FOR EARLY COMPLETION

6.1.1 Summary of Significant Data

Incentive/Disincentive (I/D) provisions have been widely used in the highway construction industry since the early 1980's to reduce construction time. Much has been written about the subject. In addition to TCS's survey of SHAs, TCS relied on several useful sources of information, studies, and surveys concerning the use of I/D provisions from the mid-1980's to the present. These include a report by Christiansen in 1986 [5], FHWA guidelines developed in 1989 [6], a report by Plummer in 1992 [7], and a survey by Iowa in 1991. [8]

6.1.1.1 Christiansen Report

In TRB Special Report 212 in 1986, Christiansen's presentation entitled "An Analysis of the Use of Incentive/Disincentive Provisions for Early Completion," stated that I/D provisions had been used in 30 states resulting in a 50% savings in time compared to traditional methods. Furthermore, the use of I/D provisions also increased SHA costs by 10 to 20%, and incentive payments averaged 5% of the contract value. The study concluded that the estimation of I/D time was critical and I/D's should be used sparingly. [5]

6.1.1.2 FHWA

FHWA 1989 Technical Advisory T 5080.10 issued guidance for I/D projects based on the experiences of states experimenting with I/D projects in the 1980's. These were guidelines for project selection, determination of I/D time, I/D rates, and other considerations. [6]

Project Selection

The guidelines for project selection were:

- high traffic volumes
- work to complete a gap in a highway system
- major reconstruction which severely disrupts traffic
- major bridge out of service
- lengthy detour

Determination of I/D Time

The FHWA guidelines defined I/D time as the time measured in calendar days, or as a specified completion date for the Contractor to complete critical work on roadways or structures. I/D time specified in this manner is clearly understood.

Critical work could be specified as part of a project or the entire project. The determination of time should answer the question, "To what extent and at what cost can construction be compressed from normal time to an accelerated schedule?" The estimate of I/D time should be based on past performance of similar work or a CPM schedule analysis using extended shifts or added resources. The engineers' estimate must incorporate weather days, holidays, and other non-working days into the schedule. FHWA encouraged SHAs to use CPM scheduling as an internal tool to estimate time.

Determination of I/D Rate

The guidelines for developing the I/D Daily Rate were:

- Calculate on a project by project basis using costs incurred by the contracting agency and road user costs (RUC).

- Do not include disruption to adjacent business costs in I/D rate, though this may be a basis for selecting an I/D approach.
- Use an incentive equal to or less than the disincentive.
- Cap the incentive at five percent of the contract amount; do not cap the disincentive. Five percent of the Contract value was the average incentive paid to contractors based on a study of experimental I/D projects.

The daily I/D rate should result in a favorable cost/benefit ratio for the traveling public. The FHWA guidelines define the cost as the daily I/D amount and the benefit as the daily savings to the road user and the SHA for each day the project finishes early. The I/D amount must be enough to motivate Contractors to finish early, but not exceed the daily savings to the road user.

6.1.1.3 Iowa Survey

Iowa DOT surveyed 50 states concerning the use of I/D projects in 1991. The findings concerning project selection, determination of I/D time, and I/D rates were as follows. [8]

Project Selection

Thirty five states had used I/D projects, and three states had let 10 to 25 I/D projects in 1991. Iowa DOT asked if the basis of selecting an I/D project was:

- construction interfering with traffic on high volume roadways
- road closures with long off-site detours
- construction causing severe economic hardship
- overnight lane closures, or
- lane closures on freeways causing two-way, two-lane traffic.

The most common bases of selection were construction on high volume roadways and long off-site detours. A significant number of responses (23) also cited economic hardship to the local community a reason for selecting an I/D.

Determination of I/D Time

The 1991 Iowa survey questioned what methods were used by SHA's to estimate I/D time. The choices were: [8]

- historic records for similar work
- CPM scheduling
- quantities and production rates for key contract items
- engineering judgement
- Contractor bids time in an A+B procedure, or
- other.

The majority of states (62%) responded that they used historic records or production rates for key contract items combined with engineering judgement. A smaller percentage (26%) used CPM. A few states relied solely on engineering judgement. One state responded that the date of a political commitment was the basis for the I/D time.

Though most of the SHAs (91%) reported that I/D time was based on calendar day or completion date schedules, several SHAs reported using work day I/D contracts. Colorado, Michigan, Montana, Nebraska and Nevada reported using working day schedules with I/D provisions.

Determination of I/D Rates

The 1991 Iowa survey included the following findings concerning I/D rates [8]:

- On average, I/D rates ranged from $2500 - $5000 per day. States in this range included Idaho, North Dakota, and Wyoming. These states has a low Average Daily Traffic (ADT) compared to more populated states. South Dakota was one of five states with typical I/D rates between $0 - $2500 per day. Twelve states reported typical I/D rates greater than $5000 per day.

- Eleven states reported that a standard procedure was used to determine I/D rates; 16 states reported that the method varied from project to project; and five states based I/D rates on engineering judgement.

- Criteria regarding a cap varied widely. Ten states reported that no cap was used. Other states responded that the cap varied. For those states using a percentage, the cap ranged from 5 - 10%. New York bases its cap on ten percent of the I/D time.

- The majority of states equate the incentive to the disincentive. Colorado reported using a larger incentive and Idaho reported using no disincentive for its first I/D project.

6.1.1.4 Plummer Report

Plummer, in his 1992 report for West Virginia, entitled "Development of Criteria for Incentive/Disincentives in Highway Construction Contracts," investigated criteria for selecting I/D projects and estimating I/D time in several states. The report also outlined a cost/benefit analysis for SHAs to determine the I/D amount. [7]

Project Selection

Apart from the FHWA guidelines, Plummer found that current SHA guidelines for selecting I/D projects yielded other criteria as follows:

Illinois

- low volume roads and river structures, if the project involves long adverse travel or area economic impacts

- river structures adjacent to central business districts

- nighttime construction on urban freeways

Maryland

- safety of the traveling public and contractor employees

- impairment of emergency services

- elimination of a hazardous condition

If the project appears to be a potential candidate, Maryland SHA further analyzes the project to determine if a portion of the road or the entire road will be taken out of service, if a detour is needed, and how long the project will take.

Determination of I/D Time

The methods used to determine I/D time ranged from using engineering judgement to using historic records in determining production rates for contract work items. Illinois developed expedited schedules based on extended work hours and work weeks, or extra shifts. Minnesota and Maryland estimated the number of work days for an I/D based on established production rates and then converted the work days to a calendar day bar chart, accounting for weather, holidays, and other non-working days. Minnesota and Maryland maintained charts of average working days per month based on weather statistics. At the time of Plummer's investigation, Ohio was considering using CPM analysis to estimate I/D time. [7]

Determination of I/D Rate

The cost/benefit analysis Plummer outlined for SHAs to determine the I/D amount included the following general steps: [7]

1. Calculate the daily road user costs and costs incurred by the SHA during the project (C).

2. Estimate the time period (X) that the project can be completed earlier than the I/D date. This time period is the difference between the I/D completion date and the earliest date that the Contractor can complete through maximum acceleration using all available resources. Completion on this earlier date would correspond to the Contractor earning the maximum incentive.

3. Estimate the Contractor's daily cost (B) to accelerate the project by X days.

4. Compare the contractor's costs (BX) with the costs to the road user (CX). If CX>BX, then the project has a favorable cost/benefit ratio.

Plummer recommended that, ideally, the potential savings to the road user and the SHA should be considerably more than the Contractor's cost to finish early. The SHA may then adjust the I/D rate downward to approximate the Contractor's costs. In this way the public and the SHA would share in the savings.

6.1.1.5 TCS's Survey of SHAs

TCS conducted a telephone survey of several states in 1995 concerning the use of I/D provisions and other innovative practices. A copy of this survey is included in Appendix 3. New information derived from this survey for project selection, and determination of I/D time and I/D rates is summarized below.

Project Selection

In North Carolina, road user costs greater than $2000 per day is the basis for selection. In New York, road user costs greater than $3000 per day, and the length of a detour for specific classes of roads are the bases for selection of an I/D.

Determination of I/D Time

In the 1995 survey, several states, consisting of Delaware, Maryland, and North Carolina, reported that the SHA's estimate of I/D time was not based on an accelerated schedule. This is also true for I/D some projects in South Dakota, which use the entire construction season as the I/D time.

Determination of Daily Rate

Where standard procedures are used, SHA's estimate RUC based on guides developed by AASHTO and FHWA, or use a program called Queue and User Cost Evaluation of Work Zones (QUEWZ) developed by the Texas Transportation Institute for lane closures on four-lane freeways. [9] Several states have developed spreadsheet programs to estimate RUC. Specific cost information and traffic data vary widely from state to state.

6.1.2 EVALUATION OF DATA

6.1.2.1 Project Selection

The findings indicate that guidelines for selection of I/D projects have expanded beyond the original FHWA guidelines. Today the use of I/D provisions covers a wide range of project types and conditions. Projects include bridge replacements and rehabilitation, roadway overlays, reconstruction, and expansion. The selection criteria is tailored to public needs and concerns, traffic impacts, economic factors, or special conditions in each state.

6.1.2.2 I/D Time

Various methods are employed to calculate I/D time. The predominant method is the use of historical production rates for contract work items combined with engineering judgement. CPM scheduling is not normally used to develop the I/D time. Further, some I/D time estimated by SHAs is not based on an accelerated schedule in many states.

Most SHAs follow the FHWA guidelines and use calendar days or completion date contracts. A few states use working day contracts. The use of working day contracts appears to coincide with states that have a short construction season and significant weather-related impacts.

With regard to accelerated project time, several states responding to the TCS survey stated that I/D time is not based on accelerated production. If the I/D date is neither estimated accurately nor based on an accelerated schedule, an efficient contractor may earn incentive payments without extra effort. Although the public will benefit from an early completion, some SHAs believed they may have paid too much, because the contract price without incentives was sufficient to cover the Contractor's cost to complete within the desired time frame.

6.1.2.3 Determination of I/D Rate

The daily I/D rate should result in a favorable cost/benefit ratio for the traveling public. This requires an analysis of costs and benefits by the SHA. Plummer recommends the daily savings must be greater than or equal to the Contractor's daily cost to accelerate. Most states do not perform an analysis. [7] The reasons given vary, but predominantly the reasons are that it is too difficult to estimate I/D time or that it is too difficult to obtain production cost data for both normal work and accelerated work.

In practice, states with relatively low RUC allocate 100 percent of the RUC to the I/D amount. This is the case in the states of Idaho, North Dakota, and Wyoming, where ADT counts are low, and RUC averages from $2500 to $5000 per day. South Dakota also allocates 100 percent of its RUC; however, its average RUC is less than $2500 per day.

Although the FHWA recommends a five percent rate cap for the incentive, the use and value of rate caps varies. The FHWA does not expressly limit the cap to five percent of the contract value.

As shown in the Iowa study, standard procedures for RUC calculations are used for 11 states, while methods vary from project to project in 16 states, and engineering judgement is used in 5 states.[8] The method used to determine RUC should be standardized so that all SHA personnel use the same approach, but it should also be flexible to include specific project variables.

6.1.2.4 Other Findings

Additional findings resulting from the implementation of I/D provisions are summarized as follows.

- I/D provisions are generally an effective means to expedite project completion. Studies have shown that contractors receive incentives for I/D projects far more frequently than assessments of disincentives. [1,5,7,8]

- SHAs have expressed concerns that the frequent payment of incentives may be a function of inaccurate estimates of I/D time rather than efficient contractors. Many SHAs have reported that the estimation of I/D time is based on the performance of the average contractor which allows ample time for the work under non-accelerated conditions.

- When disincentives are assessed, some SHAs report that disincentive payments are rarely received from contractors. Maryland reported that it had never received a disincentive payment. Contractors filed claims for unusually severe weather or changes that resulted in time extensions instead of disincentives. As a result of this, and concerns about the accuracy of the I/D time estimation, Maryland has decided not to use I/D provisions.

- I/D projects have the potential to over-extend SHA personnel. Long working days and weeks or extra shifts result in more overtime and demands on inspectors and construction engineers. Texas has suspended the use of projects with I/D provisions since 1987, in part, because of difficulties in providing adequate inspection for I/D projects. [10]

- SHAs and contractors both cite utility coordination as one of the biggest problems in using an I/D provision. Many states have no legal basis to force utilities to meet deadlines. [7]

- I/D provisions typically specify that no extensions of the I/D date will be allowed except for extraordinary circumstances, and if delays occur, the Contractor should increase production to meet the specified date. In the extreme, Wyoming has specified that the I/D date will not be adjusted under any circumstances. [11] The use

of this language has not always prevented time extensions of the I/D date. For example, unusually severe weather is a common source of delay. As previously stated, in Maryland, contractors have received time extensions to the I/D date for unusually severe weather conditions on several projects.

- Though questions have been raised concerning the quality of the work on I/D projects, no states have reported a reduction in quality on I/D projects versus traditional projects. In fact, both SHAs and Contractors felt that I/D projects may have a positive effect on quality because the Contractor is motivated to perform the work correctly the first time to avoid time-consuming rework. [7]

6.2 COST-PLUS-TIME (A + B) BIDDING

6.2.1 Summary of Significant Data

A+B bidding is an innovative method used in the highway construction industry to shorten the time of construction. This method is defined in greater detail in sub-section 6.2.1.1 of this report. Useful sources of information and findings concerning A+B bidding include 1989 FHWA guidelines, findings from California, New York, and several other states, and two reports by Herbsman.

6.2.1.1 FHWA

FHWA Technical Advisory T5080.10 dated February 8, 1989 noted that using RUC to select the low bidder, also known as the A+B bidding method, was approved for experimental use in 1985. [6] FHWA provided a brief description of the bidding method in the advisory. The "A" component of the bid is the cost bid for the work. The "B" component of the bid is defined as the number of calendar days proposed by the bidder to complete the project or a specified phase of the project multiplied by the daily RUC provided by the SHA. The low bid is chosen from the lowest overall combination of A+B. The contract price is defined as "A."

Although the FHWA defines the RUC used to calculate B as the daily costs incurred by the road users, other costs incurred by the SHA to administer and inspect the B phase of the project may also be combined with RUC to determine daily cost applied to the B component. This is consistent with FHWA guidelines for calculating a daily rate for I/D projects. Some SHAs actually include the costs to administer and inspect the project in their RUC calculations, thus expanding the definition of RUC.

The FHWA issued a follow-up memorandum on November 18, 1991 providing sample contract provisions for A+B and lane rental.[12] These provisions recommended that the contracting agency define a maximum allowable number of calendar days for the "B" bid. This language has been adopted in varying degrees by many SHAs using A+B provisions. The memorandum did not include guidelines for selection of projects or determination of the maximum "B" time.

As part of FHWA's Special Experimental Project-14 (SEP-14), SHAs experimenting with A+B bidding were required to submit work-plans and proposed specifications for A+B projects, and once approved, follow-up with documented findings from these projects. [2] TCS reviewed SEP-14 files and obtained work-plans, specifications, and findings from approximately 14 states concerning A+B projects. Five states, specifically California, Maryland, Missouri, New York, and North Carolina, have used A+B for more than 10 projects. The most extensive and useful findings in the SEP-14 files concerning the use of A+B were obtained from California, Colorado, Michigan, North Carolina, and Wisconsin.

6.2.1.2 New York State Department of Transportation (NYSDOT) Experience With A+B Bidding

NYSDOT let 24 A+B projects between February 1994 and August 1995, and plans to expand the use of A+B in the future. NYSDOT summarized its experience with these projects in an August 1995 interim report.[13] At the time of the report, nine projects had been completed. Eight contractors received incentive payments and one contractor was assessed a disincentive. NYSDOT estimated that the total estimated cost savings to the highway user for these projects was between $3 and $4 million.

TCS also obtained guidelines for implementation of A+B, special provisions for A+B, special specifications for CPM scheduling, a list of contractor concerns and state responses to these concerns, and a list of representative projects from NYSDOT. [14]

6.2.1.3 California Department of Transportation (CALTRANS) Reports on the Northridge Earthquake A+B Projects

CALTRANS reported the results of 10 A+B projects related to the Northridge earthquake reconstruction in a report entitled "The Lessons Learned From the Northridge Earthquake", dated 6 January 1995. [15] The FHWA also issued a report entitled "Cost-Plus-Time (A+B) Bidding

Method (with incentive/disincentive provisions) in Contracts Responding to the Northridge Earthquake," dated October 1994. [16] These reports included data on development of RUC and the maximum allowable time durations, evaluation of bids, contractor feedback, and other findings related to the use of A+B bidding for these emergency projects.

6.2.1.4 Herbsman Reports

Two studies by Herbsman entitled "Time is Money: Innovative Contracting Methods in Highway Construction" (1995) [1] and "The A+B Bidding Method - Hidden Success Story for Highway Construction" (1995) [17] presented findings from over 100 projects using the A+B bidding method over the past several years. The data from these reports included the percentages of projects bid as A+B in various states, comparisons of the engineer time estimate and contractor time estimate with actual completion times, summary of average time savings by state, and comparisons of engineer costs with contractor costs. The studies also showed a statistical distribution of RUC amounts and included data on the distribution of project types in terms of bridge work, roadway work, and miscellaneous work.

6.2.1.5 Additional TCS Surveys

TCS conducted telephone interviews with key SHA personnel in 14 states concerning the implementation of A+B contracts. The protocol for these interviews was explained in Section 5.0 of this report.

6.2.2 Evaluation of Significant Data

6.2.2.1 Project Selection

Guidelines from several states indicated that the basis of project selection for A+B are similar if not identical to I/D contracts. The rationale for selection of A+B includes factors such as high volume roadways, projects involving the closure of one or more lanes of a roadway, bridge rehabilitations, detours, a minimum RUC threshold, or other factors important to the surrounding community or the state. For example, NYSDOT specifies a threshold of $3000 per day in RUC above which A+B is used, or a detour length for a specific class road above which A+B is used. NYSDOT also selects A+B if projects are of special concern and time critical because of interference with public events, or because of public interest. [14]

Herbsman's study [17] of 101 A+B projects summarized the project types selected for A+B, the RUC values used, and the project size in terms of cost. The project types were generally categorized as bridge rehabilitation or replacement work, roadway construction or reconstruction, and miscellaneous barriers and medians or substructures. The results showed that the majority of A+B projects were split between road work (37%) and bridges (44%). RUCs varied from $1000 per day to $200,000 per day. Project costs ranged from very small projects ($1 million) to very large ($50 million). The conclusions were that:

1. The use of A+B is not limited to specific types of highway work, and
2. The selection and use of A+B bidding does not directly correlate to project size.

The selection of A+B bidding for a specific project is primarily a function of the project's impact to the traveling public or the surrounding community.

6.2.2.2 Contract Time

A+B bidding is used in two forms, with and without I/Ds. A+B with I/Ds attached to the completion of the "B" time is the most commonly used approach at the present time. Of the A+B projects evaluated by Herbsman, 94% included I/Ds. The RUC used to calculate "B" is also the basis of the daily I/D rate. [17]

When using the I/D method, the SHA determines critical contract time. In contrast, the A+B method requires the Contractor to determine the total number of days to complete the project or a critical portion of a project. The Contractor's estimate of time multiplied by the value of time, the daily RUC provided by the SHA, comprises the B component of the A+B bid. To insure that the project will be expedited, the FHWA recommends that the SHA estimate a not-to-exceed number of calendar days for the B component. If the bid exceeds the maximum number of days, the bid is considered to be non-responsive.

Recent findings indicate that most of the 26 states using A+B bidding as of 1995 included a not-to-exceed number of days in the A+B special provisions. However, the guidelines that SHAs use to estimate the maximum number of days vary. For example:

- CALTRANS reported that the maximum B time for the A+B Northridge earthquake-related projects was estimated using CPM analysis based on crews working 24 hours per day and seven days per week to complete the work in the minimum number of calendar days. Calendar days were then added to account for risks associated with

mobilization, work on adjacent roadways, and weather. These projects were characterized as emergency work. Estimated RUCs for these projects were high, ranging from $8400 per day to $330,000 per day. [15]

- NYSDOT implementation guidelines for A+B bidding require "a construction schedule for the overall project adequate to establish the maximum number of days to be allowed in the determination of responsible bidders." No further details are given. In further discussions, NYSDOT indicated that time is estimated in calendar days based on the production of an average contractor and then reduced based on the performance of a diligent contractor. The maximum "B" time is based on the shorter duration achieved by a diligent contractor. [14]

- Both Maryland State Highway Administration (MSHA) and Delaware Department of Transportation (DEL DOT) indicated that the maximum "B" time is based on average production rates using CPM or other scheduling methods, factoring in non-working days and other work restrictions.

The examples above and discussions with other SHAs indicate that, with the exception of the CALTRANS projects, the maximum "B" time is typically not based on accelerated production. SHAs rely on contractors to shorten the project duration by bidding less than the maximum "B" time.

NYSDOT has reported that contractors performing A+B contracts have prepared aggressive schedules, are working overtime, double shifts, or at night to reduce construction time, and are scheduling operations to maximize the efficiency of their work crews and equipment. As a result of this effort, the average estimated "B" time periods were 30% below the engineer's estimate. Additionally, out of nine completed A+B contracts with I/D provisions, eight finished early and five of the eight finished early enough to earn the maximum allowable incentive. Thus, the use of A+B contracting by NYSDOT resulted in a significant savings in time. [13] Based on studies by Herbsman, almost all states employing A+B report significant savings in time. This time savings was particularly evident for those SHAs with more experience with A+B biddings [17]

6.2.2.3 Daily RUC

The daily rate used to calculate the "B" component of the bid, and the I/D rate when I/Ds are used, is estimated by the SHA based on RUC. As previously discussed, this daily rate may also include the daily costs incurred by the SHA to administer and inspect the work, and assist in traffic control. These administrative costs should not be included in the daily rate if the completion of the "B" portion of the work coincides with overall completion of the project because these costs will

normally be included in the liquidated damages assessed at the end of project. It is important to ensure that cost components assessed against the Contractor do not overlap or duplicate one another.

6.2.2.4 Other Findings/Impacts

- Initially, bid prices may increase with A+B bidding. As contractors gain experience with A+B, bid prices become more in line with traditional bids.

- Overall, the bid amounts using A+B bidding are comparable to the engineer's estimate and traditional contracting methods. Herbsman's study of bid results for a large number of A+B projects concluded that contractors do not appreciably raise their unit prices compared to unit prices for projects bid using conventional methods. The unit prices in the "A" component of the bid may not increase even if the "B" component of the bid was low. [17]

- States that use A+B extensively for time-sensitive projects, such as Maryland, Missouri, New York, and North Carolina, have tended to move away from using pure I/D provisions. Maryland has in the past used general guidelines for selecting A+B or I/D projects as explained by Plummer. For projects with moderate impacts to the traveling public, A+B bidding was selected. For projects with more severe impacts, an I/D provision was used. [7] Presently, Maryland has eliminated I/D provisions and uses only A+B bidding. Herbsman noted that the use of pure I/D provisions in highway construction has diminished in recent years whereas the use of A+B, with or without I/Ds, is on the rise. [1]

- In response to concerns by the National AGC that A+B bidding is a departure from traditional competitive bidding, FHWA and others conclude that A+B conforms to competitive bidding procedures. [2]

- CALTRANS's use of A+B bidding with I/D provision for the Northridge earthquake projects was combined with several other measures to expedite these projects, such as: [16]

  - pre-qualification of potential bidders
  - implementation of bi-weekly payments
  - allocation of extra SHA resources to administer these contracts.

- Colorado Department of Transportation (CDOT) recommends that A+B bidding is used more effectively in conjunction with Partnering. [18] CDOT also reported that:

  - CPM scheduling should be used on all A+B projects.

- A strong commitment to the schedule from subcontractors and utilities is essential. These entities should be included in pre-planning or Partnering.
- Contractors should assume more responsibility for Quality Control to expedite the work and reduce demands on the SHA.
- Affected businesses said that the impacts to business during construction for A+B was the same as for conventional projects, but if given the choice, businesses prefer to shorten the time of construction.

- Michigan Department of Transportation reported that to facilitate the use of A+B bidding, it conducted a pre-letting briefing to explain the A+B procedure to all interested parties. Also, for A+B projects spanning more than one construction season, the provisions required two "B" calculations, one for each season. [19]

- Michigan Department of Transportation reported the results of an A+B project with I/D provisions in 1993 involving the replacement of guardrail with a concrete median barrier. The Engineer's estimate for the maximum B time was 80 calendar days. Five of the six bidders estimated an average duration of 70 calendar days for the work. The low bidder estimated 18 calendar days. The low bid contractor completed the work in 13 calendar days and received the maximum allowable incentive. The Resident Engineer commented that the project was the most efficient and well organized project he had been associated with in 37 years with Michigan DOT. If nothing else, this project illustrates the difficulty faced by SHAs in trying to estimate an accelerated contract time. [19]

- North Carolina Department of Transportation (NCDOT) has used A+B bidding for several projects, and concluded that Partnering or Project Quality Management is an "excellent basis" for A+B bidding. The major disadvantage to using A+B bidding is the added pressure placed on the SHA for field engineering, inspection and administration. In contrast to most states using A+B in conjunction with incentive payments NCDOT reported that it does not use incentives.[20]

- Wisconsin Department of Transportation (WISDOT) conducted a survey of contractors using A+B bidding that resulted in the following comments. [21]

  - A+B increased the competitiveness of the bidding.
  - If the project includes many subs, it may be difficult to determine the contract duration accurately.
  - If the incentive is capped too low, fewer contractors will bid.
  - Higher risks are involved and A+B bidding should not be used for all projects.

- NYSDOT responded to various concerns expressed by contractors in New York during a meeting between NYSDOT and contractors in 1993. Some of these concerns and responses were as follows. [14]

CONCERN: All risk is shifted to the Contractor.
RESPONSE: The method favors the traveling public by reducing construction time and inconvenience, but also provides the Contractor with an opportunity to earn an incentive for early completion. The added risk to the Contractor is tempered by changed condition clauses that permit the SHA to adjust the B schedule for occurrences that are not the fault of the Contractor.

CONCERN: A+B favors larger firms.
RESPONSE: A+B favors innovative firms, efficient firms, and firms with previous good performance.

CONCERN: Contractors will rarely get an incentive payment.
RESPONSE: Experience from other states indicates that most contractors receive an incentive payment. The size of the payment depends on the ingenuity and efficiency of the Contractor.

CONCERN: A+B projects will result in more paperwork.
RESPONSE: More detailed planning and scheduling than normal is required and may result in more paperwork. For these projects, we have decided that the additional effort is worth it.

CONCERN: The use of A+B bidding may result in more disputes and claims.
RESPONSE: There is a potential for more claims. To help avoid disputes we will require the use of CPM scheduling. Schedules will be adjusted based on responsibility for critical path items. We also will encourage Partnering.

CONCERN: Utility relocations could delay contractors.
RESPONSE: We agree. If utility relocations occur within the B portion of the contract, a utility schedule will be incorporated into the CPM schedule to accurately determine the effects of utility work. If utility work causes critical delay to the project, a contract adjustment will be made to the B portion of the project.

CONCERN: Don't pick politically sensitive projects.
RESPONSE: Only projects that meet the criteria will be selected. Large projects with significant impacts are generally politically sensitive and meet the criteria for A+B bidding.

6.3 Lane Rental

6.3.1 Summary of Significant Data

6.3.1.1 FHWA

FHWA Technical Advisory T 5080.10 and two memoranda dated April 2, and November 18, 1991 provided a description of lane rental for Construction and sample specifications for lane rental on both a daily and hourly basis.[6, 12] Similar to the A+B and I/D methods, FHWA recommends that lane rental be used to minimize traffic delays for critical projects or critical phases of projects with significant road user impacts. The lane rental fee is also based on RUC estimated by the contracting agency. Unlike the other methods, lane rental charges the Contractor on a daily or hourly basis for occupying a lane, a shoulder, or a combination of lanes and shoulders during construction. Thus, lane rental is applicable to projects which involve lane or shoulder closures, rather than detours. The method encourages contractors to shorten the time that lane reductions impact traffic.

When hourly rental charges are used, the rate is normally higher during peak periods. The rates also vary depending on the number or combination of lanes taken out of service. An example of a schedule of rental rates is illustrated below:

Closure or Obstruction	Hourly Rental Charge (6:30 - 9:30 a.m.) (3:00 - 6:00 p.m.)	Hourly Rental Charge (All other Hours)
One Lane	$2,000	$ 500
One Shoulder	$ 500	$ 125
One Lane and Shoulder	$2,500	$ 625
Two Lanes	$4,500	$1,250
Two Lanes and Shoulder	$5,000	$1,375

For extremely critical situations, if a roadway or ramp must be opened during rush hour, rental rates have been used for portions of an hour, such as 15 minute intervals, to motivate contractors to minimize usage during these periods. In these cases, rental rates may accumulate for each 15 minute interval to some maximum amount.

The FHWA guidelines do not address the manner in which lane rental charges should be incorporated into the bids.

6.3.1.2 Lane Rental in the United Kingdom (U.K.)

Bondar, of the U.K. Department of Transport, reported in 1988 that the first form of lane rental, the Bonus/Rental Charge used in the U.K. in 1984, invited contractors to bid the cost and the time to complete work in the rented lane(s). [22] This method is equivalent to the A+B bidding method.

A second form from the U.K., first used in 1985, is known as Continuous Site Rental. Under this method, contractors did not bid a time component, but were charged the daily rate specified in the contract for each day the site or part of the site was occupied. The contracting agency does not know the Contractors anticipated contract duration until after the contract is awarded and the Contractor submits a schedule. Because the Contractor is required to pay a rental fee for each day on the site, contractors face a potential cash flow problem early in the project. To counter the possibility that contractors front end load bids in the U.K., a series of maximum percentages are specified for specific groups of bid items. If these percentages are exceeded, the bid is considered to be non-responsive. [21]

The third form of lane rental used in the U.K., known as Lane-By-Lane Rental, follows the same approach as Continuous Site Rental except the Contractor is only charged when a lane or combination of lanes are taken out of service. [21] This method is the most common form used in the U.S.

Bondar reported significant time savings from the use of the various lane rental methods compared to conventional methods for contracts let between 1984 and 1987. Some have suggested that the savings is caused, in part, by overly generous estimates of time for conventional contracts on the part of the contracting agency. Bondar also reported a 3% increase in costs to the contracting agency, including incentive payments. These costs were due, in part, to additional demands on the contracting agency to work extra shifts and overtime. [21]

Regarding quality, field personnel expressed some reservations that the ride quality was reduced. Most U.K. agencies, however, reported that overall quality actually improved because contractors tightened quality control procedures to insure that re-work would not cause delays. [21]

As a final consideration, Bondar noted administrative problems related to the procedures to account for lane rental costs. If the lane rental cost was distributed among all the bid items in the contract, contractors tended to front-end load the bid to avoid a negative cash flow early in the

project. Initially, contracting agencies included provisions stipulating maximum percentages for groups of bid items. Because contractors did not agree with this approach and had difficultly meeting these percentages, the U.K. agencies revised these provisions to require that rental charges be included as a separate bid item on the bidder proposal sheets. [21]

6.3.1.3 Lane Rental in the U.S.

Data and specifications for lane rental in the U.S. were obtained from SEP-14 projects and TCS's 1995 survey of states using innovative methods. Lane rental has not been used as extensively as I/D clauses or A+B bidding in the U.S. highway industry. Several states, however, have implemented lane rental in varying forms. Oklahoma has implemented a Bonus/Rental Charge method for a project involving a bridge closure. This approach is essentially A+B bidding where the Contractor bids the number of calendar days that the bridge will be closed to traffic. [23] Other states consisting of Colorado, Maine, North Carolina, Oklahoma, and Oregon have implemented a Lane-by-Lane Rental method as outlined in the FHWA guidelines. Based on TCS's 1995 survey of SHAs using innovative methods, several other states have explored lane rental or are preparing to implement a lane rental specification for a project. These states are Arizona, Indiana, Iowa, Maryland, New York, and Washington.

The implementation of lane rental in the U.S. has resulted in varying degrees of success. The data or findings obtained from specific states related to the use of lane rental is summarized below.

Colorado - CDOT used lane rental for an interchange project to minimize the impact to traffic. No detour was suitable to handle the traffic volume. The project involved a three day lane closure period with shift work. The actual duration of the lane closure was four days due to an unexpected snow storm. The Contractor was charged for four days at $2,850 per day. CDOTs made the following comments and recommendations. [24]

- The project was very successful due in large degree to careful planning between the state and the Contractor forces.
- The work must be clearly defined and shown on the plans. This includes utility work and other possible conflicts.
- If added shifts are needed, the impacts of night work on local residents and on project personnel need to be considered. Complaints were received from local residents for noise during the night shift.

- Additional SHA personnel may be needed during the rental period.
- If weather or other conditions come into play, responsibility for authorizing a work suspension should be clearly defined.
- Safety of the traveling public should have precedence over getting the work completed.

CDOT concluded that it would use this approach again for a similar situation, and stressed that careful advance planning is needed for lane rental to be used successfully.

North Carolina - NCDOT used a lane rental approach for two projects involving lane closures during the 1992 construction season. Only two bids were received for one of the projects. The lowest bid was 74% higher than the Engineer's estimate. NCDOT considered these bids to be non-responsive. The lane rental approach was dropped for these projects. Though NCDOT continues to express an interest in using lane rental, no new projects have been implemented using lane rental. [25]

Washington - WSDOT considered implementing a lane rental provision for the SR99, Aurora Bridge project. WSDOT decided not to implement lane rental on this project or any further projects for the following reasons. [26]

- The AGC voiced no positive support for the lane rental concept.
- The lane rental specification will promote a "non-partnering" atmosphere in that all contract changes will result in a contractor proposed extension of time.
- More construction engineering dollars will be spent.
- Many hours of work over one year did not result in a workable lane rental Specification.
- I/D clauses have worked very well on two other jobs defining a lane closure window within a project of longer duration.

Maine - MDOT has implemented a Lane-by-Lane rental provision for a portion of an I-295 project involving lane closures on an hourly basis. The entire project was bid using an A+B contract with I/Ds. The RUC used to establish the rental rate, the "B" bid, and the I/D amount was estimated

using QUEWZ. The project was let during the 1995 construction season and the results of using this combined approach are not yet known. [27]

Iowa - In discussions with Iowa, IODOT used a lane rental provision for a project and found that some smaller contractors interested in bidding on the lane rental project had difficulty obtaining bonds due to the inclusion of significant lane rental costs in the bid. To solve this problem, Iowa is apparently revising its specification using a Bonus/Rental Charge method where the Contractor will bid the cost and the time. Using this approach, the lane rental charge is not included in the bid.

Arizona - ADOT plans to use a lane rental provision for SR87. The draft specification is described as a Full Roadway and One Direction Rental Incentive/Disincentive Specification. [28] The specification allows for an estimated number of full and one-directional roadway closures for blasting work. Closure periods may range from five minutes to a maximum of 40 minutes. Rental charges would be assessed using a stepped scale ranging from $0 for a 1-5 minute closure to $2000 for 31-40 minute closures. Lane closures would be permitted only during certain hours of the day. No time extensions were allowed for lane closure work. If the roadway is not opened on time, ADOT includes additional monetary and non-monetary disincentives.

Furthermore, ADOT indicated that it is not administering lane rental costs as part of the bid. ADOT will establish a separate fund to account for lane rental charges. Funds will be deducted from the account for each closure. If the Contractor uses fewer closures than estimated, the savings is earned as an incentive. If the fund is exhausted and further closures are needed, disincentives will be deducted from the Contractor's progress payments.

New York - NYSDOT is planning to implement a lane rental concept for approximately 15 to 20 projects in the coming construction season and has developed guidelines and specifications. [14] NYSDOT provides a pay item to the Contractor for Payments and Assessments for lane rental. The Contractor bids the cost of lane rental as a lump sum bid item based on daily or hourly rental rates provided by the NYSDOT. The bid item eliminates the problems caused by spreading the cost over other items of work. Furthermore, to avoid potential negative cash flow, the rental fee is set aside in a separate account equal to the amount bid for lane rental. Fees are charged against the account based on the lanes rented. When the account is exhausted NYSDOT deducts moneys due the Contractor to pay for rental charges in excess of the bid amount. Although NYSDOT has indicated that the Contractor-estimated lane rental is a bid item, because a separate fund is established, contractors are not required to include this item in their bond. Because it expects that only a small percentage of the total lane rental item will be paid to the Contractor when rental charges are less

than that bid, NYSDOT sets aside only 20 percent of the amounts bid for lane rental. This allows the other 80 percent of the amounts bid for lane rental to be available for other projects.

6.3.2 EVALUATION OF DATA

6.3.2.1 Project Selection

Similar to I/D and A+B provisions, lane rental provisions are used for critical projects with significant impacts to the road user or the surrounding community. The same criteria apply. Lane rental differs from these other approaches in that it specifically applies to roadway or bridge projects using temporary lane or roadway closures during construction.

Project selection criteria from NYSDOT differentiates between A+B bidding and lane rental. A+B bidding serves to shorten the total project duration. Lane rental serves to keep traffic flowing by minimizing the number and duration of lane closures. If applicable, NYSDOT allows both methods to be used in the same project. [14]

6.3.2.2 Lane Closure Time

The number and duration of lane closures for the Lane-by-Lane rental approach are estimated by the contracting agency. This estimate is based on the number and type of closures or obstructions anticipated by the design engineers. Closures may be intermittent, restricted to off-peak hours, night work, or the duration of blasting, or continuous, being from commencement until work is completed traffic is restored in a lane or combination of lanes. In either case, the closure time must be estimated accurately. If the agency estimates the closure time too high, the Contractor may receive an incentive without extra effort.

Lane closure durations for the Bonus/Rental Charge method are estimated by the Contractor. This method is essentially the same as A+B bidding applied to a project involving lane closures. With this approach, the agency stipulates a not-to-exceed date for completion of the critical lane closure period to minimize the lane closure impacts.

6.3.2.3 Lane Rental Charges

Daily or hourly lane rental charges are typically based on the contracting agency's estimate of RUC. As previously stated, some states have used a computer program specifically developed to

estimate RUC's caused by lane closures in a work zone. The lane rental charge could also include the agency's daily costs to administer and inspect the closed portion of work as long as these costs can be estimated by the agency and are not duplicated in liquidated damages.

6.3.2.4 Other Findings

- The use of lane rental results in significant time savings for critical portions of projects involving temporary lane or roadway closures. [21]
- The implementation of lane rental results in additional costs to the contracting agency to administer and inspect the project during lane closures. [22]
- Greater demands are placed on agency and contractor personnel compared to conventional contracting methods. Careful planning and communication are important. [21]
- The use of lane rental may result in higher bids due to the inclusion of estimated lane rental charges in the bid. Contractors in Iowa have apparently had difficulty obtaining performance bonds to cover the lane rental charges in the bid.
- More recently, lane rental charges have been estimated as a separate bid item. In New York these charges are deducted from a fund set apart from the other contract bid items and, in theory, do not affect the Contractor's cash flow or bonding capacity. [14]
- The quality of work for lane rental projects was overall reported to be better than similar work for conventional projects because contractors strived to avoid delays caused by substandard work or rework. [21]

6.4 SUMMARY OF DATA FROM SOUTH DAKOTA CONTRACTOR QUESTIONNAIRE

TCS mailed out 70 questionnaires to various contractors listed in The AGC Directory of South Dakota. The Contractors on the mailing list included both in-state and out-of-state prime contractors and at least one subcontractor. The Contractors were assured their responses would remain confidential. A copy of the questionnaire is included in Appendix 1 of this report.

The questionnaire has 33 questions related to time-based I/D contracts, cost-plus-time contracts, lane rental contracts and scheduling, as well as general questions to determine a composite of the respondents. Additionally, the respondents were permitted to offer any suggestions or comments on any of the above listed topics.

TCS received 14 completed questionnaires, representing a 20% rate of return. Only six of the respondents were in-State contractors. Respondents perform an average of 52.9 percent of their heavy highway work in South Dakota. A summary of the responses is provided in Appendix 2.

Overall, the majority of the respondents do not believe that any of SDDOT's current bidding practices hinder their ability to bid for highway work in South Dakota.

Half of the respondents have previously performed highway work for SDDOT using time-based I/D contracts. Overall, 12 of the 14 respondents have had some experience with I/D contracts nationwide. The majority have achieved an incentive and listed weather, utilities performed by another agency, and shortage of qualified craft workers as the factors or conditions which prevented them from meeting or beating an I/D date on a project.

Regarding A+B contracts, half of the respondents perceive an advantage to bidding this way. The majority of respondents, however, are opposed to bidding lane rental. One of the respondents stated that this method could cause financial hardship and higher bid prices. Others perceived lane rental as too complicated, a hidden tax, and a method which would shift responsibility for estimating the lane rental time from the DOT to the Contractor.

Additionally, the majority of contractors also prefer contracts with working days.

7.0 ROAD USER COSTS

Many SHAs implementing time based innovative contracting methods employ RUCs as a basis for the contractual time-related charges. RUCs are part of:

- the daily rate used in Incentive/Disincentive (I/D) projects
- the daily rate associated with the "B" in A+B bidding
- the hourly or daily rental fee employed with lane rental provisions

RUCs are the additional costs incurred by the public traveling through or around a highway construction project. These costs typically include:

- the cost of motorist delays
- additional energy costs or motor vehicle operating expenses
- costs associated with the increased rate of accidents in the construction zone

TCS obtained the RUC calculations from 16 states other than South Dakota. Over half the states surveyed in this study have developed or acquired computerized programs to standardize and refine the RUC calculation. It has been difficult to develop a computer program with the flexibility to accurately model all of the variables since they can differ from State to State and project to project. The following information obtained from North Carolina DOT concerns the use of the QUEWZ computer program developed by the Texas Transportation Institute (TTI).[29]

> Although the QUEWZ program provides queue and user cost data, it does not reflect the traffic patterns in North Carolina very well. The QUEWZ program is based on the highway system in Texas which uses a lot of frontage roads. In an effort to improve the accuracy of our user cost data, the NCDOT recently sponsored Highway Research Project 94-8, "Capacity and Delay in Major Freeway Construction Zones." Results from this research project indicate that our QUEWZ input values are very conservative and do not reflect actual traffic conditions very well.

Apart from QUEWZ, TCS has found that the states not using a computerized program make conservative assumptions to standardize and simplify the RUC calculation and eliminate those variables which involve complicated calculations or yield relatively small costs when compared to the costs of delay or costs of operating expenses. These SHAs based RUC calculations on procedures

in the 1977 AASHTO guide "A Manual on User Benefit Analysis of Highway and Bus Transit Improvements"[30] or the 1981 FHWA report " Planning and Scheduling Work Zone Traffic Control."[31]

Studies have identified environmental costs, related to the increased vehicle emissions in the construction zone, as a RUC. Few states, however, have incorporated environmental costs into the RUC calculation because these costs are insignificant compared to other cost components, difficult to quantify, and may only apply in limited cases. Washington State DOT was the only State surveyed which includes vehicle emissions as a cost to the road user. The 1981 FHWA report states, "It is difficult to assign a specific cost to air quality impacts so that this measure can be considered in a total cost-effectiveness analysis."[31]

All RUC calculations are dependent upon local ADTs. The calculations also depend upon the specific section of roadway based on the geometry of the roadway, the traffic control plan encompassing the construction zone, and other local variables. These local variables may include the following:

- the percentage of trucks that normally travel through the area under construction
- the number of occupants in the vehicle
- vehicle operating expenses based on local costs of fuel, oil, maintenance, and other incidentals
- costs caused by travel time delays based on average wages for truck drivers in the local community or State
- accident rates for the specific section of roadway

As a final consideration, other daily costs incurred by the SHA may also be combined with RUC to comprise the daily rate for liquidated damages (LD). LDs are assessed for late completion of a project. LDs historically have been included by the SHA for additional:

- construction engineering costs
- inspection costs
- administration costs
- costs associated with maintenance of traffic and detours

If these costs are used as part of the daily rate in an I/D innovative contract, it is important to avoid duplicating these costs when assessing LDs. Although LD costs are typically apportioned based on the total contract value of each project, they are developed from the actual costs the SHA expends performing the four tasks in the above listing. LD costs administered in this fashion do not include RUCs. Typically, SHAs use RUCs for the interim milestone completion of an I/D contract. When the I/D completion date coincides with the contract completion date, SHAs must ensure that they do not duplicate the cost for tasks included in the I/D rate and also in the LDs.

As part of this study, TCS reviewed SDDOT's current procedure and compared it with methods other states use to calculate RUCs. TCS revised SDDOT's current RUC calculation based on its review.

7.1 CALCULATION EXAMPLES

As previously stated, RUCs typically include the cost of delay, vehicle operating costs, and accident costs. Although estimates of delay vary based on the traffic control plan, ADT, and the types of roadways, the general approach to each of these calculations is similar in many states. A simplified example of each of these calculations is presented below:

7.1.1 Cost of Motorist Delay

Auto Delay Cost ($) = No. of autos x VOF x T_{avg} x C_A

Truck Delay Cost ($) = No. of trucks x T_{avg} x C_T

Where:

No. of Autos = ADT[1] x % autos

No. of Trucks = ADT x % trucks[2]

VOF = Vehicle occupancy factor[3]

T_{avg} = Average time delay per vehicle[4]

C_A = Cost per unit time (autos)[5]

C_T = Cost per unit time (trucks)[6]

Notes:

1. Average Daily Traffic (ADT) is available from SHA traffic statistics.
2. Percentage of trucks is available from local traffic statistics.
3. Vehicle occupancy factors vary depending on the type of trip. The 1977 AASHTO guide provides values that range from 1.22 for work to 1.98 for social-recreational trips.[30]

4. Average delay per vehicle may be calculated as:

   - delay due to a change in speed in the construction zone = $L_{CZ}/S_L - L_{CZ}/S_P$
     Where: L_{CZ} = Length of construction zone (miles)
     S_L = Operating speed on roadway prior to construction (MPH)
     S_P = Operating speed through construction zone (MPH)
   - delay due to a detour = $L_{CZ}/S_L - D_D/S_D$
     Where: D_D = Length of detour (miles)
     S_D = Speed limit through detour (MPH)

5. Auto cost per unit time is usually expressed in $/hour. The 1977 AASHTO guide states that the value of time is a function of the amount of time saved or lost as well as the trip type. The time increments measured were zero to five minutes, 5 to 15 minutes, and greater than 15 minutes. The types of trips were personal business, work related, and social-recreational.[30] Many SHAs simplify this calculation relying on an average wage within the state for all trip types and durations. NYSDOT uses the minimum wage of $4.25 per hour. [31] The states of Idaho and Iowa use the average wages of $9.00 and $8.00 per hour, respectively. [33,34]

6. Truck costs per unit time are based on average driver wages. The average cost for trucks evaluated in this research was $13.53.

In some instances roadways with a high volumes during peak hours may exceed the capacity of the roadway, and develop a queue if a lane is closed during construction. Thus the use of ADTs would not be as accurate. In the case of a queue, it is more accurate to estimate delay based on hourly traffic statistics and the hourly length of the queue.

Based on TCS's research, some states combine the cost per unit time for autos and trucks. This simplification reduces the cost of motorist delay calculation to one formula.

7.1.2 Additional Motor Vehicle Operating Expenses for a Detour

Auto operating expense = No. of autos x D_{delta} x C/M_A

Truck operating expense = No. of trucks x D_{delta} x C/M_T

Where:

D_{delta} = Construction detour route distance less original route distance.
C/M_A = Operating cost per mile (autos)[7]
C/M_T = Operating cost per mile (trucks)[7]

Notes:

(7) The 1977 AASHTO guide states that components of vehicle operating costs are fuel (excluding taxes), engine oil, tires, maintenance and that portion of depreciation that varies with mileage driven. The operating, or running, costs are based on averages of the components per 1,000 vehicle miles. These costs per mile were tabulated for both cars and trucks.[30]

Additional operating expenses may also occur in a construction zone without a detour. If the traffic control plan results in significant speed reductions or a queue, additional operating expenses may be calculated for acceleration, deceleration, and idling. These calculations are discussed in Section 7.4.3.

7.1.3 Accident Costs

Accident costs can be defined as follows:[31]

$$\text{Accident costs} = (AR_C - AR_P) \times L_{CZ} \times ADT \times A_{ACC}$$

Where:

AR_C = Estimated accident rate per million vehicle miles during construction
AR_P = Preexisting accident rate per million vehicle miles without construction
A_{ACC} = Average cost per accident

7.2 EVALUATION OF OTHER STATE'S RUC CALCULATIONS

RUC calculations were obtained from 16 states other than South Dakota. These states included: California, Idaho, Iowa, Kansas, Kentucky, Maine, Maryland, Michigan, Nebraska, New Jersey, New York, North Carolina, Oklahoma, Oregon, Washington, and West Virginia. The following aspects of the RUC calculations used by these states were compared. A discussion of each area follows.

7.2.1 Motorist Delay

The average hourly cost of motorist delay used for automobiles is $6.34 per hour. This average is based on the values used in 13 states. The exact figures used as the cost factor for the motorist delays was not discernable in three states as their RUC output did not identify a specific cost factor. The average cost of motorist delay for trucks in these same 13 states is $13.90. In

comparison, South Dakota's cost of delay factors, $4.25 autos and $8.50 trucks, are respectively based on the minimum wage for autos and two times the minimum wage for trucks.[35]

Six of the 16 states evaluated in TCS's sample apply a VOF to the cost of motorist delay for automobiles. The 1977 AASHTO guide recommend its use. The VOF accounts for passengers in an automobile who may also be delayed due to roadway construction. Although currently not used in SDDOT's RUC calculations, a VOF is recommended for use in South Dakota as discussed in Section 7.4 of this report.

7.2.2 Vehicle Operating Expenses

Vehicle operating costs for cars ranged from $0.10 per mile in Iowa to $0.35 per mile in Kentucky. The vehicle operating cost for trucks ranged from $0.35 per mile in Kentucky to $0.71 per mile in Kansas. Kentucky uses the $0.35 as its vehicle operating cost for both cars and trucks. These costs are based on a cost per mile due to detours. Vehicle operating costs in New York are based on speed changes and delays due to acceleration and deceleration, and on delays due to queues or idling. Maryland calculates vehicle operating costs for both delayed or detoured vehicles. It appears that SDDOT's current factors of $0.14 per mile for cars and $0.50 per mile for trucks fit within the cost ranges found in other states.

7.2.3 Accident Costs

Accident costs are calculated using either national averages or local averages found within individual states. The calculation method for accident costs is discussed in general terms in the 1977 AASHTO guide and is based on average accident rates and costs from the State of California.[30] The 1981 FHWA report includes charts and tables which were developed to simplify the accident cost calculations.[31] Both AASHTO and FHWA recommend that, if possible, local accident rates be used. TCS has obtained information from South Dakota from which specific average accident costs can be determined. This data is included in Appendix 4. Thus, SDDOT can calculate accident costs in the RUC using the FHWA approach and South Dakota's information for average accident costs.

7.2.4 Computerized RUC Calculations

As noted previously, eight of the 16 states use computerized PC software programs, such as QUEWZ-92 and spreadsheet programs. QUEWZ-92 is the latest version of a program first developed by the Texas Transportation Institute in 1982.[9] This program specifically models lane

closures on freeways with two or more lanes in each direction. The program does not apply to projects on two-lane roadways. QUEWZ-92 only includes two components of RUCs: vehicle operating costs and travel time costs. Accident costs are not included. QUEWZ-92 provides RUC output in hourly increments which is very helpful for determining lane rental costs for congested freeways during peak hours. The program analyzes traffic conditions on a freeway segment with and without a lane closure in place and provides estimates of the additional RUC resulting from a queue. QUEWZ-92 also calculates the costs of diverted traffic once the traffic has reached a maximum queue length and motorists divert from the roadway to find alternate routes. QUEWZ-92's data calculations however, are based on highway traffic patterns and road designs from urban and rural interstates in Texas.

QUEWZ-92's hourly costs are much higher than South Dakota's hourly costs. For example, in QUEWZ-92 the dollar value of time is $12.64 per vehicle hour for passenger cars with an average VOF of 1.3 persons per car and $23.09 per vehicle hour for trucks. These costs are in 1990 dollars and the user then updates these figures by providing the Consumer Price Index (CPI) for the month the calculations are being done.[9] Thus based on the August 1995 CPI, the values would be $14.79 per hour for passenger cars and $27.02 per hour for trucks. North Carolina noted that the use of QUEWZ resulted in very high RUC. NCDOT indicated that in some cases it reduced the QUEWZ estimated RUC by a factor of 7.

The QUEWZ-92 program may be useful to SDDOT only if specific SDDOT projects involve lane closures resulting in a queue on four-lane highways. With the exception of sections of four lane urban roadways in Sioux Falls and Rapid City, the typical ADTs in South Dakota, do not support the use of this program. QUEWZ-92 also does not appear to allow specific cost factors to be input into the program. Thus, if a project warrants the use of this program, SDDOT should apply a factor to reduce the unit costs per hour for cars and trucks.

7.3 CURRENT RUC CALCULATIONS IN SOUTH DAKOTA

SDDOT currently calculates the following costs incurred by the traveling public through or around a highway construction project.

- the cost of motorist delays
- energy costs or motor vehicle operating expenses for additional distance traveled

The SDDOT RUC calculations are similar to the examples presented previously. SDDOT's current RUC calculations from project IM90-4(52)198 in Jones County follow. The SDDOT RUC Quattro Pro worksheet for this project is included in Appendix 4.

7.3.1 Cost of Motorist Delay

A series of four calculations are used to develop the cost of motorist delays. First, two sets of calculations are performed for cars and trucks traveling through the construction zone with existing normal traffic before the construction project. Then, two more sets of calculations are performed for cars and trucks during the construction project. The first set of the calculations for cars and trucks before the construction delays are shown. The following numbers, excluding the C_A calculation to a minute format, are extracted from the SDDOT RUC calculation sheet for Project IM90-4(52)198. This RUC calculation sheet is included in Appendix 4. Manual calculation may yield slightly different results due to rounding.

Auto Delay Cost ($)	=	No. of Autos	x	VOF	x	T_{avg}	x	C_A
$6,633.36	=	8584	x	1	x	11.04	x	.07

Where:

No. of autos = 8584
VOF = 1
T_{avg} = 12 miles/ 65MPH = 11.04 minutes
C_A = $4.25 per hour = $. 07 per minute

Truck Delay Cost ($)	=	No. of trucks	x	T_{avg}	x	C_T
$4,445.86	=	2876	x	11.04	x	.14

Where:

No. of trucks =2876
T_{avg} = 12 miles/ 65MPH = 11.04 minutes
C_A = $8.50 per hour = $.14 per minute

Thus, the total combined costs for the cars and trucks traveling through a project site prior to the construction delay are:

Existing Normal Traffic Costs	
Vehicle	Costs
cars	$6,633.36
trucks	$4,445.86
Total	$11,079.22

These same calculations are performed using the reduced speed of 50 MPH for the construction delayed traffic. The resultant costs are:

Traffic Costs with Construction Delays	
Vehicle	Costs
cars	$8,652.21
trucks	$5,798.94
Total	$14,451.15

The difference in the values provides the Cost of Motorist Delay:

Cost of Motorist Delay	
Traffic Costs with Construction Delays	$14,451.15
Existing Normal Traffic Costs	($11,079.22)
Total	$3,371.94

7.3.2 Additional Motor Vehicle Operating Expenses for a Detour

Currently, SDDOT calculates operating expenses based on the difference in mileage traveling through the construction zone or a detour versus the mileage traveled on the same section of the highway in the absence of a construction project. This is the same as the example calculation as

shown in section 7.1.2. In the example project shown in Appendix 4, a detour is not expected to be in effect. Thus, there are no added operating expenses caused by the construction project.

To complete the calculation for the RUC, the total daily costs for the value of time and for operating costs prior to construction are added together. In this example, road users will spend an additional $3,371.94 per day based solely on delay costs.

7.4 RECOMMENDED IMPROVEMENTS TO SDDOT'S RUC CALCULATION

7.4.1. Accident Costs

Accident costs are not used when calculating RUCs in South Dakota. The 1977 AASHTO guide, the 1981 FHWA report, and the NCHRP 2-18 report entitled "Research Strategies for Improving Highway User Cost Estimating Methodologies" prepared for the National Cooperative Highway Research Program TRB by the Hickling Corporation in May 1994 lists accident costs as a component to preparing the total aggregate highway user cost estimates.[36] Thus, South Dakota is excluding one of the generally accepted components to RUCs.

The 1981 FHWA user guide provides two tables to estimate work zone accident rates.[31] By using the project ADT and accident rate prior to construction the tables provide the expected increase in the accident rate due to the construction. These tables are provided in Appendix 4. Accident rates prior to construction may be derived from average accident rates throughout the country as shown in table 6 of the FHWA user guide, or more accurately from average accident rates in South Dakota for the specific section of roadway under construction. These local accident rates are compiled in SDDOT's Annual Highway Needs Analysis and Project Analysis Report.[37]

$$\text{Accident Costs} = (AR_C - AR_P) \times L_{CZ} \times ADT \times A_{ACC}$$

Where:

AR_C = Estimated accident rate per million vehicle miles during construction(1)
AR_p = Preexisting accident rate per million vehicle miles without construction(2)
L_{CZ} = Length of construction zone
ADT = Average Daily Traffic
A_{ACC} = Average Accident Cost

Notes:

1. The estimated accident rate can be determined by using the Work Zone Accident Rate Factor - A and B tables taken from the 1981 FHWA report.[31]

2. The preexisting accident rate data of the roadway prior to construction is taken from SDDOT's Annual Highway Needs Analysis and Project Analysis Report.[37]

In the previous section of this report, Current RUC Calculations in South Dakota, project IM90-4(52)198 was used as an example. The same project, with the information provided on SDDOT's RUC printout and from SDDOT's Highway Needs Analysis Report for 1995 will be used in this section to illustrate the effect these recommendations will have on the RUC.

Accident Costs	=	$(AR_C - AR_P)$	x	L_{CZ}	x	ADT	x	A_{ACC}
$1,457.82	=	$\frac{(1.25 - .70)}{1,000,000}$	x	12	x	11,460	x	$19,274.20

Where:

AR_C =1.25, Factors A + B = 1.0 + .25, see Tables in 4.B.2.
AR_P = 0.70 accidents per million vehicle miles for the roadway . This accident rate is the average for the sections of roadway under construction.

L_{CZ} = 12 miles
ADT = 11,460
A_{ACC} = $19,274.20 was derived from information provided by South Dakota Department of Motor Vehicles and is included in Appendix 4.

7.4.2 Vehicle Occupancy Factor

The SDDOT's current RUC procedure uses a vehicle occupancy factor of one based on one person per passenger vehicle. This assumption is accurate for trucks, as generally only one person occupies a truck cab. Based on national averages, however, cars generally have more than one occupant especially during the summer construction season. Statistics from AASHTO, as shown in Figure 7.4.2-A, show that the number of adults per vehicle for social-recreational travel is significantly greater than work-related travel.[30] In South Dakota, statistics from the SDDOT Division of Planning - Data Inventory, show that traffic volumes in South Dakota fluctuate significantly between the winter and summer seasons. Based on data from continuous count station locations in South Dakota, vehicle miles traveled (VMT) for 1995 ranged from less than 5×10^6 VMT for 1995 in February to greater than 8×10^6 VMT in July 1995, an increase of 60 percent. [38] This increase is especially evident on rural and urban interstates and major arterials in the vicinity of Rapid City and Sioux Falls, and major tourist attractions. The increase in ADT during the summer months

is caused in large part by tourist and vacation traffic, and special events. The peak ADT period also coincides with the summer construction season.

Figure 7.4.2-A. below shows VOF factors used in different guides and in three different states.

FIGURE 7.4.2-A		
SOURCE	ADDITIONAL DATA	ADULTS PER VEHICLE
	Trip Type	
1977 AASHTO Guide	Work	1.22
1977 AASHTO Guide	Social-recreational	1.98
1977 AASHTO Guide	Personal business	1.64
1977 AASHTO Guide	Average	1.56

	COMMENTS	
QUEWZ-92	program developed by TTI in cooperation with FHWA	1.3
NCHRP2-18 (1994)	Study by Hickling Corp. for NCHRP, TRB	1.2
Kentucky		1.3
Nebraska		2.0
New York		1.5

In reviewing Figure 7.4.2-A, the VOF factor obtained from various sources ranges from 2.0 to 1.2. AASHTO, in particular, defines VOF for different trip types. For vacation or social-recreational travel, AASHTO uses 1.98 adults per vehicle. The AASHTO guide also defines different values of highway user travel times depending on the trip type. For social-recreational trips, the AASHTO estimated value of travel time is lower than for work on personal business trips. Thus, more highway users are in the auto during summer vacation travel but the value of time per user is lower.

In addition to reviewing the VOF, TCS also compared the values of highway user travel time in South Dakota with other states. SDDOT uses the minimum wage, $4.25 per hour, to represent the value of travel time for autos, and two times the minimum wage, $8.50 per hour, for trucks. These numbers represent the value of all travel time including work, social-recreational, and personal

business. South Dakota's representative cost per hour for travel time is low compared to other states. For example, Iowa uses an average wage of $8.00 per hour and Idaho uses $9.00 per hour. [33, 34] This compares with average wages in South Dakota of $8.25 per hour based on a 1995 wage survey from the South Dakota Department of labor.[39]

In comparing the value of truck time in South Dakota with other states, SDDOT's rate, $8.50 per hour, is also low compared to some other states. For example, NYSDOT uses $18.67 per hour. [32] SDDOT's $8.50 per hour, however, is a reasonable representation of average truck wages in South Dakota based on 1995 statistics from the South Dakota Department of Labor.[39] Since trucks are used only for work, and include one driver, a VOF does not apply to trucks.

In summary, SDDOT uses a relatively low highway user travel time value for autos. In the summer travel season the number of occupants in autos should significantly increase. It is suggested that South Dakota multiply the time value by a vehicle occupancy factor for those areas of the State showing significant increases in summer ADT. These areas would include at a minimum, the Rapid City, Sturgis, and Sioux Falls areas and the interstate roadways connecting these regions. If specific vehicle occupancy data is available for the specific region where construction is to occur, use the specific data. In the absence of local data, use 1.2 as the VOF for autos. In addition to using a VOF, SDDOT can also adjust RUC based on significant variations in ADT which may occur during a project because of a special event, the start of a holiday, or some other causes.

7.4.3 Additional Energy Costs of Speed Changes in the Construction Zone

The 1977 AASHTO guide includes tables for calculating the additional costs incurred by motorists due to speed change cycles such as decelerating when entering a construction zone and accelerating when exiting the construction zone. This deceleration/acceleration accounts for one cycle. These two tables, one for cars and another for trucks, have been updated by TCS to September 1995 and provide the cost per cycle (CPC). The updated tables, original tables, and updating factors are included in Appendix 4.

Using the previous example from project IM90-4(52)198, the following costs are calculated to account for speed changes for cars and trucks.

Speed Change Cost					
Type Vehicle	=	No. of autos	x	CPC	Cost
Autos	=	8,584	x	$\frac{\$15.99}{1,000}$	$137.26
Trucks	=	2,876	x	$\frac{\$30.93}{1,000}$	$88.95
			Total Cost		$226.21

The auto CPC of $15.99 per 1000 cycles for a speed reduction from 65 to 50 MPH and a acceleration back to 65 MPH is shown in the table entitled Excess Cost of Speed Change Cycles Above Cost of Continuing at Initial Speed for Cars located in Appendix 4. The truck CPC of $30.93 per 1000 cycles for a speed reduction from 60 to 50 MPH and an acceleration back to 60 MPH is shown in the table entitled Excess Cost of Speed Change Cycles Above Cost of Continuing at Initial Speed for Trucks located in Appendix 4. The truck speed reduction is limited to 60 MPH because the table does not exceed 60 MPH for trucks.

It should be noted that the speed cycle change costs increase the closer the speed change is to a stopping situation which often develops with a queue. For example, the 15 MPH cycle change from 65 to 50 MPH for cars resulted in an additional cost of $15.99 per 1,000 cycles. A 15 MPH cycle change from 40 to 25 MPH, however, results in an additional cost of $17.79 per 1,000 cycles for cars. Additionally, a speed change from 65 MPH to 35 MPH, a common speed limit in a construction zone, results in an additional cost of $38.37 per 1,000 cycles for cars. This is a considerable cost to the road user that should be included in the RUC calculation.

7.4.4 Conclusion

After reviewing the SDDOT RUC calculations and comparing them to both the AASHTO guide, FHWA and other various reports, and the calculations of the 16 states included in this research, TCS recommends that the following be included in future RUC calculations in South Dakota.

- accident costs
- vehicle occupancy factor
- speed cycle change costs

SDDOT should also adjust the RUC based on significant variations in ADT during a project. As shown in the following table, the inclusion of these recommended changes in the example project IM90-4(52)198 increase the RUC by 62 percent.

Results of Recommended Improvements to SDDOT's RUC Calculation		
Description	Value	Percent Change
Project IM90-4 (52) 198 current value	$3,371.94	N/A
Accident Costs	$1,457.82	43.2%
Vehicle Occupancy Factor	$403.77	12.0%
Speed Cycle Change Costs	$226.21	6.7%
Total Value	$5,459.74	61.9%

8.0 APPLICATION OF TIME-BASED INNOVATIVE CONTRACTING TO SDDOT'S FIVE YEAR CONSTRUCTION PROGRAM

The SDDOT Statewide Transportation Improvement Program (STIP) for 1995 through 1999 is SDDOT's five year plan for highway and intermodal improvements. This program was developed by the DOT with input from other State and federal agencies, local government, planning organizations, and the public. The program lists, prioritizes, and funds 21 categories of highway improvement projects in fiscal years 1995 through 1999. [3]

As noted in the introduction to this report, the majority of funds committed to this program is for roadway construction/reconstruction, resurfacing improvements, and, to a lesser extent, bridge replacement projects. Many of these projects involve improvements to existing roads and bridges, which may result in impacts to the traveling public or surrounding community during construction. Though ADTs in South Dakota as a whole are relatively low compared to other parts of the country, certain urban areas of the State, specifically Sioux Falls and Rapid City, have high summer ADTs. As evidenced by the 1995 STIP map, a significant number of highway projects are located in these areas. Thus, SDDOT would benefit from using innovative contracting to expedite selected projects in these areas. SDDOT's STIP for 1995-1999, the South Dakota Traffic Flow Map [40], and SDDOT Automatic Traffic Recorder Data for 1995 [38] were reviewed to determine candidate projects in the STIP amenable to innovative contracting. This review resulted in the following observations:

1. South Dakota roadways are divided into several classes in the STIP based on ADT and other characteristics. These include:

   - Interstate
   - High Volume Arterial (>850 ADT)
   - Low Volume Principal Arterial (<850 ADT)
   - Minor Arterial
   - State Secondary

   ADT is highest on interstates and high volume arterials in Regions 2 and 4, the Sioux Falls area and Rapid City area respectively. In the summer months, ADTs in these areas may exceed 35,000 on sections of the urban interstate. Based on ADT and project categories, strong candidate projects for innovative contracting would include the following types of projects on urban and rural interstates, and high volume arterials:

   - interchange reconstruction
   - asphalt concrete reconstruction

- bridge replacement
- bridge deck replacement or overlay
- joint and spall repair
- Portland cement concrete (PCC) pavement restoration
- Asphalt resurfacing
- PCC pavement resurfacing
- grading and interim surfacing

These project categories will be the most likely to directly impact existing traffic flow necessitating lane closures or detours. Projects such as restoration or resurfacing of shoulders on high volume roadways may also restrict traffic and benefit from an expedited completion.

Not all projects on higher volume roadways are strong candidates. Bridge painting, fence restoration, rest area and visitor information center construction, lighting and signal improvements, and signage projects do not appear to be good candidates for expedited completion unless the improvement is vital to public safety or important to the local economy.

2. Projects on low volume or minor arterials, bridge replacements, and urban system projects may be viable candidates for expedited completion using innovative contracting if the following conditions exist:

- a road or bridge closure has a long detour
- two-way traffic flow will be disrupted for extended periods of time
- severe impact to a local business
- impairment of emergency services
- hazardous highway condition
- a special event causing high ADT

A project on a minor arterial with low ADTs may have a relatively high RUC. For example, Project No. P 0015(00)175 in Fiscal Year 1995 on SD15 in Milbank involved a 17 mile truck detour. Though ADT was low, estimated at 813 for cars and 53 for trucks, the RUC exceeded $700.00 per day due to the length of the detour. [41] This is a significant RUC for this class of roadway and could warrant the use of an innovative provision to expedite time.

A project with low RUC may be a candidate for innovative contracting if expediting the project benefits the local community. The FHWA stipulates that the economic impact of a highway project on an adjacent local business should not be included in the daily RUC, but it can be a basis for selecting an innovative approach. Additionally, the elimination of a hazardous road condition or impairment of emergency services have been used in other states as criteria for using innovative

contracting. Many rural communities in South Dakota are located on low volume or minor arterials or the juncture of two arterials. RUC may not be high, but if roadways, bridges, or lanes are taken out of service for extended periods of time, the impact to the local community or a local business may justify the extra effort to finish the project early.

SDDOT has also used I/D provisions to expedite the completion of a project or phases of a project before the start of a special event. A series of projects collectively known as the Sturgis project in Fiscal year 1995 involved the reconstruction of Ramps A, B, and C of Exit 30 on Interstate 90. The intent of using the I/D provision in this case was to motivate the Contractor to complete this phase of the work before the start of the annual motorcycle rally in Sturgis causing significant increases in traffic volume on these ramps. [42]

3. Time-based Innovative contracting should not be considered for projects on state and county secondary roadways with minimal ADT, parks projects, transportation enhancement projects, or other projects having little or no impact on traffic or the surrounding community.

In summary, South Dakota will potentially benefit from the implementation of innovative contracting to expedite project completion for selected projects in SDDOT's five year STIP. SDDOT has already used I/D provisions for selected projects to expedite completion. The data from Section 6 of this report shows that other states have found innovative contracting methods to be beneficial for projects with significant impacts to highway users, and are expanding the use of A+B and lane rental. The guidelines for innovative contracting in the appendices to this report provide selection criteria for innovative methods in South Dakota.

9.0 POTENTIAL IMPACTS OF INNOVATIVE CONTRACTING IN SOUTH DAKOTA

The use of time-based innovative contracting will benefit the highway user by reducing the time roadways, bridges, or lanes are out of service during construction. This benefit is measured by the cost savings to road users traveling through the construction zone, and savings to the SHA by finishing a project or the phase of a project early. This savings is not realized without additional cost, impact, and risk to both the SHA and the contracting community. This section discusses potential impacts to the DOT and the contracting community resulting from the implementation of innovative contracting methods in South Dakota.

IMPACTS TO SDDOT

9.1 Project Development

SDDOT currently uses I/D provisions for selected projects but does not assess the cost/benefit of using an I/D provision. The decision to use an I/D is sometimes made just prior to bid letting to provide an incentive for the Contractor to finish by a certain date. At this stage, utility relocation or design issues may not be finalized. If these issues delay the project resulting in a time extension to the I/D date, the public will not benefit from an early completion and SDDOT risks paying an incentive to the Contractor without receiving the project early.

For an I/D project, the FHWA recommends that SHAs expend necessary effort during the project development phase to assure that the plans and specifications are complete and accurate, and to accurately determine I/D time. Also, if the right-of-way is not clear or if utility work interferes with the I/D portion of the project, then an I/D provision may not be beneficial. These recommendations also apply to A+B bidding and lane rental.

Once SDDOT has identified a strong candidate project for innovative contracting, SDDOT must weigh the benefits against the costs of implementing an innovative method for the project. During the project development phase, this effort involves the calculation of RUC, detailed estimates of contract time and costs, and the assessment of potential impacts to the project by utilities, right-of-way acquisition, design uncertainties, and other special concerns. If an innovative approach is warranted, then SDDOT must expend necessary effort before bids are let to assure that the plans and specifications are complete and accurate, materials and resources are available, the right-of-way is clear, and utility work or other site conditions will not impact the schedule. This necessary effort during design development should be factored into the cost of implementing innovative contracting for a project.

9.2 Project Administration

Findings from the use of I/D provisions, A+B bidding, and lane rental in other states generally conclude that using these methods places more demands and responsibilities on SHA field personnel during construction. If the project is accelerated, field engineers and inspectors may work overtime or increase staffing levels, expedite submittals and pay requisitions, and make more decisions at the field level to keep the project moving. This results in additional cost to the SHA.

SDDOT has not always based I/D time on accelerated construction. This is also true in other states. One reason cited is the fact that smaller contractors have limited manpower resources. If SDDOT chooses to use an accelerated schedule for an I/D project, SDDOT can readily estimate the additional administrative costs needed to expedite the project during the project development phase and factor these costs into its cost/benefit analysis.

The use of A+B bidding and lane rental shifts the responsibility for estimating critical contract time to the Contractor during the bidding phase. Though the SHA estimates a maximum time duration for planning purposes, the exact contract duration is not known until the bids are opened. To control the work, SHAs usually define the number of working days per week and other restrictions in the special provisions for A+B bidding or lane rental. For example, some projects prohibit night work or work on Sundays and holidays. States with less manpower may limit number of work days or amount of overtime per week. This approach may result in less aggressive time bids, but will allow SDDOT to effectively manage these projects with limited resources, and will allow smaller contractors in South Dakota with limited resources to be more competitive.

9.3 Contractual Costs

For I/D projects, bids may be potentially greater than traditional projects due to the cost of accelerating the project. I/D projects are designed to motivate contractors to accelerate a project in return for the payment of an incentive. If the Contractor earns an incentive, the amount paid to the Contractor will increase for each day the Project finishes early. In South Dakota, I/D bids have not been appreciably higher than traditional contracts. In fact, SDDOT has noted that in some cases bids may be lower than conventional bids for similar work because contractors anticipate earning an incentive. SDDOT and many other states using I/D provisions routinely pay incentives to contractors. Though I/D projects in South Dakota may not experience higher bids, the amount paid to the Contractor for I/D projects still increases in direct proportion to the number of days the project finishes early.

Surveys of A+B bidding have found that bids may be higher when first introduced, but once contractors become familiar with this approach, the bid amounts are comparable to the Engineer's estimate and traditional contracting methods for similar projects. [17] Because critical contract time is competitively bid, the project could realize a substantial savings in time without incurring higher bids and paying incentives.

In some states lane rental fees are included in the bid causing higher bid prices. Lane rental has recently been implemented in New York and Arizona with special provisions that allow for lane rental fees to be excluded for the bonded price and administered in a separate account by the SHA.

9.4 Training/Pre-bid Meetings/Partnering

To implement any new policy, contracting practice, or management method, the DOT should train the appropriate construction personnel, and meet with the local contracting community to explain the new procedures and obtain feedback. SDDOT started this process in the initial stages of this research project. If SDDOT decides to implement new contracting methods, this process should continue.

Some SHAs have invited the contracting community to a special meeting to explain new contracting procedures prior to bid letting. Pre-bid conferences for specific projects have also been used to introduce innovative provisions to contractors. SDDOT can use a pre-bid conference or a special meeting to explain the new procedure and its implications to the contracting community. Within this framework, other SHAs have further developed and refined innovative contracting special provisions with the assistance of the local AGC.

Partnering is also a useful forum to resolve problems, build teamwork, and introduce innovative concepts to the key project participants. An essential element of the Partnering process is to establish procedures for resolving problems, a timetable for decisions, and a sequence for escalating the decision process if a problem cannot be resolved at the lower level. This rapid response procedure reduces the opportunity for animosity to grow and allows the parties to address issues while they are fresh. SDDOT currently uses Partnering for selected projects, and this approach is recommended in conjunction with the use of innovative contracting.

CPM training for SDDOT personnel and contractors is a recommended step in the implementation of innovative methods. This training is needed not only for innovative contracts, but is useful for managing many other construction projects in SDDOTs five year program.

Pre-bid meetings, CPM, and Partnering all result in additional costs to SDDOT. These methods are justified for innovative contracting to minimize the risk that SDDOT would be exposed to greater costs resulting from changes or delays. These methods are useful tools for many projects in SDDOT's five year program.

9.5 Safety/Quality

Though concerns have been expressed that safety and quality may be compromised on expedited projects, findings from other states reported that quality and safety is not reduced. In fact, some agencies reported that contractors pay more attention to quality and safety to avoid rework and delay. One SHA engineer reported that an A+B bid project was the most efficient and well organized project he was associated with in his 37 year career. [17,19]

9.6 Impacts of Innovative Contracts on other Contracts in the Same Season

SDDOT expressed concerns that contractors working on multiple contracts in the state in the same construction season will focus resources on projects with I/D provisions to the detriment of their conventional projects with liquidated damages. This concern arises from the fact that manpower resources in South Dakota are limited and a contractor will allocate resources to maximize profit on an I/D project and pay LDs on other projects. SDDOT has revised LD rates upwards in 1995 which should help to lessen this impact. Another practice used by the Local Government Assistance which may also help is to allow flexible project start dates within the construction season allowing contractors more flexibility to shift manpower among multiple projects. This approach may not be possible if a project is long, must be completed by a specific date, or involves extensive coordination with utilities or other contractors. If the I/D project dates cannot be moved, then it might be possible to build flexibility into the conventional projects.

The innovative project is by nature a higher priority project because the impacts to the public are more severe and the risks to the SHA and the Contractor are higher. Thus, a contractor will focus on these projects first and SDDOT may not be able to avoid some impact to lower priority projects in the same season. In the event a contractor is awarded an innovative contract, SDDOT could ask the Contractor to submit a manpower allocation plan for all its contracts awarded during the same season representing the Contractor's best effort to manage its resources. This plan, however, should not be a basis for excluding otherwise qualified small contractors from bidding on multiple projects in the same season.

10.0 IMPACTS TO SOUTH DAKOTA CONTRACTORS

The introduction of any new procedure or contracting practice will potentially impact the contracting community. Some impacts are temporary and can be attributed to a learning curve. These temporary impacts can be alleviated by training, pre-bid conferences, and Partnering. Other impacts are a permanent part of bidding and managing innovative contracts. These permanent impacts could potentially include:

- because of shorter time frames, bid more work in the construction season
- more effort estimating time, and bidding the project
- more effort planning, and managing the project
- the use of CPM scheduling to improve contractor efficiency
- larger work force, longer hours, more overtime
- more coordination with the DOT, utilities, subcontractors, and suppliers
- more risk/higher profits
- competitive advantage for more time-efficient contractor

I/D provisions have been used in South Dakota for several years. Contractors have reported that they earn incentives on most I/D projects and are comfortable with this approach. Several contractors reported that they accelerated performance to meet or beat the incentive date in South Dakota. Despite this acceleration, SDDOT indicated that bids for I/D projects were not appreciably higher than other bids for similar work.

SDDOT has in the past not always based I/D contract time on accelerated performance. To earn incentives, efficient contractors may not need to accelerate. If SDDOT estimates I/D time based on a tighter schedule, contractors could expend additional effort to meet the I/D date resulting in higher bid prices. A study of I/D projects in 1985 by Christiansen found that contractors expend approximately 10 to 20 percent more for I/D projects, the cost of which is passed on to the agency in higher bid prices.[5] A more recent report by Herbsman, however, found that Florida and California reduced the engineer's I/D time estimates by as much as 20% without major delays or cost increases. [1] Thus, it is not certain that reducing I/D time will result in substantially greater costs. If the project results in a significant time savings, the benefit can still outweigh the moderate increases in contractor costs which are passed on to the SHA in higher bids.

The use of A+B bidding and lane rental shifts the responsibility for estimating critical contract time to the Contractor. This responsibility requires more pre-bid effort by the Contractor to estimate time, plan, and schedule the work. Contractors in South Dakota and other states have expressed

concerns that these approaches favor larger contractors with more resources or contractors who work longer hours. SHAs have responded that these methods favor contractors who plan and schedule their work more efficiently. In theory, shifting this responsibility and risk to contractors potentially results in higher bids. In practice, A+B bidding has not substantially increased bid prices. Contractors have absorbed this risk to obtain a competitive advantage.

Some members of the highway industry have argued that potential problems may arise if contractors underestimate the construction time in A+B bidding or lane rental to gain a competitive advantage. This could result in a contractor "cutting corners" to limit losses or filing claims to recoup losses. One suggested solution would be to include language in the special provisions allowing the SHA to reject unreasonably low bids on the grounds of an unresponsive bid. [1] The problem with this approach is that SHAs may have difficulty defining what constitutes an unreasonable bid. Also, findings from the use of A+B bidding and lane rental have, thus far, not shown that these methods reduce quality and safety, or increase the number of contractor claims.

11.0 CONCLUSIONS

I/D provisions, A+B bidding, and lane rental have all been demonstrated to save construction time. Contracting agencies implementing these methods have not detected any decrease in the quality of the work. In fact, some practitioners report that quality may improve. In terms of cost to the highway user and the SHA, the data suggests that A+B bidding is the least risk to the SHA of the three because time reductions are primarily achieved through competitive bidding rather than the payment of an incentive or lane rental fees.

Some SHAs have reduced or eliminated the use of pure I/D provisions for early completion in favor of a combination of A+B bidding and I/D provisions. These SHAs expressed that the I/D time was difficult to accurately estimate and contractors may earn incentives without extra effort. Through A+B bidding, the SHA shifts the responsibility to estimate a time savings to the Contractor. This method also shifts more risk to the Contractor in terms of bidding the optimum combination of time and cost, and efficiently planning and managing the work.

Lane rental appears to be a promising approach to minimize construction time for projects involving lane or roadway closures with high ADTs. Agencies have used different approaches to implement lane rental and administer rental charges. The inclusion of rental charges in the bid have resulted in higher bid prices. As a result, some contractors have experienced difficulties in obtaining bonds and expressed concerns that the payment of rental charges may result in a negative cash flow early in the project. Recent applications of this method in NYSDOT and other states appear to solve these problems by removing the lane rental bid item from the bonded amount and eliminating the requirement to pay rental charges during the performance of the contract.

After evaluating SDDOT's five year highway construction program, current highway use, road user costs, and assessing the potential impacts of innovative methods on SDDOT and the contracting community, TCS concludes that South Dakota will benefit from the selected use of innovative methods to reduce highway construction time and improved methods of calculating RUC. Taking into account SDDOT's current construction program and contracting practices, and feedback obtained from the South Dakota contracting community, the next section lists recommended procedures for implementing innovative contracting methods in South Dakota to expedite project completion.

12.0 RECOMMENDED POLICIES AND PROCEDURES FOR IMPLEMENTING TIME-BASED INNOVATIVE CONTRACTING IN SOUTH DAKOTA

1. Update methods for calculating RUC in South Dakota.

SDDOT currently does not use accident costs, a vehicle occupancy factor, and operating costs due to speed changes in the construction zone. Integrate these elements into SDDOT's current RUC calculations and update these costs annually based on the consumer price index.

2. Continue to use I/D provisions to expedite project time.

- In deciding whether or not to use I/D provisions, first estimate the I/D completion date using a CPM schedule based on expedited production rates. Assess the cost/benefit of using an I/D provision. If the daily estimated savings in RUC equals or exceeds the Department's estimate of a contractor's daily cost to accelerate, then the use of an I/D provision is cost-effective for the project.

- The FHWA recommends that the incentive rate be equal to the disincentive rate. If the daily rates are not the same, the FHWA recommends that the incentive be less than the disincentive. To limit the exposure of the Department if its estimate of I/D time is such that the Contractor can earn incentives without extra effort, cap the incentive at five percent of the contract amount. The FHWA does not limit its participation in incentives to five percent of the contract amount. In fact, the FHWA states that with experience, an SHA may want to use a different cap or no cap. Other states have used different caps or no caps at all.

- Recommended guidelines for implementing I/D provisions are provided in Appendix 5, and a sample I/D specification is shown in Appendix 8.

- In the future consider phasing out the use of I/D provisions in favor of A+B bidding with or without I/D provisions. The Contractor is in the best position to estimate its manpower, production and sequencing needed to complete the work in the shortest possible time frame.

3. **Implement A+B bidding for selected projects in SDDOT's five year construction program.**

- The Contractor's estimate of the "B" time is the primary basis of time savings for A+B bidding without an I/D provision. Because the time is competitively bid, the Department will gain a reduction in time without paying an incentive. In some cases the lowest responsive bidder may not be the bidder with the shortest B duration. If reducing the time of construction is as critical to the Department, use I/D provisions in conjunction with A+B bidding to further motivate contractors to shorten the construction time, and assess the cost/benefit of using them.

- The Department should estimate a maximum B duration for the project based on the performance of a time-efficient contractor to encourage the early completion of the project and control the timing of expenditures by the Department. Time bids exceeding this amount are considered to be non-responsive.

- Recommended guidelines for implementing A+B bidding are provided in Appendix 6, and a sample A+B bidding provision is found in Appendix 9.

4. **Use a Window or Closure Period method for shorter duration projects with a flexible schedule where the public will benefit from an expedited completion.**

- The window is typically the construction season. The Contractor may start at any time as long as the project is completed within the construction season and the Contractor provides sufficient notice to the Department.

- For these projects, use A+B bidding, I/D provisions, or A+B bidding with I/D provisions to shorten the project duration..

- This type of contracting method allows highway contractors with limited manpower and multiple highway contracts in the same season the flexibility to minimize schedule conflicts and optimize their resources.

- Since the project does not have a definite completion date and is short in duration, a working day or a calendar day schedule may be used.

- Do not use this approach if the project is long, involves extensive utility work, coordination with other contracts, or has other similar complications.

5. **Implement lane rental for selected highway projects.**

- Lane rental is applicable to joint and spall repair projects, or similar projects where lanes or a combination of lanes are taken out of service to perform the work and off-site detours are impractical.

- Use a lane rental bid item. Do not include the lane rental bid item in the bonded amount to reduce the amount of the bond required from contractors.

- Keep a monthly tally of the rental charges and deduct these from the lane rental bid item, but do not deduct them from the Contractor's pay requisitions. If funds are left in the lane rental bid, pay these unused fees as an incentive to the Contractor at the completion of the lane rental work. Cap these payments at 20 percent of the lane rental bid item. If the rental charges exceed the bid amount, deduct these excess charges from the final contract amounts due to the Contractor.

- To conserve the Department's funds, allocate a percentage of the lane rental bid item for the project budget to cover potential incentive payments to the Contractor. Allocate 20% of the lane rental bid item to the project budget.

- Lane rental has been used in conjunction with A+B bidding and I/D provisions. Avoid this combination because of potential complications related to duplication of rental fees with I/D amounts.

- Obtain future findings from some states currently implementing lane rental in their construction programs, specifically New York, Arizona, Maryland, and Iowa, to fine tune lane rental procedures in South Dakota.

- Recommended guidelines for implementing lane rental are provided in Appendix 7, and a sample lane rental specification is shown in Appendix 10.

6. **Evaluate potential projects for time-based innovative contracting early in the PCEMS. Re-evaluate these potential projects after final design and during final plan**

reviews and select the most suitable time-based innovative contracting method (See Figure 12-A).

Phase 1 - Identify potential projects during or as soon as possible after the preliminary design is complete.

Phase 2 - Re-evaluate the project between final design and plan reviews, and if feasible, select a specific innovative contracting method based on the criteria provided in Recommendation No. 7.

7. **Use criteria for the evaluation and selection of time-based innovative contracting methods (See Figure 12-A).**

(1) Identify a project as a candidate for expedited completion during or as soon as possible after the preliminary design is complete based on:

- High traffic volumes, with traffic restrictions, or lane closures resulting in RUC estimates in excess of $1500.00 per day, or in excess of the liquidated damages for the project.
- long detours causing delay in excess of 10 minutes,
- high accident rates or safety concerns during construction,
- potentially significant impacts to the local community or economy, or
- projects coordinated with special events.

Identify if right-of-way acquisition, utilities, or other factors may impact the project. Coordinate information with utilities.

(2) Re-evaluate the candidate project between issuance of the final design and the completion of plan reviews. Refine the estimate of RUC. If right-of-way acquisition, seasonal limitations, utility relocation, design uncertainties, material or manpower shortages, coordination with adjacent contracts, or other factors do not severely impact the bid letting date or the critical project schedule, estimate the project time and select an innovative contracting method as follows.

use A+B if:

- the project is not required to finish by a specific completion date,
- RUC is relatively low but other factors warrant expediting the project, and
- The Department seeks contractor expertise to estimate contract time.

Use an I/D provision if:

- RUC is relatively high, and the monetary benefit equals or exceeds the costs to finish early,
- it is in the public interest to complete the project as soon as possible, or by a specific completion date, and
- the Department can estimate contract time based on a similar projects or using a CPM schedule.

Use A+B bidding with an I/D provision if:

- the RUC is high, and the monetary benefit equals or exceeds the costs to finish early.
- the project is not required to finish by a specific completion date, but it is in the public interest to complete the project as soon as possible.
- the Department seeks contractor expertise to estimate contract time.

Use lane rental provisions if:

- the use of off-site detours or alternate routes is impractical,
- the work requires the closure of a lane, or a combination of lanes and shoulders, while maintaining traffic on the remaining lanes and shoulders,
- RUC is relatively high, and the monetary benefit to finish early equals or exceeds the incentives paid to the Contractor in the form of rental fees,

- The Department seeks contractor expertise to minimize the time that the roadway or portions of the roadway are out of service.

8. **If utility work is needed for the project, coordinate with utility companies as early as possible (See Figure 12-A).**

   - In phase 1, request information on utility locations as early as possible after the preliminary design is complete and notify utilities that the project is being considered for an expedited completion.

   - In phase 2, coordinate reviews of utility plans with related construction plans to catch and eliminate any conflicts.

9. **Ensure that plans and specifications are complete, accurate, and well coordinated prior to bid.**

   - Innovative contracting methods increase risks to the Department and the Contractor. SDDOT's risk is that the Contractor will seek time extensions if errors exist in the plans or specifications requiring addenda or excessive field changes.

   - Consider a design review performed by an independent design firm at the 90% or 100% stage of the construction documents. Having an independent "set of eyes" to review the plans and specifications may be worth the additional cost for time critical projects.

10. **Use Partnering in conjunction with innovative contracting methods.**

    - All innovative contracting methods increase risks to the Department and the Contractor. Partnering is an effective tool to identify and resolve problems during the project before they become disputes and is worth the added effort and cost for higher risk projects.

11. **Use CPM scheduling for projects using innovative contracting methods.**

    - SDDOT has implemented a specification for CPM scheduling. Provide additional requirements for updating the schedule at least monthly.

- Without an approved CPM schedule and monthly or periodic updates, it is difficult to verify the completeness and logic of a contractors plan, and to monitor the actual progress of construction. The same consideration would apply to projects not using innovative methods.

12. To aid in resolving weather related delays, use a working day weather chart.

- The chart provides the average number of working days per month for highway projects in each geographic region of the State. An example of a working day chart from Maryland is provided in Appendix 11. This chart could aid in the estimate of the I/D, B, or lane rental time durations, and resolve potential delays due to weather.
- Incorporate the chart by reference into the Contract.

- The chart correlates rainfall amounts with non-working days due to weather from Department records for previously completed projects. Rainfall data can be obtained from the National Oceanographic and Atmospheric Administration (NOAA) through the local weather stations in each geographic of the State.

- Check the records to determine if it is practical to develop separate charts for grading, paving, and bridge projects.

13. Develop and implement training programs.

- SDDOT is proceeding with CPM training.

- Develop and conduct internal training for implementing innovative contracting procedures.

- Invite contractors to a pre-bid meeting or special meeting to introduce and discuss a new innovative contracting method. Review the proposed special provisions and solicit comments and suggestions from contractors.

- Conduct Partnering training. A one or two day training course in Partnering concepts and Partnering facilitation is offered through the National Highway Institute.

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APPENDIX 1

CONTRACTOR QUESTIONNAIRE
INNOVATIVE CONTRACTING METHODS

QUESTIONNAIRE
INNOVATIVE CONTRACTING METHODS

Appendix 1

TO: AGC Highway Contractors Working in South Dakota

FROM: Sid Scott, Senior Consultant
Trauner Consulting Services, Inc. (TCS)
Consultant to South Dakota Department of Transportation (SD DOT)

DATE: August 21, 1995

SUBJECT: Innovative Contracting Procedures

SD DOT is currently using Incentive/Disincentive (I/D) provisions for contract time for selected highway contracts in South Dakota with a significant impact to the traveling public. SD DOT is exploring other innovative time-based contracting procedures used in other states to minimize impact to the traveling public. TCS is conducting a study for SD DOT to assess whether or not these methods are suitable for South Dakota and how to implement them. TCS met with several contractors at the AGC office in Pierre during the May 1995 bid letting to explain and discuss the study, and received feedback from members of the local contracting community. As a follow-up to this meeting, we are sending out this questionnaire to the contractors listed in the AGC of South Dakota directory. This questionnaire provides you the opportunity to comment on the innovative contracting methods included in this study and to address your concerns with implementing these methods in South Dakota. We have also included several questions related to CPM Scheduling because time management is viewed as essential to the successful implementation of these time-based innovative methods.

The identity of the respondents will remain confidential. Responses to this survey are important to us, and will make a difference in our final recommendations to SD DOT. A blank page is added if you need more space for your responses. Thank you for your time.

A postmarked envelope with our address is included for your convenience. Our address is listed below in case the envelope is misplaced:

Sid Scott, P.E.
Trauner Consulting Services, Inc.
1500 Walnut Street, Suite 800
Philadelphia, PA 19102

QUESTIONNAIRE **Appendix 1**
INNOVATIVE CONTRACTING METHODS

GENERAL

1. What approximate percentage of your heavy highway work is performed in South Dakota?

2. In what other states do you perform highway work? List states and percentage of your work.

   State _____ %____

   State _____ %____

   State _____ %____

3. Do you own or lease the majority of your equipment?
   ____ own ____ lease

4. Based on annual billings, where does your company fit within the dollar ranges shown below in millions of dollars?

   0 - 3M$ ____

   3 - 5M$ ____

   5 - 10M$ ____

   > 10M$ ____

5. Do you consider yourself to be a small, medium, or large contractor in South Dakota?

   ____ small ____ medium ____ large

6. If you are an in-state contractor, do any SD DOT bidding practices or procedures reduce your ability to successfully bid against out-of-state contractors for highway work in South Dakota? If so, please explain.

_____

_____

_____

_____

7. If you are an out-of-state contractor, do any SD DOT bidding practices or procedures affect your ability to bid for highway work in South Dakota? If so, please explain.

_____

_____

_____

_____

TIME-BASED I/D CONTRACTS

8. Have you performed highway work for SD DOT using time-based incentive/disincentive (I/D) contracts? _____ If your answer is NO, go to Question No. 14

9. Did you beat the I/D completion date, such that you earned a partial or maximum incentive? _____ If yes, how many days early did you finish to earn the incentive and did you achieve the maximum incentive?

Project No./Description	No. of Days Early	Maximum Incentive (yes/no)
_____	_____	_____
_____	_____	_____
_____	_____	_____

10. Did you accelerate your normal production rate to meet or beat the I/D completion date?

___ Yes ___ No

11. Have you been assessed a disincentive for finishing the work or portions of the work later than the I/D date?

___ Yes ___ No

12. What factors or conditions, if any, prevented you from meeting or beating the I/D date on a given project?

_____

_____

_____

_____

13. If you finished late for causes beyond your control, did SD DOT agree to a time extension and a waiver of the disincentive? _____ How were delays for the I/D project(s) resolved?

___ with SD DOT Area Personnel

___ SD DOT Region Personnel

___ SD DOT Central Office Personnel

___ Transportation Commission

___ Other _____

14. Have you declined to bid a SD DOT I/D project? _____ If your answer is NO, go to Question No. 15.

Did you decline to bid because the incentive amount was not sufficient to offset your extra costs to finish on or before the I/D date and allow you to earn a reasonable profit?

____ Yes ____ No

What other reasons, if any, prevented you from bidding a SD DOT I/D project?

_____

_____

_____

_____

15. Have you performed highway work for any state other than SD DOT using time-based incentive/disincentive (I/D) contracts? _____ If your answer is NO, go to Question No. 22.

16. Did you beat the I/D completion date, such that you earned an incentive?___ If your answer is YES, please fill out the following:

State	Project No./Description	No. of Days Early	Maximum Incentive (yes/no)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

17. Did you accelerate your normal production rate to meet or beat the I/D completion date? In which state?

___ Yes ___ No State: _____

___ Yes ___ No State: _____

___ Yes ___ No State: _____

18. Have you been assessed a disincentive for finishing the work or portions of the work later than the I/D date? In which state?

___ Yes ___ No State: _____

___ Yes ___ No State: _____

___ Yes ___ No State: _____

19. What factors or conditions, if any, prevented you from meeting or beating the I/D date on a given project?

_____

_____

_____

_____

_____

20. If you finished late for causes beyond your control, did the DOT agree to a time extension and a waiver of the disincentive?

____ Yes ____ No State: _____

____ Yes ____ No State: _____

How were delays for the I/D project(s) resolved?

State:_____

___ Project Level ___ Regional Office ___ Central Office

___ Other _____

State:_____

___ Project Level ___ Regional Office ___ Central Office

___ Other _____

21. Apart from South Dakota, have you declined to bid any state DOT I/D project?
____ If your answer is NO, go to Question No. 22.

In what State(s)? _____

Did you decline to bid because the incentive amount was not sufficient to offset your extra costs to finish on or before the I/D date and allow you to earn a reasonable profit?

____ Yes ____ No

What other reasons, if any, prevented you from bidding an I/D project?

_____

_____

_____

_____

22. In your opinion, what contract procedures or practices need to be implemented, modified, or improved to facilitate I/D contracts? For example, some suggested areas are bidding or pre-bid procedures, permitting, submittal reviews, scheduling, coordination with DOT, coordination with utilities or other contractors, and expedited approval of change orders and time extensions? Please explain your answer.

_____

_____

_____

COST-PLUS-TIME CONTRACTS

South Dakota is exploring the use of a time-based contracting method called Cost-Plus-Time bidding (A+B) for selected projects. In an A+B contract, the contractor bids on both the contract amount (A) as well as the time (B) to achieve a particular milestone or substantial completion. The time component, "B" of the bid, is converted into a dollar value based on the daily road user costs, which are calculated by the state and provided in the contract proposal. The two components, contract amount (A) added to the value of time (B x daily road user cost) comprise the bid.

The value of the bid is used to determine the low bidder, however, only the "A" component is used as the total contract value. The daily road user cost can be used as the incentive/disincentive in achieving the contract milestone or substantial completion. The following is an example of a cost + time bid.

Bidders	Contract Amount (A)	Time in Calendar Days (B)	Daily Road User Cost*	Total Cost
Brown Constr.	$5,695,828	235	$5000	$6,870,828
Smith Constr.	$5,758,000	215	$5000	$6,833,000
Jones Constr.	$5,798,000	210	$5000	$6,898,000

* Provided in bid proposal

As shown, the low bidder was Smith Construction. The contract value is $5,758,000.

23. Do you perceive an advantage/disadvantage to contractors bidding the time as well as the costs of performance? Why?

___ Advantage ___ Disadvantage

_____

_____

_____

_____

24. Do you prefer contracts using working days, calendar days, or a fixed completion date as a basis for the contract duration? Why?

___ Working Days ___ Calendar Days ___ Fixed Completion Date

_____

_____

_____

_____

_____

LANE RENTAL

Lane Rental or Lane-By-Lane Rental assesses rental fees for portions of a roadway occupied by the contractor. The rental fee is based on the daily impact to the road user caused by taking a portion of the roadway out of service. The fee might vary depending upon the time of day and the number or configuration of lanes occupied. For example, the rental fee would be less for a shoulder than a lane or a ramp, and would increase during peak travel hours. The intent of this method is to encourage contractors to minimize lane closures and construction impacts to road users. Other states have implemented this method by directing the contractor to include an hourly or daily lane rental fee in the items of work in its bid. The state would then deduct a rental fee for the length of time that the roadway is out-of-service. If the roadway is out-of-service for less time than estimated in the bid, then the contractor retains the unused rental fee. The state may also assess a daily disincentive for failure to open the roadway by the specified completion date. SD DOT has suggested that this method might be applicable to joint-spall repair projects on I-29 and I-90.

25. Based on your experience in South Dakota and surrounding states, could you identify a project type amenable to this approach?

_____

_____

_____

26. Do you perceive an advantage/disadvantage to contractors bidding Lane Rental?
___ advantage ___ disadvantage Why?

_____

_____

_____

SCHEDULING

To successfully manage time-based innovative contracts, Critical Path Method (CPM) Scheduling is recommended by FHWA. SD DOT is currently providing CPM Scheduling training for its area engineers.

27. Do you use CPM scheduling to plan and schedule your projects?

___ Never ___ Sometimes ___ Always

28. If you never, or sometimes use CPM schedules, what type of schedule do you use most often?

_____

29. If you have used CPM scheduling, on what kind of projects was a CPM schedule implemented?

_____

_____

30. If you have used CPM schedules, did you hire a scheduling consultant to prepare the CPM or did you prepare the schedule in-house?

___ hired scheduling consultant ___ prepared in-house

31. Would you consider using CPM scheduling as a tool for managing your projects, even if it was not a specific contract requirement? Why or why not?

_____

_____

_____

32. If South Dakota offered training in CPM scheduling would you be interested in participating?

___ Yes ___ No

SUMMARY

33. This study is designed to explore the feasibility of various innovative contracting procedures in South Dakota. Are there any existing SD DOT procedures you would like to see changed or other innovative methods that might improve highway contracting practices in South Dakota? Please comment.

This sheet is added as additional space for your answers. Please provide the number of the question to which you are responding.

APPENDIX 2

RESULTS OF
CONTRACTOR QUESTIONNAIRE
INNOVATIVE CONTRACTING METHODS

Appendix 2

QUESTIONNAIRE ON INNOVATIVE CONTRACTING METHODS

Background

Number of questionnaires mailed out: 70
Number returned undelivered and uncompleted to TCS: 1
Number of questionnaires completed and returned to TCS: 14
Overall percentage return rate of the questionnaires: 20%
Delivered questionnaire return rate: 20.3%.

All results for each question are based on the number of respondents who answered that particular question and not on the number of questionnaires returned completed to TCS.

Results: General

1. *What approximate percentage of your heavy highway work is performed in South Dakota?*

   52.9%.

2. *In what other states do you perform highway work? List states and percentage of your work.*

   Approximately 35% of the heavy highway work performed by the respondents is in North Dakota, Minnesota, and Iowa. They are also performing work in Louisiana, Montana, Nebraska, and Texas. Less than one percent is performed in both Kansas and Wyoming.

3. *Do you own or lease the majority of your equipment?*

   own: 14 lease : 0

4. *Based on annual billings, where does your company fit within the dollar ranges shown below in millions of dollars?*

   0 - 3 M$: 0
   3 - 5 M$: 4
   5 - 10 M$: 4
   > 10 M$: 6

5. *Do you consider yourself to be a small, medium, or large contractor in South Dakota?*

Small: 2 Medium: 11 Large: 1

6. *If you are an in-state contractor, do any SD DOT bidding practices or procedures reduce your ability to successfully bid against out-of-state contractors for highway work in South Dakota? If so please explain.*

Number of in-state contractors: 6

NO SD bidding practices and procedures do not affect bidding: 4
YES SD bidding practices and procedures affect bidding against out-of-state contractors for highway work in South Dakota: 1

Comments offered:

- Total quality management cators [sic] to the larger out-of-state contractors as we are not large enough to have our own quality management forces
- We do not own our own batch plant therefore [we] always have to rely on a commercial source for our asphalt concrete
- No. But things could be done to give the in-state bidders a one up. Such as Contractor Licensing, Equipment Licensing, and retainage for any contractor who does not have a history of paying their state taxes.

7. *If you are an out-of-state contractor, do any SD DOT bidding practices or procedures affect your ability to bid for highway work in South Dakota? If so, please explain.*

Number of out of-state contractors: 8

NO SD practices and procedures do not affect ability to bid: 6
YES SD practices and procedures affect ability to bid: 2

Comments offered:

- Bridge piers are sometimes odd sized and shaped in South Dakota and the contractor does not have suitable forms.
- We pay ND [North Dakota] rates + benefits which are higher than SD [South Dakota] rates + our labor expense is therefore higher for bidding purposes.

Results: Time-Based I/D Contracts

8. *Have you performed highway work for SD DOT using time-based incentive/disincentive (I/D) contracts?*

   Have previously performed I/D highway work for SD DOT: 7

   In-state contractors: 4
   Out-of-state contractors: 3

9. *Did you beat the I/D completion date, such that you earned a partial or maximum incentive? If yes, how many days early did you finish to earn the incentive and did you achieve the maximum incentive?*

   Five (5) earned an incentive on a SD DOT I/D project.
   One (1) contractor did not receive any incentive.
   One (1) was a subcontractor and did not know if any incentives were earned.
   Number of projects listed: 9
   Average number of days early: 34.8
   Maximum incentive achieved on a SD DOT I/D project: 2

10. *Did you accelerate your normal production rate to meet or beat the I/D completion date?*

    YES: 5 NO: 1 (note: worked as a subcontractor)

11. *Have you been assessed a disincentive for finishing the work or portions of the work later than the I/D date?*

    YES: 3 NO: 4

12. *What factors or conditions, if any, prevented you from meeting or beating the I/D date on a given project?*

- Problem with getting employees to work Saturdays: 1
- SD weather conditions: 3
- Scheduling due to subcontractor delays: 1
- Changing site conditions: 1
- Private utility work: 2
- Availability of skilled workers: 1
- State limiting availability of work days: 1

13. *If you finished late for causes beyond your control, did SD DOT agree to a time extension and a waiver of the disincentive? How were delays for the I/D project(s) resolved?*

YES SD DOT agreed to a time extension: 2
NO SD DOT did not agree to a time extension: 1

- 2 were resolved with SD DOT area personnel
- 1 was resolved with SD DOT regional personnel
- 0 were resolved with SD DOT central office personnel
- 1 was resolved with the Transportation Commission
- 0 were resolved by any other source

14. *Have you declined to bid a SD DOT I/D project? Did you decline to bid because the incentive amount was not sufficient to offset your extra costs to finish on or before the I/D date and allow you to earn a reasonable profit? What other reasons, if any, prevented you from bidding a SD DOT I/D project?*

One (1) respondent has declined to bid a SD DOT I/D project. It was an out-of-state contractor and the reason for declining was the job size and location, not because the incentive amount.

Results: I/D Contracts in Other States

15. *Have you performed highway work for any state other than SD DOT using time-based I/D contracts?*

Six of the respondents have performed highway work for any state other than SD DOT using time-based I/D contracts. Only one of these six contractors also performed an I/D contract for SD DOT. Thus, overall, 12 of the 14 respondents have had some experience with I/D contracts.

16. *Did you beat the I/D completion date, such that you earned an incentive?*

Four (4) respondents beat the completion date and earned an incentive
Two (2) respondents did not beat the completion date and earn an incentive
Average number of days early: 83.25
Achieved maximum incentive: 1

17. *Did you accelerate your normal production rate to meet or beat the I/D completion date? In what state?*

All of the respondents indicated that they did accelerate their normal production rate in their attempts to meet or beat the I/D completion date. Collectively, these contractors have had experience with I/D contracts in Iowa, Louisiana, Minnesota, and North Dakota.

18. *Have you been assessed a disincentive for finishing the work or portions of the work later than the I/D date?*

YES have been assessed a disincentive: 2
NO have not been assessed a disincentive: 4

19. *What factors or conditions, if any, prevented you from meeting or beating the I/D date on a given project?*

All of the five respondents who answered this question included weather as a factor. Also mentioned as hindrances to meeting or beating the I/D date for projects in states other than South Dakota were a shortage of qualified craft workers and utilities performed by another agency.

20. *If you finished late for causes beyond your control, did the DOT agree to a time extension and a waiver of the disincentive? How were delays for the I/D project(s) resolved?*

The contractors indicated that they have resolved delays for these I/D projects at the project level in Iowa, Louisiana, and Minnesota and at the regional level also in Minnesota. Additionally, in North Dakota, one delay has yet to be resolved and is currently at the central office level.

21. *Apart from South Dakota, have you declined to bid any state DOT I/D project? Did you decline to bid because the incentive amount was not sufficient to offset your extra costs to finish on or before the I/D date and allow you to earn a reasonable profit? What other reasons, if any, prevented you from bidding an I/D project?*

Two contractors have declined to bid an I/D project. One contractor indicated that he declined to bid because the incentive amount was not sufficient to offset his extra costs necessary to finish the project before the I/D date and allow him to earn a reasonable profit and also due to difficulty coordinating the scheduling of the I/D project with work on hand. The other contractor only cited job size and location as the reasons he declined to bid an I/D project.

22. *In your opinion, what contract procedures or practices need to be implemented, modified, or improved to facilitate I/D contracts? For example, some suggested areas are bidding or pre-bid procedures, permitting, submittal reviews, scheduling, coordination with DOT, coordination with utilities or other contractors, and expedited approval of change orders and time extensions? Please explain your answer.*

The respondents made the following comments:

- Contractor needs to know the exact utilities location and if there is work to be done by the utilities companies how long it will take to complete that work.
- Earlier utility relocation helps[.] Can do more work in the winter[.] Prefer to do substructures in the winter
- Detailed prebid conference with "not later than" dates established for utilities adjustments arranged by DOT
- The time from B.O.D. to start date has to be sufficient to thoroughly plan the work, order all materials, complete other work-on-hand in order to be ready by the start date.
- More decisions and approval of COs in the field.
- A turn around time commitment by DOT for submittals and CCO approvals.
- Change orders which are not on the critical path can consume resources which could be applied to making the incentive work go faster.
- More coordination with the DOT, especially regarding unknowns as work progresses.
- State and subcontractors should be more involved in developing project schedule and adherence not documented during project
- Plants should be certified to perform QM/QA work
- Required partnering between DOT, contractor and subs and time extensions for delays caused by suppliers failure to perform.

Results: Cost-Plus-Time

23. *Do you perceive an advantage/disadvantage to contractors bidding the time as well as the costs of performance? Why?*

Half of the respondents perceive an advantage to bidding the time as well as the costs of performance. The comment most common, however, was that larger contractors, particularly out-of-state contractors, would have an advantage over smaller firms. There is concern that a few contractors will monopolize the work and that "this will further drain highway funds out of S.D. so that they will not multiply in the S.D. economy". It was suggested, by another contractor, that small contractors could joint venture when bidding a cost-plus-time project.

The cost-plus-time method of bidding was seen as an advantage for companies which usually tend to work long hours. Additionally, comments were made that if the contractor is willing to take this "high risk", compensation should be justly due and that good performance by a contractor is rewarded with this method.

Three contractors who thought there is an advantage to this method commented that the cost-plus-time method requires more scheduling prior to bidding. One of these contractors commented that sufficient time must be allowed between receiving the plans and bidding. Additionally, a couple of contractors were concerned that inclement weather and/or wet soil conditions can unfairly impede the project completion process.

One contractor thought this method complicates the bidding procedure and did not see any advantage to either the contractor or the DOT.

Finally, a contractor who thought bidding cost-plus-time was a disadvantage thought that A+B bidding lends itself to the opportunity for claim filing if the contractor perceives that the owner has impeded the production of the contractor.

Results: Work Days, Calendar Days, Fixed Completion Date

24. *Do you prefer contracts using working days, calendar days, or a fixed completion date as a basis for the contract duration? Why?*

Eleven (11) prefer a contract with working days
Two (2) prefer a contract with calendar days
Five (5) prefer a contract with a fixed completion date

Note: some respondents checked off more than one answer

Comments made by the respondents regarding Working Days:

- fairer as inclement weather would not count against the contractor
- unforeseen changing site conditions are taken into consideration
- allows for both bidding a project that may not "fit" with a fixed date completion date and allows the contractor to start when the job "fits".

Comments made by the respondents regarding Fixed Completion Date:

- We can bid more work because our schedule is more flexible
- A fixed completion date allows contractor to schedule his own work to fit all the projects together.

Comment made by a respondent regarding Calendar Days:

- I think they take more planning and I see that as an advantage. There needs to be some flexibility in the start dates so the contractor can schedule his work.

Additionally, one contractor suggested a fixed completion date with a minimum number of work days.

Results: Lane Rental

25. *Based on your experience in South Dakota and surrounding states, could you identify a project type amenable to this approach (lane rental)?*

- No/None (6)
- Bridge overlay/bridge repair (2)
- Interstate staged projects (1)
- paving in urban areas (1)
- joint spall repair (1)
- Regarding joint-spall, one contractor commented: Joint-spall repair projects tend to over run on quantities. Project engineers may be reluctant to add work that should be done under this program.

26. *Do you perceive an advantage/disadvantage to contractors bidding Lane Rental? Why?*

Three (3) respondents perceive an advantage to bidding Lane Rental
Five (5) respondents perceive a disadvantage to bidding Lane Rental

Comments regarding Lane Rental were:

- good performance is rewarded
- advantage if contractor is willing to preplan and schedule the jobs
- if the plans and quantities are correct, this can be a good program
- this method could cause a host of new problems on more complicated jobs that require subcontractors and DBE participation
- would motivate multiple crews
- all I/D projects are dependent upon weather-somehow factor in weather
- I don't know-are the rental fees figured in the bid?
- too complicated
- this makes no sense other than another hidden tax
- larger out-of-state contractors would have an advantage and drain federal and state highway funds out of South Dakota
- disputes arising in determining who is responsible + payment following. This would be seen as a shift of responsibility from the DOT to the prime contractor. Could cause financial hardship to contractors initially + higher bid prices would be final result.

Results: Scheduling

27. *Do you use CPM scheduling to plan and schedule your projects?*

Four (4) of the respondents never use CPM scheduling
Ten (10) of the respondents sometimes use CPM scheduling

None (0) of the respondents always use CPM scheduling

28. *If you never, or sometimes use CPM schedules, what type of schedule do you use most often?*

The respondents use bar charts most often for scheduling purposes. Additionally, decision tree scheduling, Primavera project planner, Gant charts, and in-house scheduling were also cited as the types of schedules used most often by the respondents.

29. *If you have used CPM scheduling, on what kind of projects was a CPM schedule implemented?*

For those respondents who have used CPM scheduling, they used the CPMs most often on bridge projects. CPM scheduling was also used on airport work, buildings, dams, high traffic/commercial use areas, multiple phase projects, reconstruction, state projects, structural work, and water and wastewater plants.

30. *If you have used CPM schedules, did you hire a scheduling consultant to prepare the CPM or did you prepare the schedule in-house?*

Six (6) hired a scheduling consultant
Six (6) prepared the schedules in-house

31. *Would you consider using CPM scheduling as a tool for managing your projects, even if it was not a specific contract requirement? Why or why not?*

Yes would consider using CPM scheduling even if not required: 7
No would not consider using CPM scheduling if not required: 6

Comments offered regarding CPMs:

- allows preplanning to be more detailed, identifies milestones and the critical path, and improves the thought process
- helps show "bottlenecks"
- is a good scheduling and planning tool
- helps identify material lead times and critical activities
- is a "living" document and must be updated regularly
- involves all contractors in the scheduling process and documentation of delays.
- not necessary as projects are quite basic
- too many jobs and crews plus weather variables to contend with
- critical path can fluctuate on different controls too frequently

32. *If South Dakota offered training in CPM scheduling would you be interested in participating?*

Nine (9) of the respondents would be interested in CPM training
Four (4) of the respondents would not be interested in CPM training

33. *This study is designed to explore the feasibility of various innovative contracting procedures in South Dakota. Are there any existing SD DOT procedures you would like to see changed or other innovative methods that might improve highway contracting practices in South Dakota? Please comment.*

One contractor proposed some suggestions to "level the playing field" between South Dakota contractors and those out-of-state. The following was suggested:

- Make out-of-state firms accountable for same fees (i.e. license plates, fuel taxes, use taxes) as
- Do away with current prequalification practices for bidding
- Maybe go to contractor licensing
- Maybe go to equipment licensing
- More out-of-state audits by Department of Revenue with DOT enforcement

Other comments offered:

- these proposed innovative contracting methods cater to larger out-of-state contractors and will, in turn, cause a drain on the South Dakota economy
- SD DOT should evaluate the quality of construction and limit construction companies' bidding if their workmanship is of a poor quality
- more responsibility for decisions should be in SD DOT area offices
- more decisions need to be made in the field with field inspectors given more authority, responsibility, and support by the central office
- planning more projects with winter time work, in particular, river bridges
- SD DOT working with contractors more and an increase in partnering
- SD DOT's current procedures regarding utilities need to be changed and that rules governing utilities need to be created
- appearing in front of the Transportation Board and "arguing" about work days after completion to be very intimidating and unfair to the contractor
- more leeway with various methods of form work, standardizing superstructures for small stream crossings, using precast concrete piling, reducing or eliminating deep foundations (spread footing) for small structures, and eliminating skews for bridges when less than 15° indicated

APPENDIX 3

SHA INNOVATIVE CONTRACTING SURVEY

INNOVATIVE CONTRACTING SURVEY
SDDOT - TCS PROJECT NO. 519

State:_____ Date _____ Phone_____

Name/Position:_____ Ext_____

Name/Position:_____ Ext._____

Name/Position:_____ Ext._____

TCS is under contract with SD DOT to research innovative contracting practices. Our scope is to gather existing information and findings related to the use of these methods, and comparatively analyze and assess which methods or combination of methods can be immediately implemented by U.S. highway agencies. A product of this research is to produce a set of guideline, and criteria to determine when, where, and how to implement these innovative methods and sample specifications.

1. Has your state implemented any of the following concepts or practices in its construction program?
   ____incentives and disincentives (I/D) for time
   ____road user costs
   ____multi-parameter bidding (A+B)
   ____lane rental

If possible, we would like to obtain:

a) criteria for selection of projects using innovative contracting methods.

b) procedures and guidelines or a work plan for implementation of these methods, and

c) sample specifications

2. Did your state produce any reports or findings resulting from the use of these methods? If so, can we obtain copies of these reports or findings?

3. Do legal considerations in your state influence or prevent the use of a particular

innovative approach?

4. Did you use any of the methods noted above in combination? For example, do you use a cost-plus-time and lane rental approaches in combination?

5. Did the use of a particular innovative practice or combination of practices on a project result in a measurable:

    a. increase/decrease in bid prices relative to traditional projects of this type or the Engineer's estimate,

    b. increase/decrease in quality or performance of the end product as evidenced by the frequency of defects, pay reductions, or rejections of materials and workmanship,

    c. increase/decrease in use of state resources,

    d. increase/decrease in project costs,

    e. increase/decrease in the time duration of a project?

    f. increase/decrease in safety?

6. Are there any perceived risks/rewards or advantages/disadvantages to the State or the Contractor in implementing these practices?

7. How have Contractors responded to the implementation of innovative approaches in the past? Has the state undertaken training programs to educate contractors?

8. Has your state adjusted or altered its standard procedures in implementing innovative contracting procedures?

9. Does your state use or require contractor CPM scheduling for projects using innovative contracting methods?

APPENDIX 4

Road User Cost Attachments

A. SD DOT RUC calculation for project IM90-4(52)198 in Jones County
B. Accident Costs Tables
    1. Average Accident Rates-Number of Accidents per Million Vehicle Miles
    2. Work Zone Accident Rate Factor A and B Charts
    3. Average Cost per Accident in South Dakota by Road Type (4 pages)
        a. Accidents by Type of Highway 1994
        b. South Dakota Yearly Comparison of Motor Vehicle Traffic Fatalities, Injuries, Accidents, Miles Traveled, & Registered Motor Vehicles
        c. National Safety Council, "Estimating the Cost of Unintentional Injuries, 1993"
        d. 1994 Economic Loss (handwritten)
C. Speed Cycle Change Charts
    1. Excess Cost of Speed Change Cycles Above Cost of Continuing at Initial Speed for Passenger Cars
    2. Excess Cost of Speed Change Cycles Above Cost of Continuing at Initial Speed for Trucks
    3. Consumer Price Index

Appendix 4.A

SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION
DIVISION OF PLANNING
PROJECT IM90-4(52)198

Estimate of Daily Road User Costs -I90 (Jones County)
I90 From 3 miles West Draper Interchange for 12 miles West

ADT=Estimate of Vehicles Affected By Construction Detour
Data From Estimate of Traffic Using Facility During Summer, 1995

ALTERNATE >	*EXISTING*	*CONSTRUCTION*
	I90 NORMAL TRAFFIC	*TRAFFIC DELAYED*
DISCRIPTION		
ADT	11,460	11,460
Cars	8,584	8,584
Trucks	2,876	2,876
DISTANCE	12.00	12.00
TRAVEL TIME	11.04 (@ 65 MPH)	14.40 (@ 50 MPH)
VEHICLE MILES		
Cars	103,002	103,002
Trucks	34,518	34,518
VEHICLE MINUTES		
Cars	94,762	123,603
Trucks	31,756	41,421
COSTS		
$.07 Per Min Cars	$6,633.36	$8,652.21
$.14 Per Min Trucks	$4,445.86	$5,798.94
$.14 Per Mile Cars	$14,420.35	$14,420.35
$.50 Per Mile Trucks	$17,258.76	$17,258.76
TOTAL DAILY COSTS	$42,758.32	$46,130.26
DIFFERENCE	$46,130.26-$42,758.32	$3,371.94 Added Costs

NOTES:
1. Costs per Minute Car Based On $4.25 Per Hour Wage(Minimum Wage)
2. Costs per Minute Truck Based On $8.50 Per Hour Wage
3. Costs per Mile Car Set at $.14 per Mile
4. Costs per Mile Trucks Set at $.50 per Miles

Appendix 4.B.1

Table 6. Average Accident Rates

Roadway Type	Accidents Per Million Vehicle Miles[1]			
	Fatal	Injury	PDO[2]	Total
Rural				
No Access Control				
2 Lanes	0.070	0.94	1.39	2.39
Multilane, Undivided	0.047	0.89	1.95	2.89
Multilane, Divided	0.063	0.77	1.25	2.09
Partial Access Control				
2-lane Expressway	0.051	0.52	0.76	1.33
Divided Expressway	0.038	0.44	0.76	1.24
Freeway	0.025	0.27	0.49	0.79
Suburban				
No Access Control				
2 Lanes	0.048	1.26	2.56	3.88
Multilane, Undivided	0.037	1.58	3.31	4.93
Multilane, Divided	0.030	1.10	2.24	3.37
Partial Access Control				
2-lane Expressway	0.096	0.82	1.42	2.34
Divided Expressway	0.060	0.82	1.29	2.16
Freeway	0.015	0.32	0.74	1.07
Urban				
No Access Control				
2 Lanes	0.045	1.51	3.38	4.94
Multilane, Undivided	0.040	2.12	4.49	6.65
Multilane, Divided	0.027	1.65	3.19	4.86
Partial Access Control				
2-lane Expressway	0.033	6.65	1.05	1.73
Divided Expressway	0.022	1.08	2.04	3.14
Freeway	0.012	0.40	1.01	1.43

1. Source: Ref. 3
2. Property Damage Only

Average Accident Rates Table copied from:
U.S. Department of Transportation, Federal Highway Administration. "Planning and Scheduling Work Zone Traffic Control." Impementation Package, FHWA-IP-81-6, User Guide. October 1981.

Appendix 4.B.2

Work Zone Accident Rate Factor - A and B Charts copied from:
U.S. Department of Transportation, Federal Highway Administration. "Planning and Scheduling Work Zone Traffic Control." Implementation Package, FHWA IP-81-6, User Guide. October 1981.

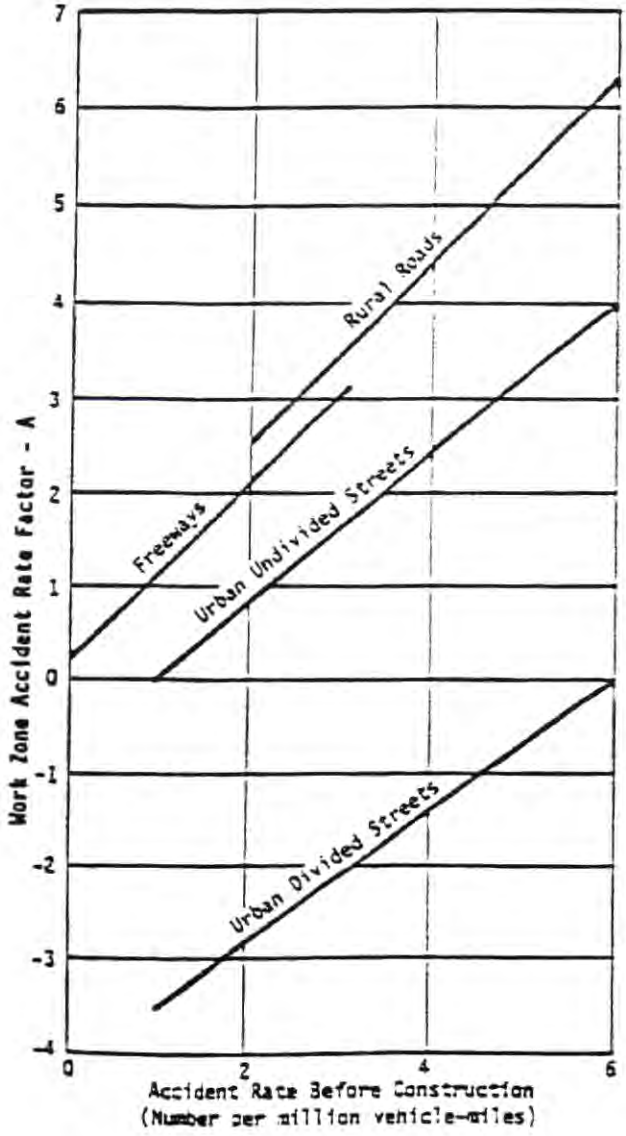


Figure 18. Work Zone Accident Rate Factor - A

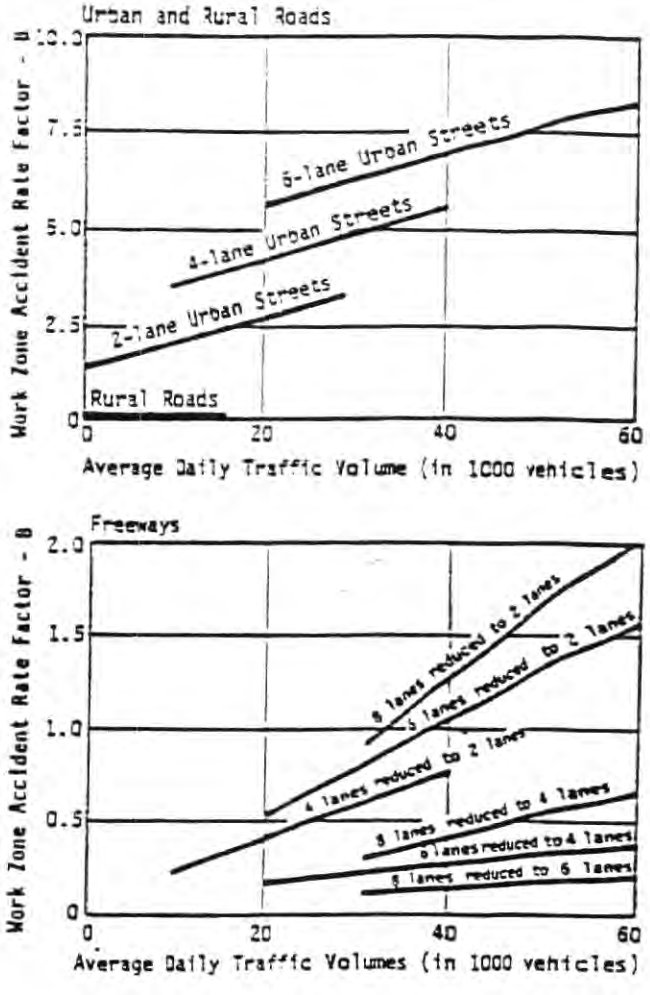


Figure 19. Work Zone Accident Rate Factor - B

FIGURE 12-A
RECOMMENDATIONS

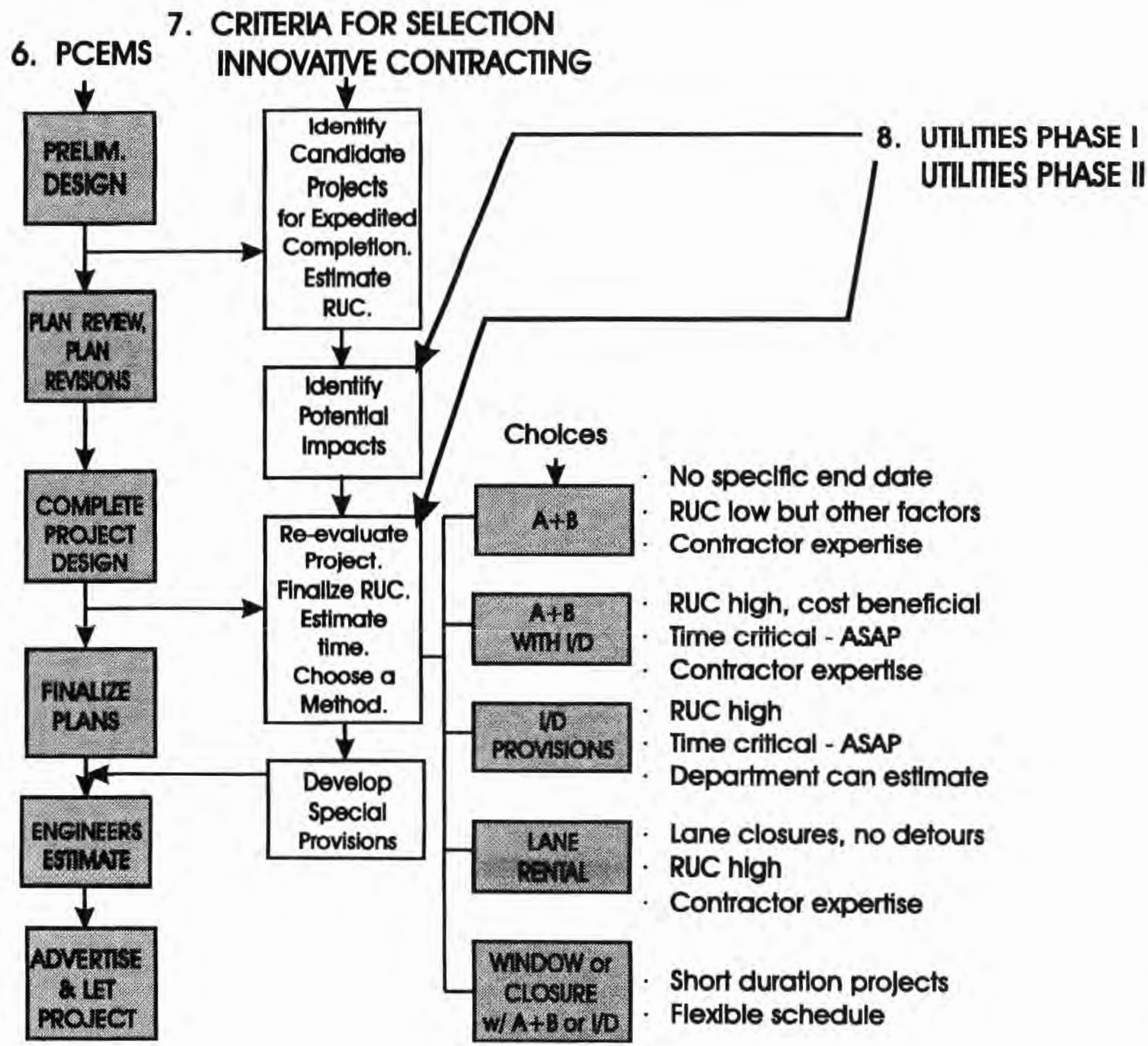
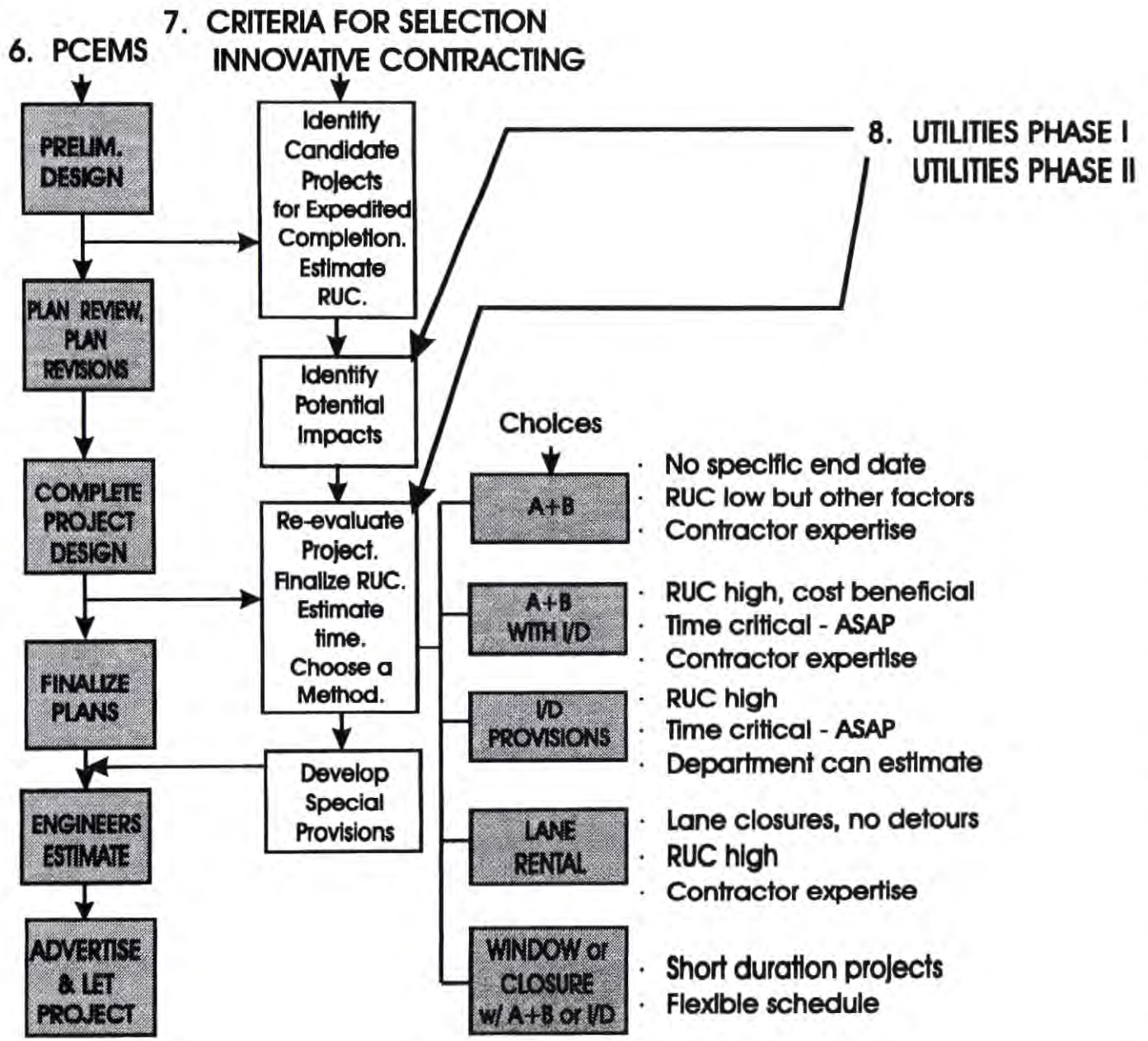


FIGURE 1

RECOMMENDATIONS



Appendix 4.B.3

Average Cost per Accident in South Dakota by Road Type

Type of Roadway	Average Cost per Accident
Interstate - Rural	$19,274.20
US/State Highways - Rural	28,424.23
County/Local Roads - Rural	28,305.82
Interstate - City	15,810.36
US/State Highways - City	17,665.84
City Streets/Alleys	14,604.46

The average cost per accident by road type is determined by first calculating the total cost of fatalities, injuries, and property damage accidents on each particular type of roadway. These three calculations are added together to determine the total cost of all accident types on the particular type of roadway. Finally, the total cost of all accidents is divided by the total number of accidents on that type of roadway to determine the average cost per accident. Thus, the formula for determining average cost per accident is:

Average Cost per Accident by Road Type	=	Total cost of all fatalities by road type	+	Total cost of all injuries by road type	+	Total cost of all property damage accidents by road type
		Total number of accidents by road type				

The following is an example of this formula for the average cost per accident on interstate rural roadways in South Dakota:

$19,274.20	=	$11,795,744.64	+	$8,948,849.60	+	$6,374,200.00
		1,407				

Appendix 4.B.3

The Total Cost of All Fatalities by Road Type

The total cost of all fatalities by road type for this example is $11,795,744.64. This number represents the total cost of all fatalities on interstate rural roadways in South Dakota. This number is determined by the following computation:

Total cost of all fatalities by road type	=	Number of fatal accidents by road type	x	Average cost per fatal accident by road type

Based on the previous example, the following is the computation to determine the total cost of all fatalities on interstate rural roadways in South Dakota:

$11,795,744.64	=	12	x	$982,978.72

The number of fatal accidents on interstate rural highways, 12 in the example, is found in the Accidents by Type of Highway 1994 table which is provided in Appendix 4.B.3.a. The average cost per fatal accident on interstate rural roadways is determined to be $982,978.72. To determine this cost it is necessary to distinguish between the number of fatalities and the number of accidents which produced those fatalities because a fatal accident may result in more than one death. Thus, the average cost per fatal accident on interstate rural roadways is determined by the following computation:

Average cost per fatal accident by road type	=	Number of all fatalities for previous year	x	Cost per death
		Number of all accidents resulting in fatalities for previous year		

Based on the previous example, the following is the computation to determine the average cost per fatal accident on an interstate rural roadway in South Dakota:

$982,978.72	=	154	x	$900,000.00
		141		

The number of automotive fatalities for 1994, a total of 154, is listed in the South Dakota Yearly Comparison of Motor Vehicle Traffic Fatalities, Injuries, Accidents, Miles Traveled, & Registered Motor Vehicle Table which is provided in Appendix 4.B.3.b. The cost per death, $900,000.00, is a national average reported by the National Safety Council. This figure can be found in it's report, "Estimating the Cost of Unintentional Injuries, 1993" which is provided in Appendix 4.B.3.c. The number of all accidents resulting in fatalities for 1994, a total of 141, is listed in the

Appendix 4.B.3

South Dakota Yearly Comparison of Motor Vehicle Traffic Fatalities, Injuries, Accidents, Miles Traveled, & Registered Motor Vehicle Table.

The Total Cost of All Injuries by Road Type

The total cost of all injuries by road type is determined by the following formula:

Total cost of all injuries by road type	=	Number of injury accidents by road type	x	Average cost per injury causing accident

Based on the previous example, the following is the computation to determine the total cost of all injuries on interstate rural roads in South Dakota:

$8,948,849.60	=	296	x	$30,232.60

The number of injury accidents on interstate rural roads is 296. The number of injury causing accidents by road type can be found in the Accidents by Type of Highway 1994 table. The average cost per injury causing accident can be determined by the following formula:

Average cost per Injury Causing Accident	=	Cost of all injuries for the previous year
		Total number of accidents causing injuries

Based on the previous example, the following is the computation to determine the average cost per injury causing accident in South Dakota:

$30,232.60	=	$172,658,400
		5,711

The cost for all injuries can be determined two ways. The first, more accurate way, is to contact the Department of Transportation, Division of Planning - Accident Records. From this department, obtain a breakdown of all injuries by severity. The breakdown should be as follows: incapacitating injuries, nonincapacitating injuries, and possible injuries. Take these totals per type of injury and multiply by the applicable cost per type of injury as listed in the National Safety Council's report, "Estimating the Cost of Unintentional Injuries, 1993." This method was used for the following example:

Appendix 4.B.3

According to the 1994 Economic Loss Calculation Sheet for South Dakota which is provided in Appendix 4.B.3.d, there were:

1902 incapacitating injuries @ $49,000 =	$ 93,198,000
3110 nonincapacitating evident injuries @ $15,000 =	$ 46,650,000
3528 possible injuries @ $9,300 =	$ 32,810,400
	$172,658,400

If a breakdown of injuries by severity is not available, the total number of injuries for the year may be used. This number can be found in the South Dakota Yearly Comparison of Motor Vehicle Traffic Fatalities, Injuries, Accidents, Miles Traveled, & Registered Motor Vehicle Table. The total number of injuries for 1994 is 8,540. This number should be distinguished from the number of injury causing accidents as one injury causing accident may result in more than one injury. The total number of injuries can be multiplied by the nonfatal disabling injury figure to yield the approximate total cost of all injuries for the year. Once the cost for all injuries for the year is calculated by one of the above methods, divide by the total number of injury causing accidents. The total number of accidents causing injuries is reported in the South Dakota Yearly Comparison of Motor Vehicle Traffic Fatalities, Injuries, Accidents, Miles Traveled, & Registered Motor Vehicle Table for 1994. The number of injury causing accidents for 1994 was 5,711. Thus, the average cost per injury causing accident for 1994 is as follows:

Average cost per injury causing accident	=	$172,658,400 / 5,711	=	$30,232.60

Total Cost of All Property Damage Accidents by Road Type

The total cost of all property damage only (PDO) accidents by road type can be determined by the following formula:

Total cost of all property damage accidents by road type	=	Number of PDO accidents by road type	x	Average cost per PDO accident

The total number of PDO accidents by road type is reported in the "Accidents by Type of Highway 1994" table. The average cost per PDO accident is reported in the National Safety Council's report, "Estimating the Cost of Unintentional Injuries, 1993." Thus, the total cost of all PDO accidents on interstate rural roads for 1994 is:

$6,374,200	=	1,099	x	$5,800

Appendix 4.B.3.a

Highway System

The number of reported accidents by highway system is presented in TABLE 3-7. Injury and PDO accidents happened predominately within city limits. City streets and alleys experienced 39.1 percent of the PDO accidents and 39.3 percent of the injury accidents.

Nonintarstate rural roads tallied 74.5 percent of the fatal accidents with 56 (39.7%) fatal accidents occurring on U.S./State highways and 49 (34.8%) on County/Local roads. The Interstate system experienced 1,983 (10.2%) of the total accidents while accounting for an estimated 23 percent of the vehicle miles traveled in 1994. Thirteen (9.2%) of the fatal accidents happened on the interstate system. Twenty-four (17.0%) of the fatal accidents happened in a town or city (see FIGURES 3-3 and 3-4).

TABLE 3-7
ACCIDENTS BY TYPE OF HIGHWAY
1994

Type of Highway	Total Accidents Number	%	Fatal Accidents Number	%	Injury Accidents Number	%	PDO Accidents Number	%
Interstate - Rural	1,407	7.2	12	8.5	296	5.2	1,099	8.1
US/State Hwys.-Rural	3,250	16.8	56	39.7	779	13.6	2,425	17.9
Co./Local Rds.-Rural	3,186	16.4	49	34.8	975	17.1	2,162	15.9
Interstate - City	576	3.0	1	0.7	196	3.4	379	2.8
US/State Hwys.-City	3,420	17.6	11	7.8	1,221	21.4	2,188	16.1
City Streets/Alleys	7,559	38.9	12	8.5	2,244	39.3	5,303	39.1
Total	19,408	100	141	100	5,711	100	13,556	100

Source: Department of Transportation: Accident Records

Appendix 4.B.3.b

TABLE 2-2

SOUTH DAKOTA YEARLY COMPARISON
OF MOTOR VEHICLE TRAFFIC FATALITIES, INJURIES,
ACCIDENTS, MILES TRAVELED, & REGISTERED MOTOR VEHICLES

Year	Deaths	Death Rate[1]	Injuries	Total Accd.	Total Accd. Rate[4]	Fatal Accd.	Injury Accd.	PDO[2] Accd.	Miles[3] Traveled +(000,000)	Registered Motor Vehicle +(000)
1962	246	6.77	4,248	8,305	242.50	191	2,592	6,022	3,631	377
1963	220	5.83	4,123	8,874	235.01	185	2,530	6,159	3,776	386
1964	270	7.03	4,569	9,349	243.53	211	2,816	6,322	3,939	387
1965	244	6.13	4,685	10,015	251.44	194	2,880	6,941	3,983	396
1966	265	6.50	5,072	10,321	265.55	205	3,087	7,529	4,075	402
1967	224	5.41	5,286	12,154	293.43	183	3,250	8,721	4,142	407
1968	255	5.91	5,612	14,061	326.01	215	3,396	10,450	4,313	409
1969	296	6.79	5,921	16,563	379.34	219	3,584	12,762	4,361	422
1970	238	5.12	5,492	16,155	347.78	189	3,395	12,581	4,648	427
1971	262	5.36	6,705	16,995	347.97	210	4,152	12,633	4,884	444
1972	294	5.83	6,718	17,883	354.99	235	4,267	13,381[2]	5,039	467
1973	286	5.57	6,774	14,985	291.76	228	4,321	10,436[2]	5,136	494
1974	229	4.47	6,211	11,727	228.77	203	4,077	7,447[2]	5,125	519
1975	198	3.82	6,765	15,146	292.06	163	4,398	10,585[2]	5,186	533
1976	224	4.07	7,423	15,755	286.30	188	4,840	10,727	5,503	554
1977	211	3.67	7,603	18,022	313.17	180	5,013	12,827[2]	5,754	575
1978	194	3.33	7,861	18,285	310.21	162	5,263	12,654[2]	5,830	599
1979	211	3.75	7,189	16,059	285.05	169	4,825	11,064	5,614[3]	616
1980	229	3.69	7,147	14,845	240.25	188	4,770	9,887	6,179[3]	622
1981	177	2.86	6,771	14,375	232.38	162	4,614	9,599	6,186	637
1982	148	2.33	6,174	14,605	229.57	129	4,192	10,284	6,362	640
1983	175	2.77	6,287	14,971	237.07	147	4,175	10,649	6,315	655
1984	143	2.24	6,158	15,093	236.42	132	4,297	10,664	6,384	669
1985	130	2.07	6,240	15,435	245.94	109	4,229	11,097[2]	6,276	674
1986	134	2.15	6,008	13,714	219.85	118	4,105	9,491[2]	6,238	686
1987	134	2.09	6,221	13,083	203.59	107	4,173	8,803	6,426	711
1988	147	2.22	6,579	14,821	224.02	127	4,455	10,239	6,616	709
1989	152	2.27	6,828	15,005	223.79	134	4,605	10,266	6,705	719
1990	153	2.19	7,261	15,073	215.67	139	4,829	10,114	6,989	698
1991	143	2.10	7,310	16,009	235.32	130	4,830	11,049	6,803	710
1992	161	2.24	7,813	17,170	238.61	141	5,112	11,917	7,199	722
1993	140	1.89	8,410	18,664	251.74	118	5,525	13,021	7,414	749
1994	154	1.98	8,540	19,408	249.52	141	5,711	13,556	7,778	805

[1] Number of deaths per 100 million vehicle miles traveled.

[2] Prior to July 1, 1973 the threshold for a reportable property damage only (PDO) accident was $100 to one person's property. July 1, 1973 the PDO amount was increased to $250.

January 1, 1975, the PDO threshold definition changed to accumulated property damage of $250 or more. July 1, 1978 the PDO threshold was increased to $400 accumulated property damage. July 1, 1986, the PDO threshold definition changed to $500 damage to any one person's property or $1000 accumulated property damage per accident.

[3] Miles traveled from years 1980 through 1991 have been revised to agree with the Highway Performance Monitoring System's (HPMS) miles traveled. The revised travel was provided by Data Inventory of the SD Department of Transportation. Note: This revision of the miles traveled has caused the Death Rates to be adjusted also. Current year 1994 may be adjusted an updated in next year's publication.

[4] Number of accidents per 100 million vehicle miles traveled.

Source: Department of Transportation Accident Records

55 mph speed limit 3/1/74

Appendix 4.B.3.c

K-2 9/1/94

National Safety Council

Estimating the Cost of Unintentional Injuries, 1993

The National Safety Council makes estimates of the average costs of fatal and nonfatal unintentional injuries to illustrate their impact on the nation's economy. The costs are a measure of the dollars spent and income not received because of accidents, injuries, and fatalities. It is another way to measure the importance of prevention work.

Estimating costs is not exact – they can only be approximated. The estimates depend on many factors. The Council extensively revised its cost estimating procedures for the 1992 data year. New components were added, new benchmarks and inflation factors adopted, and a new discount rate of 4 per cent was assumed. For this reason, the cost estimates shown here are not comparable to those before the 1992 data year.

This bulletin shows how costs can be estimated for a community or state. The figures should be used to estimate the actual costs to the nation of deaths and injuries. The comprehensive cost figures (discussed below) should be used for cost benefit analyses.

It is important to round an estimate, to show it is an approximation, not an exact figure. The recommended rule is: if the estimate is less than $3,000,000, round to the nearest $100,000; if $3,000,000 to $10,000,000 round to nearest $500,000; if $10,000,000 to $30,000,000 round to nearest $1,000,000; if more than $30,000,000 round to nearest $5,000,000.

COST OF MOTOR-VEHICLE ACCIDENTS

The calculable costs of motor-vehicle accidents are wage and productivity losses, medical expenses, administrative expenses, motor-vehicle damage, and employer costs. See the definitions on the reverse for a description of what is included in each component. In 1993, the costs of all these items for each death (not fatal accident), injury (not injury accident), and property damage accident were:

Death	$ 900,000
Nonfatal Disabling Injury	$ 32,300
Property Damage Accident (including minor injuries)	$ 5,300

Because of the different ratios of nonfatal injuries and property damage accidents per death, the cost per death for all accidents—fatal, nonfatal, and property damage— differs for urban and rural areas. The costs shown below include the cost of one death and the number of injuries and property damage accidents indicated by the appropriate ratios.

	All	Urban	Rural
Nonfatal injuries per death	48	89	26
Property damage accidents per death	260	509	127
Cost, per death (rounded)	$3,980,000	$6,480,000	$2,650,000

These averages may be used to estimate the motor-vehicle accident cost in cities or states, but if a city is small they must be used with care. For example, if the year's death total is five, and four resulted from one accident, do not use the $6,480,000 average per death. It includes the cost of 89 injuries and 509 property damage accidents. In such an unusual experience these ratios do not hold. Here it is more accurate to use the unit costs for deaths, injuries, and property damage accidents separately.

If a city has at least 10 deaths, using the $900,000 average cost per death is usually satisfactory. Many cities and states do not keep complete injury and property damage accident records. If a city's records are believed incomplete, using the $6,480,000 total cost per death is more satisfactory. However, use this figure only if there were at least 10 deaths and only one or two occurred in each fatal accident. When fewer than 10 deaths, figure the costs of deaths, injuries, and property damage cases separately, adding a reasonable amount to cover the estimated degree of incompleteness.

To estimate the cost of motor-vehicle accidents while on the job, see "Cost of Other Injuries" below.

Motor-vehicle injuries by severity. Estimates are given here of the 1993 costs by severity of injuries, as defined in sections 2.2.4 through 2.3.6 of the *Manual on Classification of Motor Vehicle Traffic Accidents* (Fifth Edition) ANSI Standard D16.1-1989. These injury severity designations are sometimes referred to as "A," "B," and "C."

"Incapacitating injury"	$49,000
"Nonincapacitating evident injury"	$19,000
"Possible injury"	$ 9,200

These estimates may be helpful for cities and states that do not use the concept of "disabling" injury (see definitions). Estimates used for deaths or property damage accidents are not changed by using these estimates.

Cost-benefit analysis. The figures above are appropriate for measuring the economic loss to a community resulting from past motor-vehicle accidents. They should not be used, however, in computing the dollar value of future benefits due to traffic safety measures because they do not include the value of a person's natural desire to live longer or to protect the quality of one's life. That is, the economic loss estimates do not include what people are willing to pay for improved safety. Recent work has been done to create the necessary theoretical groundwork and empirical valuation of injury costs under the "willingness to pay" or comprehensive cost concept. Estimates in the following section are based on the comprehensive cost concept and should be used for cost benefit analyses wherever feasible.

Comprehensive costs of motor-vehicle accidents. In addition to the economic cost components listed above, the following comprehensive cost estimates also include a measure of the value of lost quality of life which was obtained through empirical studies of what people actually pay to reduce their safety and health risks. In 1993 the average comprehensive costs on a per person basis were:

Appendix 4.B.3.d

1994 ECONOMIC LOSS

154[1]	Deaths	@	900,000[2]	=	138,600,000
1902[2]	Incapacitating injury	@	49,000[2]	=	93,198,000
3110[3]	Non-Incapacitating evident injury	@	15,000[2]	=	46,650,000
3528[3]	Possible Injury	@	9,300[2]	=	32,810,400
Property damage amount from PDO Audits				=	35,433,900
Economic Loss				=	346,692,300

Sources:

1. "South Dakota Yearly Comparison of Motor Vehicle Traffic Fatalities, Injuries, Accidents, Miles Traveled, and Registered Motor Vehicles" table supplied by South Dakota Department of Transportation, Division of Planning - Accident Records. Appendix 4.B.3.b.

2. "Estimating the Cost of Unintentional Injuries, 1993," National Safety Council. Appendix 4.B.3.c.

3. Breakdown of injuries supplied by the South Dakota Department of Transportation, Division of Planning - Accident Records. Total number of injuries (1902+3110+3528=8540) listed in "South Dakota Yearly Comparison of Motor Vehicle Traffic Fatalities, Injuries, Accidents, Miles Traveled, and Registered Motor Vehicles" table supplied by South Dakota Department of Transportation, Division of Planning - Accident Records. Appendix 4.B.3.b.

APPENDIX 4.C

SPEED CYCLE CHANGE CHARTS

1. Excess Coat of Speed Change Cycles above Cost of Continuing at Initial Speed for Passenger Cars.

2. Excess Coat of Speed Change Cycles above Cost of Continuing at Initial Speed for Trucks.

3. Consumer Price Index

Appendix 4.C.1

EXCESS COST OF SPEED CHANGE CYCLES
ABOVE COST OF CONTINUING AT INITIAL SPEED FOR PASSENGER CARS
(Dollars per 1,000 Cycles)

Initial Speed (MPH)	*SPEED REDUCED TO AND RETURNED FROM (MPH)*															
	STOP	*5*	*10*	*15*	*20*	*25*	*30*	*35*	*40*	*45*	*50*	*55*	*60*	*65*	*70*	*75*
5	$2.44															
10	$7.47	$3.44														
15	$14.99	$8.73	$4.15													
20	$22.76	$15.32	$9.26	$3.91												
25	$33.08	$23.84	$16.35	$9.58	$5.00											
30	$42.63	$32.46	$24.08	$16.81	$10.82	$5.67										
35	$52.19	$41.34	$32.02	$24.23	$17.46	$11.35	$5.09									
40	$61.74	$50.77	$41.01	$32.34	$24.61	$17.79	$10.94	$5.59								
45	$71.30	$60.63	$50.74	$41.72	$32.90	$24.87	$17.38	$11.38	$5.62							
50	$80.85	$70.68	$60.65	$51.19	$41.16	$32.60	$24.26	$17.29	$11.11	$5.64						
55	$90.41	$80.41	$70.21	$60.53	$50.57	$41.10	$31.84	$23.76	$16.70	$10.55	$5.23					
60	$100.08	$90.17	$80.00	$69.77	$59.59	$49.57	$39.87	$30.78	$22.70	$15.91	$10.08	$5.06				
65	$110.10	$100.46	$90.55	$79.53	$68.68	$58.33	$48.19	$38.37	$29.75	$22.34	$15.99	$10.41	$5.76			
70	$120.25	$110.66	$100.67	$89.41	$77.67	$67.30	$56.54	$46.39	$37.66	$29.64	$22.64	$16.20	$10.88	$5.85		
75	$131.92	$122.19	$112.10	$100.20	$87.76	$76.59	$65.71	$54.92	$45.66	$36.93	$29.46	$22.37	$16.20	$10.64	$5.97	
80	$144.30	$134.51	$124.22	$111.04	$98.25	$86.20	$75.21	$63.77	$53.74	$44.19	$36.57	$28.61	$21.93	$15.98	$10.61	$6.03

Table updated and reproduced from the AASHTO publication, "A MANUAL ON USER BENEFIT ANALYSIS OF HIGHWAY AND BUS-TRANSIT IMPROVEMENTS 1977".

Updated with CPI (Base Year 1967) = 459.0 September 1995

EXCESS COST OF SPEED CHANGE CYCLES ABOVE COST OF CONTINUING AT INITIAL SPEED FOR TRUCKS (Dollars per 1,000 Cycles)

Initial Speed (MPH)	SPEED REDUCED TO AND RETURNED FROM (MPH)											
	STOP	5	10	15	20	25	30	35	40	45	50	55
5	$9.97											
10	$19.26	$10.14										
15	$34.16	$21.73	$12.94									
20	$51.54	$37.84	$25.37	$14.91								
25	$77.91	$60.21	$45.54	$30.02	$15.52							
30	$102.37	$82.76	$66.00	$48.72	$31.43	$18.38						
35	$129.01	$106.22	$86.79	$69.12	$49.48	$33.78	$18.55					
40	$142.50	$124.51	$107.22	$88.35	$68.77	$51.45	$33.25	$17.90				
45	$165.29	$145.77	$127.30	$109.02	$88.05	$69.83	$49.13	$35.10	$19.85			
50	$181.87	$163.61	$146.35	$127.71	$107.96	$89.08	$70.32	$52.66	$36.34	$18.52		
55	$195.45	$177.84	$160.61	$143.62	$123.98	$104.58	$85.73	$67.77	$51.51	$32.72	$17.35	
60	$209.65	$191.84	$174.67	$157.03	$141.91	$119.57	$101.37	$84.41	$67.50	$48.57	$30.93	$17.76

Table updated and reproduced from the AASHTO publication,
"A MANUAL ON USER BENEFIT ANALYSIS OF HIGHWAY AND BUS-TRANSIT IMPROVEMENTS 1977".

Updated with CPI (Base Year 1967) = 459.0 September 1995

Appendix 4.C.3

U.S. DEPARTMENT OF LABOR, BURHAU OF LABOR STATISTICS
Philadelphia Regional Office, P.O. Box 13309, Philadelphia, PA 19101-3309
Information Staff (215) 596-1154/ Fax (215) 596-4263/ FAXSTAT (215) 596-4160

FAXSTAT CODE 9160

CONSUMER PRICE INDEX
U.S. City Average ALL ITEMS 1967=100 ALL URBAN CONSUM SERIES=CUUR0000AA0

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1982	282.5	283.4	283.1	284.3	287.1	290.6	292.2	292.8	293.3	294.1	293.6	292.4
1983	293.1	293.2	293.4	295.5	297.1	298.1	299.3	300.3	301.8	302.6	303.1	303.5
1984	305.2	306.6	307.3	308.6	309.7	310.7	311.7	313.0	314.5	315.3	315.3	315.5
1985	316.1	317.4	318.8	320.1	321.3	322.3	322.8	323.5	324.5	325.5	326.6	327.4
1986	328.4	327.5	326.0	325.3	326.3	327.9	328.0	328.6	330.2	330.5	330.8	331.1
1987	333.1	334.4	335.9	337.7	338.7	340.1	340.8	342.7	344.4	345.3	345.8	345.7
1988	346.7	347.4	349.0	350.8	352.0	353.5	354.9	356.6	358.9	360.1	360.5	360.9
1989	362.7	364.1	366.2	368.8	370.0	371.7	372.7	373.1	374.6	376.2	377.0	377.6
1990	381.5	383.3	385.5	386.2	386.9	389.1	390.7	394.1	397.5	400.0	400.7	400.9
1991	403.1	403.8	404.3	405.1	406.3	407.3	408.0	409.2	411.1	411.5	412.7	413.0
1992	413.8	415.2	417.2	417.9	418.6	419.9	420.8	422.0	423.2	424.7	425.3	425.2
1993	427.0	428.7	430.1	431.2	432.0	432.4	432.6	433.9	434.7	436.4	436.9	436.8
1994	437.8	439.3	441.1	441.4	441.9	443.3	444.4	446.4	447.5	448.0	448.6	448.4
1995	450.3	452.0	453.5	455.0	455.8	456.7	457.0	458.0	459.0			

PERCENT CHANGE FROM PREVIOUS MONTH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1982	0.4	0.3	-0.1	0.4	1.0	1.2	0.6	0.2	0.2	0.3	-0.2	-0.4
1983	0.2	0.0	0.1	0.7	0.5	0.3	0.4	0.3	0.5	0.3	0.2	0.1
1984	0.6	0.5	0.2	0.5	0.3	0.3	0.3	0.4	0.5	0.3	0.0	0.1
1985	0.2	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.3	0.3	0.3	0.2
1986	0.3	-0.3	-0.5	-0.2	0.3	0.5	0.0	0.2	0.5	0.1	0.1	0.1
1987	0.6	0.4	0.4	0.5	0.3	0.4	0.2	0.6	0.5	0.3	0.1	-0.0
1988	0.3	0.2	0.5	0.5	0.3	0.4	0.4	0.5	0.6	0.3	0.1	0.1
1989	0.5	0.4	0.6	0.7	0.5	0.2	0.3	0.1	0.4	0.4	0.2	0.2
1990	1.0	0.5	0.6	0.2	0.2	0.6	0.4	0.9	0.9	0.6	0.2	0.0
1991	0.5	0.2	0.1	0.2	0.3	0.2	0.2	0.3	0.5	0.1	0.3	0.1
1992	0.2	0.3	0.5	0.2	0.2	0.3	0.2	0.3	0.3	0.4	0.1	-0.0
1993	0.4	0.4	0.3	0.3	0.2	0.1	0.0	0.3	0.2	0.4	0.1	-0.0
1994	0.2	0.3	0.4	0.1	0.1	0.3	0.2	0.5	0.2	0.1	0.1	-0.0
1995	0.4	0.4	0.3	0.3	0.2	0.2	0.1	0.2	0.2			

PERCENT CHANGE FROM 12 MONTHS AGO

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1982	8.4	7.7	6.8	6.6	6.7	7.1	6.5	5.9	5.0	5.1	4.6	3.9
1983	3.8	3.5	3.6	3.9	3.5	2.6	2.4	2.6	2.9	2.9	3.2	3.8
1984	4.1	4.6	4.7	4.5	4.2	4.2	4.1	4.2	4.2	4.2	4.0	4.0
1985	3.6	3.5	3.7	3.7	3.7	3.7	3.6	3.4	3.2	3.2	3.6	3.8
1986	3.9	3.2	2.3	1.6	1.6	1.7	1.6	1.6	1.8	1.5	1.3	1.1
1987	1.4	2.1	3.0	3.8	3.8	3.7	3.9	4.3	4.3	4.5	4.5	4.4
1988	4.1	3.9	3.9	3.9	3.9	3.9	4.1	4.1	4.2	4.3	4.3	4.4
1989	4.6	4.8	4.9	5.1	5.3	5.1	5.0	4.6	4.4	4.5	4.6	4.6
1990	5.2	5.3	5.3	4.7	4.3	4.7	4.8	5.6	6.1	6.3	6.3	6.2
1991	5.7	5.3	4.9	4.9	5.0	4.7	4.4	3.8	3.4	2.9	3.0	3.0
1992	2.7	2.8	3.2	3.2	3.0	3.1	3.1	3.1	2.9	3.2	3.1	3.0
1993	3.2	3.3	3.1	3.2	3.2	3.0	2.8	2.8	2.7	2.8	2.7	2.7
1994	2.5	2.6	2.6	2.4	2.3	2.5	2.7	2.9	2.9	2.7	2.7	2.7
1995	2.9	2.9	2.8	3.1	3.1	3.0	2.8	2.6	2.6			

APPENDIX 5

INCENTIVE/DISINCENTIVE GUIDELINE

INCENTIVE/DISINCENTIVE GUIDELINE

This policy provides guidelines when Incentive/Disincentive (I/D) clauses for Contract Time are being considered for use. The guidelines are organized into seven sections:

A. Background
B. Project Selection Criteria
C. Information Required from Area Engineers
D. Determination of Road User Costs
E. Determination of Construction Engineering Daily Cost
F. Determination of I/D rate
G. Contracting Procedures

A. Background

An I/D contract provision compensates the contractor a specified amount of money for each day that identified critical work is completed ahead of the specified I/D date and assesses a deduction for each day that the contractor fails to complete identified critical work by the specified I/D date.

An I/D contract provision can be used on a calendar day basis, completion date basis, or in a calendar or workday window during the construction season. The I/D time is the period needed to complete the critical work on the roadway or structure. The I/D time begins when traffic is critically impacted by the project and normally ends when unrestricted traffic is permitted on the identified roadway or structure. The I/D time and contract time may be the same in situations where the traffic impact exists for the full duration of the project, or different in situations where the traffic impact exists for a phase or certain phases of the work.

To be effective in accomplishing the objectives of I/D provisions, the I/D amount must be sufficient to encourage the Contractor to use innovative ideas to meet tight schedules. If the incentive payment is not sufficient to cover the Contractor's extra costs and reasonable profit, then there is no incentive to accelerate production and the I/D provisions will not produce the intended results. To ensure these objectives are met, the Department must determine if the benefit to the public and the Department is greater than the Contractor's extra costs.

B. Project Selection Criteria

If the Area Engineer determines that a phase of the project or the project as a whole has the following characteristics, it may be a candidate for an I/D project.

1. The project causes significant impacts to traffic flow resulting in a road user cost estimate in excess of $1500.00 per day or in excess of the liquidated damages for the project. These impacts could include:

    - lane closures or lane restrictions on interstates, or on high volume or principal arterials,
    - disruption to two-way traffic for extended periods,
    - roadway or bridge closures with long off-site detours causing delays in excess of 10 minutes,
    - reconstruction of signalized intersections, or
    - special events or other circumstances.

2. The project impacts on public, pedestrian, or worker safety,

3. The project impairs emergency services, or

4. The project severely impacts local businesses or a local community.

If a project has other complications, an I/D provision may not be beneficial for the project; for example:

- the right-of-way is not clear,
- utility work by an entity other than the Contractor or work on other projects interferes with the I/D phase(s) of the work,
- uncertainties in the design cannot be resolved prior to construction, or
- shortages of manpower or materials impact the work.

If the project fits any of the listed criteria and potential problems can be resolved, then the Area Engineer must provide information to the Region Engineer and the Division of Planning for further assessment of the use of an I/D project provision.

C. Information Required from Area Engineers

With each project submitted as an I/D candidate, the Area Engineers should submit the following information.

1. Provide accurate description of the work subject to the I/D provision, along with clearly defined critical start and completion dates.

2. Provide information and feedback from local officials, utilities, police, affected business owners, local traffic engineers, and construction engineers obtained from public hearings and meetings during the early phases of project development.

3. Provide information needed to calculate road user costs such as:

   - traffic counts for trucks and autos during construction,
   - local accident rates, and
   - preliminary traffic control plans.

4. Provide an estimate of the I/D time using a CPM construction schedule meeting the following requirements.

   a. The CPM schedule should be based on the performance of the most time-efficient contractor working extended shifts or with extra workers.

   b. Include information with the schedule showing the basis for the activity durations in the schedule. This information should include the quantities of critical work items and the production rates for the stated quantities. The production rates should be taken from the past performance of contract work performed under similar circumstances as the planned project. For more complex projects, consult with Contractors to determine the reasonableness of production rates.

   c. Allow for weather, submittal review time, or any special work restrictions in the schedule. Include an explanation for extraordinary production rates or innovative construction methods assumed in the development of the schedule.

5. Supply any meeting minutes from pre-design field reviews. These reviews are essential since "as-built" plans or old construction plans may not be reliable due to maintenance operations or field changes not being recorded on the plans.

D. Determination of Road User Costs

The Region will provide the Division of Planning with the information outlined in paragraph C.3. of this guideline to allow the Division of Planning to determine the estimated road user costs (RUC). The Division of Planning will use the Department worksheet in calculating the road user cost. The Division of Planning will provide a copy of this report to the appropriate Region Engineer.

Note: The Department's worksheet for RUC should be revised to include additional costs due to accidents, the number of occupants in autos, and energy costs from speed changes in the construction zone as recommended in TCS's report.

E. Determination of Construction Engineering Daily Cost

The Region may include the construction engineering (CE) daily cost in the I/D daily rate. Since CE costs are also included in liquidated damages assessed for late completion, the region must ensure that this cost component is not duplicated when the disincentive and the liquidated damages are assessed for the same period.

If the I/D time represents a portion of the project, determine the CE daily cost by one of the following methods:

1. Calculate the percentage of the total Contract amount that represents the value at the I/D portion of the work. Multiply this percentage by the appropriate liquidated damage rate for the full value of the project from Subsection 8.7 of the Standard Specifications.

2. Compute the estimated construction engineering needs for the work included in the I/D portion of the work on a daily basis. This cost should include the anticipated salary, overhead, and equipment costs related to CE.

3. Determine the historic CE percent (%) for a project of this type and multiply by the value of the I/D portion of the work. Divide this cost by the estimated number of days to complete the I/D portion of the work.

Document and include the daily CE cost determined from one of these methods in the proposal to use an I/D clause for the project.

F. Determination of I/D Rate

For I/D provisions to be cost effective, the benefit, as defined below, must be greater than the Contractor's costs to accelerate.

Benefit	>	Cost
Daily RUC + construction engineering daily costs	>	Contractor's daily acceleration cost + profit

Estimate the Contractor's extra daily costs to accelerate the project and earn an incentive. Develop accelerated daily production rates based on the available manpower and resources in the region, and the physical limitations of the project. Use the CPM schedule to determine the manner in which the project may be accelerated. Based on the resources required to achieve the accelerated production rates, estimate the Contractor's daily costs to accelerate. If these extra costs do not

exceed the daily RUC determined by the Division of Planning and the Department's construction engineering daily costs for the critical I/D period, an I/D provision will be cost effective for the project.

The I/D daily rate typically equals the daily RUC plus the CE daily costs. If the benefit amount is much greater than the Contractor's extra cost, the I/D should be adjusted downward to more closely approximate the Contractors daily costs.

If the Contractor's costs exceed the benefit amount, an I/D provision is not cost effective based on RUC. The Department, however, may still decide to use I/D provisions, based on criteria such as public safety, impairment of services, or impacts to the local community. These factors are more difficult to quantify in terms of cost.

Generally, the incentive daily rate should equal the disincentive daily rate. If different rates are selected due to differences in the applicable cost components, the incentive daily rate should not exceed the disincentive daily rate. For example, a higher disincentive rate may be justified if an I/D project is scheduled to be completed before the start of the peak holiday travel season or the start of a special event causing higher traffic volumes.

Unless approved by the Secretary of Transportation, the total incentive payment shall be capped at a maximum amount not to exceed 5% of the total Contract. No cap should be placed on the disincentive amount.

G. Contracting Procedures

The use of I/D provisions to expedite the completion of critical work places an increased risk on the Contractor and the Department. The following guidelines concerning the contract documents will reduce the Department's and the Contractor's risk in using I/D provisions.

1. The plans and specifications must be complete, accurate, and without conflicts to permit a common and clear understanding of what is to be constructed. If utility work must be performed along with the critical I/D work, carefully review and coordinate the utility plans with the related construction plans to avoid conflicts. If the I/D project is to be coordinated with adjacent work on other projects, carefully review the plans and schedule for the adjacent work to avoid conflicts with the I/D work.

2. The plans and specifications should indicate any unusual condition or any restriction under which the Contractor may be required to work. For example, prohibiting work during peak traffic hours and weekends, or prohibiting jack hammering or pile driving during the night would limit the Contractor's options in scheduling the work. The Contractor must be aware of such limitations prior to bid.

3. The I/D provision must clearly define the I/D amount, the I/D work items, and the basis for I/D time. The contract time associated with the I/D provision may be based on calendar days, working days, or a specific completion date. To provide more flexibility for contractors to manage resources, the Department may specify the I/D work to be performed within a discrete window or number of consecutive days during the construction season, provided the Contractor gives the Department sufficient notice to arrange for inspection. This window approach, based on working days or calendar days, should be used for relatively uncomplicated projects with short durations.

4. The bid advertisement must include a pre-bid meeting to review and explain the I/D phase(s) and any unusual features of the project.

5. The Contractor should be required to submit a CPM schedule for review and approval prior to commencement of work. The Contractor should also be required to update the schedule at the minimum on a monthly basis. This schedule will be the basic document to gauge and analyze the Contractor's progress, determine time adjustments, and evaluate claims. Regularly scheduled job site progress meetings should be held for the purpose of reviewing the updated the CPM schedule.

6. Cooperation and coordination between the Contractor and SD DOT is essential. Partnering is strongly recommended. The delay in approval of a field change or working drawings by the Department can be costly. Decision making and approval authority should be promptly provided at all times that I/D work is in progress. If nighttime or weekend work is allowed, all offices that have decision making and approval authority should designate a contact person with authority to make decisions for the agency represented.

7. Time limits for certain actions should be specified in the Contract and incorporated into the schedule. For example, allow seven days for review and approval of shop drawings. The use of contractual time limits for both parties for submittal activities and other administrative issues will allow the contractor to develop a realistic schedule and force both parties to follow the schedule to achieve the I/D date.

8. Extensions of time for an I/D date should not be granted unless extraordinary circumstances occur. The Department should consider all alternatives, including additional Contractor and CE costs, to keep the project on schedule. If changes occur, the Department should not base time extensions for changes on a percentage of the contract amount. The Contractor must justify I/D time adjustments based on major work items affecting the critical path in the current updated CPM construction schedule.

9. When determining delays caused by adverse weather on a calendar day or calendar date contract, both the Contractor and the Department should use the Department's Working Day Chart. The chart provides the number of working days in each month that have been historically available for Construction Contracts. Weather related delays would be considered only when the number of actual working days experienced on the project were limited by weather to less than those identified in the chart. The use of this chart by both the Department and the Contractor will reduce the risk of weather delays for both parties.

Note: The use of a working day chart is one of the recommendations noted in TCS's report. TCS recognizes that SD DOT does not currently use a working day chart. TCS has included an example of a working day chart in our report to aid SD DOT in developing its own chart.

APPENDIX 6

A + B BIDDING GUIDELINE

A + B BIDDING GUIDELINES

This policy provides guidelines when A + B bidding provisions are being considered for use. The guidelines are organized into six sections.

A. Background
B. Project Selection Criteria
C. Information Required from Area Engineers
D. Determination of Road User Costs
E. Daily User Costs
F. Contracting Procedures

A. Background

The A+B bidding method, also referred to as cost-plus-time bidding, requires contractors to bid a contract amount, which is defined as the sum bid for the Contract's work items and the number of days specified by the Contractor to complete the work. The contract amount is the "A" portion of the bid. The number of days specified by the Contractor in its bid multiplied by the daily user cost provided by the Department is the "B" portion of the bid. The successful bid is then determined as the lowest combination of "A" plus "B". The Department specifies the maximum time allowed for the work. Bids which specify time longer than the maximum time for the work are declared non-responsive. The sum of "A" plus "B" is used only to determine the successful bid. The Contract is awarded in the amount bid for the Contract work items, which is the "A" portion of the bid. The time bid by the Contractor, used to determine the "B" portion of the bid, becomes the B duration defined in the Contract.

This approach requires contractors to review the contract and prepare efficient schedules prior to bidding. The A+B bidding approach is intended to shorten construction time through competitive bidding. This bidding approach differs from an I/D provision in that the Contractor has the risk to determine the optimal combination of cost and time.

This guideline has been developed to implement A+B bidding with or without incentive/disincentive (I/D) provisions. These approaches are outlined in the following two paragraphs.

For A+B bidding without I/Ds, a daily user cost is developed from road user costs (RUC) and construction engineering (CE) costs. This amount is the cost basis of the "B" portion of the bid and becomes the liquidated damages (LD) should the contractor fail to complete the project within the time stated in its bid. The time element bid by the Contractor is generally the entire contract period, but may also be defined as the time required for a critical portion of the work. For contracts where the time bid is for only a portion of the work, a daily user cost may be assessed as a disincentive for failure to complete the B duration of the project based on RUC and the portion of daily CE costs

associated with the B duration of the project. If a disincentive is used, the Department must provide a mechanism to ensure that disincentive costs are not duplicated in LD when both are assessed at the same time.

The A+B bidding approach can also be used in conjunction with an I/D clause to motivate the Contractor to further shorten the contract time. If an A+B bidding approach is being considered for use in conjunction with an I/D provision, review the I/D guideline in conjunction with this guideline and satisfy the additional requirements related to scheduling and the assessment of the cost versus the benefit of using I/D provisions.

B. Project Selection Criteria

If a phase of the project or the project as a whole has the following characteristics it may be a candidate for A+B bidding.

1. The project causes impacts to traffic flow resulting in a road user cost estimate in excess of $1500.00 per day or in excess of the liquidated damages for the project. These impacts could include:

    - lane closures or lane restrictions on interstates, or on high volume or principal arterials,
    - disruption to two-way traffic for extended periods,
    - roadway or bridge closures with long off-site detours causing delay in excess of 10 minutes.,
    - reconstruction of signalized intersections,
    - special events or other circumstances.

2. The project impacts public, pedestrian, or worker safety.

3. The project impairs emergency services.

4. The project severely impacts local businesses or the local community.

If a project has other complications, A+B bidding may not be beneficial for the project; for example:

- the right-of-way is not clear,
- utility work by an entity other than the Contractor or work on other projects interferes with the B portion of the work,
- uncertainties in the design cannot be resolved prior to construction, or
- shortages of manpower or materials impact the project.

If the project fits any of the listed criteria, and potential problems can be resolved prior to construction, then the Area Engineer must provide information to the Region Engineer and the Division of Planning for further development of A+B bidding provisions.

C. Information Required from Area Engineers

For each project submitted for A+B bidding, the Area Engineers should submit the following information to the Region.

1. Provide an accurate description of the work associated with the project along with clearly defined critical start and completion dates for the B duration. The B duration may be the entire project or a critical portion of the project.

2. Provide information and feedback from local officials, utilities, police, affected business owners, local traffic engineers, and construction engineers obtained from public hearings and meetings during the early phases of project development.

3. Provide information needed to calculate road user costs including:

   - traffic counts for trucks and autos during construction,
   - local accident rates, and
   - preliminary traffic control plans.

4. Develop and submit a construction schedule for the project to establish the maximum number of days in the contract for the B duration of the work. Ensure the schedule meets the following requirements.

   a. Base the schedule on the performance of the most time-efficient contractor. The B duration may be based on calendar days, a completion date, or the maximum number of calendar days or working days allowed in a window period during the construction season.

   b. Include information with the schedule showing the basis for the activity durations in the schedule. This information should include the quantities of critical work items and the production rates for the stated quantities. The production rates should be taken from the past performance of contract work performed under similar circumstances as the planned project. For more complex projects, consult with Contractors to determine the reasonableness of production rates.

   c. Allow for weather delays, submittal review time, or any special work restrictions in the schedule. Include an explanation for extraordinary production rates or innovative construction methods assumed in the development of the schedule.

5. Supply any meeting minutes from pre-design field reviews. These reviews are essential since "as built" plans or old construction plans may not be reliable due to maintenance operations or field changes not being recorded on the plans.

D. Determination of Road User Costs

The Region will provide the Division of Planning with the information outlined in paragraph C.3 of this guideline to allow the Division of Planning to determine the estimated road user costs (RUC). The Division of Planning will use the Department worksheet in calculating the RUC. The Division of Planning will provide a copy of this RUC report to the appropriate Region Engineer.

Note: The Department's worksheet for RUC should be revised to include additional costs due to accidents, the number of occupants in autos, and energy costs from speed changes in the construction zone as recommended in TCS's report.

E. Daily User Costs

The daily user cost used to calculate the "B" component of the bid consists of RUC and the Department's construction engineering (CE) daily cost. If the B duration is for a critical portion of the project, the daily user cost may be assessed as a disincentive for late completion of the B duration of the project. Since CE costs are also included in LD assessed for late completion of the entire project, the Region must ensure that CE costs are not duplicated when the disincentive and the LD are assessed for the same time period.

Determine the CE cost for the B duration by one of the following methods:

1. Calculate the percentage of the total contract amount that represents the value of the B duration of the work. Multiply this percentage times the appropriate liquidated damage rate for the project from Subsection 8.7 of the Standard Specifications.

2. Compute the estimated daily construction engineering needs for the work included in the B duration of the project. This cost should include the anticipated salary, overhead, and equipment costs.

3. Determine the historic CE percent (%) for a project of this type and multiply by the value of the B duration of the work. Divide this cost by the estimated number of days to complete the B duration of the work to determine the average daily CE cost.

Document and include the daily CE cost determined from one of these methods in the proposal to use A+B bidding for the project.

F. Contracting Procedures

The use of A+B bidding provisions to expedite the completion of critical work places an increased risk on the Contractor and the Department. The following guidelines concerning the contract documents will reduce the Department's and the Contractor's risk in using A+B bidding.

1. The plans and specifications must be complete, accurate, and without conflicts to permit a common and clear understanding of what is to be constructed. If utility work must be performed along with the critical work during the B duration of the project, carefully review and coordinate the utility plans with the related construction plans to avoid conflicts. If an A+B project is to be coordinated with adjacent work on other projects, carefully review the plans and schedule for the adjacent work to avoid conflicts with the B duration work.

2. The plans and specifications should indicate any unusual condition or any restriction under which the Contractor may be required to work. For example, prohibiting work during peak traffic hours and weekends, or prohibiting jack hammering or pile driving during the night would limit the Contractor's options in scheduling the work. The Contractor must be aware of such limitations prior to bid.

3. The A+B bidding provision must clearly define the A and B amounts, the work encompassed by the B duration of the project, and the basis for the B duration. The contract time associated with A+B bidding may be based on calendar days, working days, or a specific completion date. To provide more flexibility for contractors to manage resources, the Department may specify that the B duration of the work be performed within a discrete window or number of consecutive days during the construction season, provided the Contractor gives the Department sufficient notice to arrange for inspection. This window approach, based on working day or calendar days, should be used for relatively uncomplicated projects with short durations.

4. The bid advertisement must include a pre-bid meeting to review and explain the A+B bidding provision and any unusual features of the project.

5. The Contractor should be required to submit a CPM schedule for review and approval prior to commencement of work. The Contractor should also be required to update the schedule at the minimum on a monthly basis. This schedule will be the basic document to gauge and analyze the Contractor's progress, determine time adjustments, and evaluate claims. Regularly scheduled job site progress meetings should be held for the purpose of updating the CPM schedule.

6. Cooperation and coordination between the Contractor and SD DOT is essential. Partnering is strongly recommended. The delay in approval of a field change or working drawings by the Department can be costly. Decision making and approval authority should be promptly

provided at all times that the crtical B duration of the work is in progress. If nighttime or weekend work is allowed, all offices that have decision making and approval authority should designate a contact person with authority to make decisions for the agency represented.

7. Time limits for certain actions should be specified in the Contract and incorporated into the schedule. For example, allow seven days for review and approval of shop drawings. The use of contractual time limits for both parties for submittal activities and other administrative issues would allow the contractor to develop a realistic schedule and force both parties to follow the schedule so as to not delay the B date.

8. Extensions of time for the B date should not be granted unless extraordinary circumstances occur. The Department should consider all alternatives, including additional Contractor and CE costs, to keep the project on schedule. If changes occur, the Department should not base time extensions for changes on a percentage of the contract amount. The Contractor must justify time adjustments to the B date based on delays to major work items affecting the critical path in the currently updated CPM construction schedule.

9. When determining delays caused by adverse weather on a calendar day or calendar date contract, both the Contractor and the Department should use the Department's Working Day Chart. The chart provides the number of working days in each month that have been historically available for Construction Contracts. Weather related delays would be considered only when the number of actual working days experienced on the project were less than those identified in the chart. The use of this chart by both the Department and the Contractor would reduce the risk of weather delays for both parties.

Note: The use of a working day chart is one of the recommendations noted in TCS's report. TCS recognizes that SD DOT does not currently use a working day chart. We have included an example of a working day chart in our report to aid SD DOT in developing its own chart.

APPENDIX 7

LANE RENTAL GUIDELINE

LANE RENTAL GUIDELINES

This policy provides guidelines when Lane Rental clauses are being considered for use. The guidelines are organized into these six sections:

A. Background
B. Project Selection Criteria
C. Information Required from Area Engineers
D. Determination of Road User Costs
E. Lane Rental Fees
F. Contracting Procedures

A. Background

Lane rental consists of charging the Contractor a daily or hourly rental fee for restrictions or a reduction in the number of available travel lanes or shoulder width.

To minimize the probability of unbalanced bidding, the Department should provide a pay item for lane rental. This lane rental pay item may be based on daily or hourly lane rental as follows:

Item ___, Payments and Assessments For Lane Rental - Daily Basis and
Item ___, Payments and Assessments For Lane Rental - Hourly Basis

The lane rental bid item is calculated by the Contractor as the total amount of time in days or hours that a lane, a shoulder, or a combination of lanes and shoulders are planned to be taken out of service, multiplied by the daily or hourly rental fees provided by the Department. If a daily lane rental bid item is used, the Department should provide a daily rental fee for a lane, a shoulder, or combinations of lanes or shoulders. If traffic volumes significantly vary between peak hours and off-peak hours or the lane closures are of short duration, the Department may choose to use hourly rental fees. These hourly fees will be greater for peak hours and less for off-peak hours. The hourly fees will also vary for a lane, a shoulder, or a combination of lanes and shoulders.

Providing a bid item for lane rental eliminates the necessity for the Contractor to spread the cost of lane rental fees over other items of work. To avoid negative cash flow to the Contractor, the Department does not collect a daily rental fee. Instead, the Department keeps a tally of rental charges and each month deducts these rental charges from the lump sum lane rental bid item. This process continues until the project is complete or the cumulative rental charges exceed the bid item. The Department assesses rental charges only after the Contractor's cumulative rental fees exceed the total lump sum bid for lane rental.

Alternatively, the Lane Rental Provision could result in the Contractor collecting unused lane rental fees if the cumulative rental charges at the completion of lane rental work are less than the lump sum bid for lane rental. This provides an incentive to do the work more quickly than bid or minimize the time that portions of the roadway are out of service.

To reduce the amount of the bond for projects with lane rental provisions, the lane rental bid item is not included in the bonded amount. Similarly, to free up more funds for other projects, the Department may allocate a percentage of the lane rental bid item to the project budget to cover the potential payment of rental fees to the Contractor as an incentive.

B. Project Selection Criteria

The lane rental provisions are intended to minimize traffic delays for critical projects or phases of projects which have high impacts on traffic flow. The project may be a candidate for lane rental provisions if a phase of the project or the project as a whole causes significant impacts to traffic flow resulting in a road user cost estimate in excess of $1500.00 per day or in excess of the liquidated damages for this project. These impacts could include:

- lane and shoulder closures or restrictions on interstates, or on high volume or principal arterials,
- disruption to two-way traffic for extended periods,
- roadway or bridge closures, or
- reconstruction of signalized intersections.

If a project has other complications, a lane rental provision may not be beneficial for the project; for example:

- the right-of-way is not clear,
- utility work by an entity other than the Contractor or work on other projects interferes with the lane rental phase(s) of the work,
- uncertainties in the design cannot be resolved prior to construction, or
- shortages of manpower or materials impact the work.

If the project fits any of the listed criteria, and the potential problems can be resolved, then the Area Engineer must provide information to the Region Engineer and the Division of Planning for further assessment of a lane rental provision.

C. Information Required from Area Engineers

For each project submitted for lane rental, the Area Engineers should include the following information:

1. Provide an accurate description of the work subject to lane rental along with clearly defined time frames for the work associated with lane rental. The lane rental time frames may be the entire project or a critical portion or portions of the project.

2. Provide information and feedback from local officials, utilities, police, affected business owners, local traffic engineers, and construction engineers obtained from public hearings and meetings during the early phases of project development.

3. Supply information needed to calculate road user costs such as:

   - daily or hourly traffic counts for trucks and autos during construction,
   - local accident rates, and
   - preliminary traffic control plans.

4. Develop and submit a construction schedule for the entire project which establishes the Contract Completion Date meeting the following requirements.

   a. The schedule should be based on the performance of the most time-efficient contractor.

   b. Include information with the schedule showing the basis for the activity durations in the schedule. This information should include the quantities of critical work items and the production rates for the stated quantities. The production rates should be taken from the past performance of contract work performed under similar circumstances as the planned project. For more complex projects, consult with Contractors to determine the reasonableness of production rates.

   c. Allow for weather delays, submittal review time, or any special work restrictions in the schedule. Include an explanation for extraordinary production rates or innovative construction methods assumed in the development of the schedule.

5. Supply any meeting minutes from pre-design field reviews. These reviews are essential since "as built" plans or old construction plans may not be reliable due to maintenance operations or field changes not being recorded on the plans.

D. Determination of Road User Costs

The Region will provide the Division of Planning with the information outlined in paragraph C.3 of this guideline to allow the Division of Planning to determine the estimated road user costs (RUC). The Division of Planning will use the Department worksheet to calculate the RUC for taking a lane, a shoulder, or combinations of lanes and shoulders out of service. The Division of Planning may also calculate hourly RUC for peak and off-peak hours of the day. The Division of Planning will provide a copy of this RUC report to the appropriate Region Engineer.

Note: The Department's worksheet for RUC should be revised to include additional costs due to accidents, the number of occupants in autos, and energy costs from speed changes in the construction zone as recommended in TCS's report.

E. Lane Rental Fees

The daily or hourly lane rental fees are based on RUC and the Department's construction engineering (CE) costs. Since CE costs are also included in liquidated damages assessed for late completion, the region must ensure that CE costs are not duplicated when lane rental charges and liquidated damages are to be assessed for the same period. Determine the CE cost for lane rental periods by one of the following methods:

1. Calculate the percentage of the total Contract amount that represents the value of the work subject to lane rental. Multiply this percentage times the appropriate liquidated damage rate for the full value of the project from Subsection 8.7 of the Standard Specifications to obtain a daily CE rate. To obtain an hourly rate, divide the daily rate by the average number of hours subject to lane rental per day.

2. Compute the daily or hourly estimated construction engineering needs for the work subject to lane rental. This cost should include the anticipated salary, overhead, and equipment costs.

3. Determine the historic CE percent (%) for a project of this type multiplied by the value of the work subject to lane rental. Divide this cost by the estimated number of days or hours to complete the lane rental portion(s) of the work to determine the CE cost.

Document and include the daily CE cost determined from one of these methods in the proposal to use lane rental for the project.

F. Contracting Procedures

The use of lane rental provisions to minimize the time of critical lane closures or lane restrictions places increased risk on the Contractor and the Department. The following guidelines concerning the contract documents reduce the Department's and the Contractor's risk in using lane rental.

1. The plans and specifications must be complete, accurate, and without conflicts to permit a common and clear understanding of what is to be constructed. If utility work must be performed along with the critical work during the lane rental portion of the project, carefully review and coordinate the utility plans with the related construction plans to avoid conflicts. If a lane rental project is to be coordinated with adjacent work on other projects, carefully review the plans and schedule for the adjacent work to avoid conflicts with the lane rental duration work.

2. The plans and specifications should indicate any unusual condition or any restriction under which the Contractor may be required to work. For example, prohibiting work during peak traffic hours and weekends, or prohibiting jack hammering or pile driving during the night would limit the Contractor's options in scheduling the work. The Contractor must be aware of such limitations prior to bid.

3. The lane rental provision must clearly define the lane rental charges, the work encompassed by the lane rental portion(s) of the project, and the number and duration of lane closures. The time associated with the lane rental may be based on hours, or a number of calendar days.

4. The bid advertisement must include a pre-bid meeting to review and explain the lane rental provision and any unusual features of the project.

5. The Contractor should be required to submit a CPM schedule for review and approval prior to commencement of work. The Contractor should also be required to update the schedule at the minimum on a monthly basis. This schedule will be the basic document to gauge and analyze the Contractor's progress, determine time adjustments, and evaluate claims. Regularly scheduled job site progress meetings should be held for the purpose of updating the CPM schedule.

6. Cooperation and coordination between the Contractor and SD DOT is essential. Partnering is strongly recommended. The delay in approval of a field change or working drawings by the Department can be costly. Decision making and approval authority should be promptly provided at all times that the lane rental portion of the work is in progress. If nighttime or weekend work is allowed, all offices that have decision making and approval authority should designate a contact person with authority to made decisions for the agency represented.

7. Time limits for certain actions should be specified in the Contract and incorporated into the schedule. For example, allow seven days for review and approval of shop drawings. The use of contractual time limits for both parties for submittal activities and other administrative issues would allow the contractor to develop a realistic schedule and force both parties to follow the schedule so as to not delay the lane rental closure.

8. Extensions of time for lane rental periods should not be granted unless extraordinary circumstances occur. The Department should consider all alternatives, including paying additional Contractor and CE costs, to minimize lane rental closures. If changes occur, the Department should not base time extensions for changes on a percentage of the contract amount. The Contractor must justify time adjustments to the lane rental periods based on delays to major work items affecting the critical path in the current updated CPM construction schedule.

9. When determining delays caused by adverse weather on a calendar day or calendar date contract, both the Contractor and the Department should use the Department's Working Day Chart. The chart provides the number of working days in each month that have been historically available for Construction Contracts. Weather related delays would be considered only when the number of actual working days experienced on the project were less than those identified in the chart. The use of this chart by both the Department and the Contractor would reduce the risk of weather delays for both parties.

   Note: The use of a working day chart is one of the recommendations noted in TCS's report. TCS recognizes that SD DOT does not currently use a working day chart. We have included an example of a working day chart in our report to aid SD DOT in developing its own chart.

APPENDIX 8

SPECIAL PROVISION
INCENTIVE/DISINCENTIVE PROCEDURE
FOR CONTRACT TIME

STATE OF SOUTH DAKOTA
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
INCENTIVE/DISINCENTIVE PROCEDURE
FOR CONTRACT TIME
(in calendar days)

PROJECT NO. _____

The Department seeks to accelerate the project by using an Incentive/Disincentive Procedure for Contract Time. The incentive/disincentive completion date for the Project is *[insert the completion date].*

[If incentive/disincentive (I/D) provisions are applied to interim completion dates, define the interim completion dates and the overall completion date for the Project.]

The Department seeks to achieve the following items of work by the incentive/disincentive completion date. The incentive/disincentive work is as follows:

[Describe the items of work that must be performed before the I/D completion date. Define any work restrictions or special circumstances affecting the performance of the work]

The Department will make an incentive payment of *[Insert the daily I/D dollar amount]* to the Contract for each calendar day, including Saturdays and Sundays, that the Contractor completes the incentive/disincentive work described above prior to the incentive/disincentive completion date. The total incentive amount will not exceed *[insert total allowable incentive dollar amount].*

The Department will assess a disincentive deduction at the rate of *[insert daily I/D dollar amount]* for each calendar day after the incentive/disincentive completion date that the Contractor has not completed the items of work described above.

[If the critical I/D work is to be completed by an interim completion date, and the project has a separate overall completion date, liquidated damages will be assessed for late completion of the overall project. Therefore, the above paragraph should be revised to state that the Department will also assess liquidated damages according to Section 8.7 of the Standard Specifications and the Special Provision for General Provisions dated November 17, 1995.]

The Department will not allow extensions of time to incentive/disincentive completion dates unless extraordinary circumstances *[the Department must define extraordinary circumstances]* occur which directly impact the above described I/D items of work. Additional time will only be allowed as justified and documented by the Contractor using the current update of the CPM schedule and approval by the Department.

When using these special provisions, the Department should consider the following modifications to the 1990 edition of the Standard Specifications:

1. *Section 8.3, Prosecution and Progress, is modified by requiring a detailed CPM construction schedule according to the Department's current Special Provision for Progress Schedule. The scheduling specification should address special work restrictions if any exist, expected weather conditions, or any other circumstances affecting the performance of the work.*

2. *Section 8.6, Determination and Extension of Contract Time, is modified to address the following considerations:*

    - *Time extensions for extra work or increased quantities should be based on the controlling (critical) work items defined in the approved CPM schedule update instead of a percentage of the contract amount. Time extensions will be in calender days.*

- *Adverse weather is a common cause of delay on highway construction projects. In the guidelines, TCS recommends the use of a working day chart for I/D projects to aid in the resolution of weather-related delays and limit time extensions for weather to extraordinary weather delays.*

3. *Section 8.7, Failure To Complete on Time, currently bases liquidated damage assessments on working days. Amend the assessment of liquidated damages for a calendar day or fixed completion date contract such that liquidated damages are deducted for every calendar day that the project remains uncompleted after the project completion date.*

APPENDIX 9

SPECIAL PROVISION
COST + TIME BIDDING PROCEDURE

STATE OF SOUTH DAKOTA
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
COST + TIME BIDDING PROCEDURE
(in calendar days)

PROJECT NO. _____

A. General

The Department is using a Cost + Time Bidding Procedure to select the bidder that will be awarded the Contract. The selection process will take into account the price offering and the time in which the Contractor proposes to substantially complete the Project or a critical portion of the Project. The Project consists of *[provide a brief description of the work]*.

[If the critical portion of the project is not the entire project duration, replace "the Project" with the words "the critical portion of the Project" hereafter in this Special Provision]

B. Definitions and Terms

(a) Daily User Cost - The summation of the average daily cost of interference and inconvenience to the road user and the Department's construction engineering costs.

(b) Substantial Completion:

The Project is substantially complete when all of the following have occurred:

(1) All lanes of traffic are accepted and traffic can move unimpeded through the project at the posted speed;

(2) All signage is in place and accepted;

(3) All guardrails, drainage devices, ditches, excavation and embankment have been accepted;

(4) The only work left for completion is incidental, away from the paved portion of the highway, and does not affect the safety or convenience of the traveling public.

The decision whether the Project is substantially complete is solely within the discretion of the Engineer.

[The above definitions supplement Section 1 of the Standard Specifications, Definitions and Terms.]

C. Preparation of Proposal

The bidder shall submit a proposal consisting of two parts. Part A is the total dollar amount of the unit price bids in the Bid Schedule. Part B is the number of calendar days that the Bidder will require to substantially complete the Project multiplied by the Daily User Cost listed in this special provision. The Bidder shall enter this calendar day number on the Bid Schedule in the Proposal Form. The number of calendar days shall not exceed *[insert maximum number of days]* days or the bid will be considered to be non-responsive. The Department will evaluate each bid as the sum of parts A and B. The successful bid is the lowest combination of parts A and B. The Department will award the Contract in the amount specified in part A of the bid. The B time will be the Calendar day time period specified in part B of the bid.

[The above section modifies Section 2.6 of the Standard Specifications, Preparation of Proposal. The Department should review the compatibility of this section with the Standard Specifications.]

D. Consideration of Proposals

After the proposals are opened and read they will be compared based on the following:

Each Bid submitted shall consist of two parts:

A = The total dollar amount for all the unit price items of work to be performed under this Proposal.

B = The total number of calendar days proposed by the bidder to substantially complete the Project multiplied by the Daily User Cost.

The Daily User Cost for this project is *[insert dollar amount]*.

The successful bid will then be determined by the lowest combination of parts A and B according to the following formula:

A + B = Bid Amount for evaluation purposes.

[The above section modifies Section 3.1 of the Standard Specifications, Consideration of Proposals. The Department should review the compatibility of this section with the Standard Specifications.]

E. Failure to Complete on Time

If the Contractor fails to complete the work by the completion date specified for the Project or as amended by formally approved time extensions, the Department will deduct *[insert Daily User Cost]* from the contract amount for each calendar day that the project is late until the Contractor has substantially completed the work.

[The above section replaces the text from Section 8.7, Failure to Complete on Time, in the Standard Specifications. If the B work is to be completed within an interim completion date and the Project has a separate overall completion date, liquidated damages will be assessed for late completion of the overall project. Therefore, the above paragraph should be revised to state the Department will

also assess liquidated damages according to Section 8.7 of the Standard Specifications and the Special Provision for General Provisions dated November 17, 1995.]

[If the Department wishes to add an Incentive for Early Completion to this Cost + Time Bidding Procedure, add the following section.]

F. Early Opening of the Project

The Department seeks to accelerate the project by offering an incentive to the Contractor. The Department will make an incentive payment of *[insert Daily User Cost]* to the Contract for each calendar day, including Saturdays and Sundays, that the Contractor substantially completes the work before the completion date specified for the Project or as amended by formally approved time extensions. The total incentive will not exceed *[insert maximum incentive dollar amount]*.

When using these special provisions, the Department should consider the following modifications to the 1990 edition of the Standard Specifications:

1. *Section 8.3, Prosecution and Progress, is modified by requiring a detailed CPM construction schedule according to the Department's current Special Provision for Progress Schedule. The scheduling specification should address special work restrictions if any exist, expected weather conditions, or any other circumstances affecting the performance of the work.*

2. *Section 8.6, Determination and Extension of Contract Time, is modified to address the following considerations:*

   - *Time extensions for extra work or increased quantities should be based on the controlling (critical) work items defined in the approved CPM schedule update instead of a percentage of the contract amount. Time extensions will be in calender days.*

   - *Adverse weather is a common cause of delay on highway construction projects. TCS recommends the use of a working day chart for I/D projects to aid in the resolution of weather-related delays and limit time extensions for weather to extraordinary weather delays.*

3. *Section 8.7, Failure To Complete on Time, currently bases liquidated damage assessments on working days. Amend the assessment of liquidated damages for a calendar day or fixed completion date contract such that liquidated damages are deducted for every calendar day that the project remains uncompleted after the project completion date.*

APPENDIX 10

SPECIAL PROVISION FOR LANE RENTAL

STATE OF SOUTH DAKOTA
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION FOR LANE RENTAL
[daily basis - in calendar days]

PROJECT NO. _____

A. General

The Department is using lane rental provisions to minimize the delay and inconvenience to the traveling public caused by roadway closures. The Contractor is encouraged to use innovative construction or staging techniques to minimize the number or duration of roadway closures. The Department will assess a daily rental charge for each calendar day that a lane or shoulder is closed or obstructed until traffic is fully restored to the roadway.

The Project or critical portion of the Project subject to lane rental consists of *[provide a brief description of the work]*.

The Department will hold a meeting prior to the bid opening. Project information and project data will be available for review by the Contractors. Representatives of the Department will be available to answer questions. Lane Rental is a new contracting method in South Dakota. All prospective bidders are requested to attend this meeting.

B. Definitions and Terms

For the purposes of these Special Provisions the following definitions apply:

(1) Calendar day - A day shown on the calendar, beginning and ending at midnight, which includes Saturdays, Sundays, and legal holidays.

(2) Lane Closure - A lane closure is a lane or any portion of a lane which is not open to public traffic due to the Contractor's operations.

(3) Shoulder Closure - A shoulder closure is a shoulder or any portion of a shoulder which is not available for its intended use due to the Contractor's operations.

(4) Daily User Cost - The summation of the average daily cost of interference and inconvenience to the road user and the Department's construction engineering costs.

(5) Rental Charge - The daily user cost assessed against the Contract for each day that a lane, a shoulder, or a combination of lanes and shoulders is closed to public traffic.

C. Lane Rental

The Contractor is assessed a daily rental charge for each lane, shoulder, or combination of lanes and shoulders closed during the Project. During the performance of the work to which lane rental applies, the Contractor shall keep open at all times *[insert the minimum number of lanes required to be open]* lane(s) for each direction of traffic. The daily rental charges are as follows:

Closure or Obstruction	Daily Rental Charge
one lane	$*[daily user cost for one lane]*
one shoulder	$*[daily user cost for shoulder]*
one lane and shoulder	$*[daily user cost for lane and shoulder]*
two lanes	$*[daily user cost for two lanes]*
two lanes and shoulder	$*[daily user cost for two lanes and shoulder]*

The Contractor shall count the number and type of closures required for the Project including:

(1) closures shown on the contract plans, and
(2) closures not shown on the contract plans but allowed by the contract.

For the purpose of counting closures not shown on the plans, closures occurring in the same lane but located a distance of one-half mile or greater apart shall be counted as separate closures and rental charges are applied to each closure separately. The Contractor will measure the distance between closures from the end of the taper of one closure to the beginning of the taper for the following closure.

The Contractor shall identify each closure and provide information for the work related to each closure including:

(1) a description of the work,
(1) the limits of the work,
(2) the start and finish dates for the work, and
(3) any special conditions applicable during the performance of the work..

D. Preparation of Proposal

As specified in Section A of these Special Provisions, the Contract includes a lane rental provision on a calendar day basis. The Bidder must enter a bid for Item *[insert bid item number]*, Lane Rental Payments and Assessments in the Bid Schedule. The amount bid for this item is based on the Bidder's estimate of the total number of calendar days required to rent each lane, shoulder, or combination

of lanes and shoulders multiplied by the respective lane rental charges specified in Section C of this Special Provision. If the Contractor leaves this item blank or inserts a negative amount, the Department will consider the bid to be non-responsive.

E. Lane Rental Payments and Assessments - Daily Basis

To determine payments and assessments the following procedure shall be used:

The Department will keep a tally of daily lane rental charges and each month subtract the monthly lane rental charges from the original lump sum bid for this item. This process will continue until:

(a) the Project ends, or
(b) the cumulative rental charges exceed the original lump sum bid.

For the purpose of determining rental charges, if the Contractor rents any part of the roadway for a fraction of a day the Department will consider it as a whole day.

Payments

If at the end of the Project or phase of the Project involving lane rental the cumulative lane rental charges are less than the original lump sum bid for this item, the Department will pay the Contractor the difference between the lump sum bid and the total lane rental charges.

Assessments

If at the end of the Project or phase of the Project involving lane rental the cumulative lane rental charges exceed the original lump sum bid for this item, the Department will deduct the excess lane rental charges from moneys due the Contractor for other items of work in the monthly estimate or the final estimate.

F. Failure to Complete Work on Time

The Contractor shall complete all contract work by *[insert the overall completion date for the Project]*. If the Contractor fails to complete the work by the completion date for the Project or as amended by formally approved time extensions, the Department will assess liquidated damages according to Section 8.7 of the Standard Specifications and the Special Provision for General Provisions dated November 17, 1995.

When using these special provisions, the Department should consider the following modifications to the 1990 edition of the standard specifications:

1. *Section 3.5, Requirement of Contract Bond, is modified such that the bond equals the Contract price less the amount bid for lane rental under Lane Rental Payments and Assessments - Daily Basis.*

2. *Section 8.6, determination and extension of contract time, is modified to address the following considerations:*

    - *Time extensions for extra work or increased quantities should be based on the controlling (critical) work items defined in the approved CPM schedule update instead of a percentage of the contract amount. Time extensions will be in calendar days.*

    - *Adverse weather is a common cause of delay on highway construction projects. TCS recommends the use of a working day chart for I/D projects to aid in the resolution of weather-related delays and limit time extensions for weather to extraordinary weather delays.*

3. *Section 8.7, Failure To Complete on Time, currently bases liquidated damage assessments on working days. Amend the assessment of liquidated damages for a calendar day or fixed completion date contract such that liquidated damages are deducted for every calendar day that the project remains uncompleted after the project completion date.*

APPENDIX 11

MARYLAND STATE HIGHWAY ADMINISTRATION
WORKING DAY CHART

Appendix 11

Figure 23

Maryland State Highway Administration Working Day Chart

AVERAGE NUMBER OF WORKING DAYS ON CONSTRUCTION CONTRACTS

	SOUTH/EASTERN MD		CENTRAL MARYLAND		WESTERN MARYLAND	
	Bridges	Roads	Bridges	Roads	Bridges	Roads
January	10	5	8	8	4	3
February	10	7	8	8	4	3
March	14	11	12	13	10	10
April	16	15	15	17	15	15
May	18	14	18	17	16	15
June	20	19	19	18	18	18
July	20	17	19	17	19	18
August	20	18	20	19	19	18
September	18	18	18	20	18	18
October	19	18	19	17	18	18
November	17	13	16	13	10	10
December	10	9	11	10	6	6
TOTAL	192	164	183	177	157	143

Calvert	Baltimore	Garrett
Charles	Cecil	Allegany
Caroline	Carroll	
Dorchester	Frederick	
Kent	Harford	
Prince George's	Howard	
Queen Anne's	Montgomery	
St. Mary's	Washington	
Somerset	Anne Arundel	
Talbot		
Wicomico		
Worcester		

The region into which borderline counties are categorized may vary depending upon job location within the county. Use average work days per pertinent region accordingly.

Effective July 12, 1990

John S. Koenn, Chief
Construction Inspection Division
July 12, 1990