

# INCENTIVE/DISINCENTIVE GUIDELINES FOR HIGHWAY CONSTRUCTION CONTRACTS

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**ABSTRACT:** Contract incentives have traditionally been used as a means of aligning the goals of the contracting agency with those of the contractor. One area in which contract incentives are used is highway construction and refurbishing. The use of incentives and disincentives (I/Ds) for project completion time has helped highway agencies in various states to reduce construction time significantly. However, I/D provisions increase costs to the contracting agency, and should therefore be used sparingly. For these types of contracts to succeed, it is necessary for the contracting agency to be extremely careful in the development, documentation, and execution of I/D clauses. In this research, the current use of I/D contracts in many states and the experience of several contractors were examined. Then, a general set of guidelines was developed for the use of I/D provisions in highway construction or refurbishing contracts. The guidelines aid in determining which projects should contain the I/D provisions and how to structure the I/D provisions to achieve maximum success.

## INTRODUCTION

As the user demand on the nation's roadways increases, so do the age and deterioration of the structures. While most may recognize that an overhaul of the nation's highway structures is needed, the task of completing this overhaul is not an easy one.

Highway construction and repairs involve high-cost contracts that require large amounts of time to complete. In addition to the direct construction cost, there are indirect costs such as traffic delays, loss of business by those located off the construction zone, increased safety risk to the user, and increased gasoline consumption. While the direct construction costs are based on the materials, manpower, equipment used, and specific condition of construction site, the indirect costs are affected by the length of the contract period and the extent of disruption of travel. By reducing the overall project completion time, the indirect costs would also be reduced.

One method to reduce overall project completion time is through the use of contract incentives and disincentives. A contract with an incentive/disincentive (I/D) structure built in contains a provision "that compensates the contractor a certain amount of money for each day identified critical work is completed ahead of schedule and assesses a deduction for each day the contractor overruns the I/D time" ("Incentive/Disincentive" 1989).

The schedule-based I/D plan is one that would be used to reduce the implicit costs associated with the disruption of the normal traffic flow. An I/D plan can be structured, however, to encompass several goals of the agency issuing the contract. Abu-Hijleh and Ibbs (1989) discuss the merits of assigning various weights to the desired project goals. The I/D is then based on the percent that each goal was successfully completed. This is valuable because it allows emphasis to be placed not only on the time-span of the project but also on the quality of the project, as well as on cost reductions.

I/D contracts do not come without a price. The I/D provisions require increased administration to determine when project targets have been reached. It is important that close attention be paid to the construction process of an I/D contract. As discussed in *Contract Time Determination* ("Contract" 1981), the I/D provisions may result in increased claims by the contractor and increased pressure from outside organizations, such as the press, that the amount of the bonus may not be warranted.

This raises the issue of how to determine the I/D amounts that should be used in developing a contract. This is a rather difficult question, as each individual contracting situation is unique and must be treated as such. It is generally agreed that the I/D amount must be based on the implicit costs discussed earlier; (1) safety of the users; (2) loss of user time due to traffic; (3) the increase in gasoline consumption; and (4) the increased administrative and monitoring costs associated with the use of an I/D contract. Monetary losses incurred by adjacent commercial enterprises should not be used to determine the I/D amount; however, it should be used to determine if a project warrants the use of an I/D project.

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It must be noted that the courts have refused to enforce a penalty contract clause in the absence of a corresponding bonus clause. Liquidated damages may be assessed only if they represent the anticipated losses to the owner at the time the contract is signed.

Additional questions arise as to the form that the I/D provisions should take. There are various forms of the I/D contract that can be considered for any particular project. These forms consist of a bonus/penalty plan, a bonus-only plan, a penalty- (or liquidated-damages-) only plan, a lane-rental plan, and nonmonetary incentives. The literature on the various forms of I/D provisions provides no definite answers to the question of which form of I/D provision is the most effective. However, Christiansen (1987) reports that nonmonetary I/D plans do not attain the same degree of success as monetary plans.

## BACKGROUND

According to Finchum (1972), there are two different types of cost-based contract incentives; fixed-price firm incentives and cost-plus incentive fee. A fixed-price incentive firm plan provides the contractor with both a base payment and incentive/disincentive amounts. The I/D amount is based on a percentage of the target fee, which represents a fair profit for work that comes in at the target cost. Thus, if the project comes in below cost, a percentage of the savings gained by the agency that awards the contract as a result of the performance of the contractor is passed on in the form of an incentive payment. If the contractor's performance results in an overrun on the contract cost, then he or she will be assessed disincentive amount equal to the incentive rate, as outlined in the contract. A cost ceiling is included in the incentive/disincentive plan, which represents the maximum liability of the contractor should a disincentive be assessed.

The cost-plus incentive fee is an I/D plan that places maximum limits on the amount of incentive that can be received by the contractor for cost underruns and a minimum payment the contractor will receive if there are cost overruns. Thus, the contractor is guaranteed some amount of profit regardless of performance on the job.

Another type of incentive plan is a cost-reimbursable plan. Stukhart (1984) states that a cost-reimbursable plan places more risk on the contracting agency, as it bears sole financial responsibility due to overruns. These types of incentive plans can be divided into three different types: cost, schedule, and performance. Schedule-based incentives place the I/D restriction on the time required to finish all or part of a contract. Performance I/D plans use some aspect of the contractors' performance on a job—quality, for example—as a basis for the use of incentives or disincentives. Schedule- and performance-based I/D plans are generally easier for the contracting agency to monitor.

A study conducted by the Federal Highway Administration (FHWA) Office of Program Review ("Incentive/Disincentive" 1988) found that one area of I/D contracting requiring additional research was that of determining the road-user costs, which act as a basis for the I/D amount. FHWA specifies that the road-user costs be based on construction engineering inspection costs, traffic-control costs, detour costs, and accident costs. Some states have also included the costs to surrounding businesses in their calculation of road-user costs. The costs to surrounding businesses are not considered to be road-user costs by FHWA and therefore should not be included. The study also found that calculations to determine the road-user costs were rarely performed. The common practice for developing road-user costs was to rely on rules of thumb and personal knowledge.

Perhaps the most important aspect of any I/D contract is that of the time period of the project. FHWA states ("Incentive/Disincentive" 1989) that contract-time determination for I/D contracts should be calculated in terms of calendar days. Thus, the contractor has a specified number of calendar days to complete the project regardless of the working conditions during those days. *Contract Time Determination* ("Contract" 1981) states that contract-time determination should be based on four areas: length of the construction season, production rates, work-flow techniques, and estimated costs. Length of the construction season plays an important role in the contract-time determination as the contractor's ability to perform the job may be adversely affected or completely halted due to inclement weather or increased traffic. Production rates based on previous projects provide the basis for estimating the time in days or hours that is required to complete a project according to its specifications. Work-flow methods, such as Gantt charts and critical-path-method (CPM) diagrams, are important as they provide a visual display of the progression of the work. They are also a helpful tool in the coordination of materials ordering and delivery. At the time the current paper was written, only seven states used CPM on a regular basis. However, more states used CPM on larger projects to emphasize major aspects.

The use of well-documented goals is also demonstrated in an FHWA memorandum (Use 1990). This memo discusses an Alabama Supreme Court decision that involved contractors who sued over the assessment of disincentives. The Alabama Supreme Court ruled against the contracting agency in two cases of contract disincentive assessments. The court felt that the methods for determination of the daily amount of the disincentive and the contract time had

not been adequately demonstrated and instead represented arbitrary values. In that context, the disincentive was considered a penalty and the contractor did not have to pay it.

## INITIAL CONSIDERATIONS

The goal of the contracting agency in any particular project is to complete a given project successfully within a specified time period and meet various requirements such as quality and cost levels. On each specific project, the various goals of cost, quality, and time span carry different levels of importance, with all having some minimum level of requirement. The success of any project depends on the degree to which all goals have been met.

Because each project has a unique set of goals, the I/D plan provides a way for the contracting agency to specifically determine the goals of the project and communicate those goals to the contractor. To implement an I/D contract successfully, several areas must be addressed:

1. How can one determine which projects warrant the I/D contracts?
2. How should the cost of the I/D provisions be determined so that the goals of the contracting agency are met and the contractor is properly motivated?
3. How can the success and effectiveness of the I/D contract be measured?
4. How can additional and/or unforeseen problems be addressed within the I/D contract to ensure its success?
5. How should the magnitude of I/D be determined such that it can affect time compression?
6. Can nonmonetary rewards be used to align contractors' goals to those of the contracting agency?
7. Can a combination of monetary and nonmonetary considerations be used to develop the I/D provisions?

These are all areas of concern for the agency issuing the contract and need to be discussed and resolved.

## DETERMINING I/D DOLLAR AMOUNTS

The I/D amount is the daily dollar amount awarded to the contractor for each day that he or she completes the project early or assessed for each day the contractor runs past the scheduled I/D completion date. The I/D amount must be determined in such a way that it is large enough to motivate the contractor yet it is small enough that the increased costs can be justified by the contracting agency.

The way in which the I/D amount is determined and documented is very important to the contracting agency. If the contracting agency becomes involved in a legal dispute with the contractor concerning the use of I/D provisions, and the I/D amount has not been well developed and documented, then the contracting agency may very well lose in a court case.

In addition to the I/D amount, each state contracting agency must determine what is the maximum I/D payment they are willing to make. The federal government will pay the same portion of the incentive payment as it pays for the regular construction. FHWA recommends a cap of 5% of the total project cost be used as the maximum incentive ("Incentive/Disincentive" 1989). In addition, with experience, states may feel comfortable in not setting a limit on the number of days for which an incentive can be earned.

It must be noted that liquidated damages are routinely assessed and are different from the disincentive component of the I/D contract. The disincentive is based on road-user costs associated with the project not being completed by the specified time, rather than on the state highway agency's administrative costs. It is common for both the liquidated damages and the disincentive to be assessed concurrently when the project is not completed on time.

## DETERMINATION OF I/D TIME

The determination of the I/D time is perhaps the most important aspect of the I/D contract. The goal of the I/D contract is to provide an incentive to motivate the contractor to work above and beyond what would normally be expected to complete a project in the shortest possible time. If the I/D time is not accurately estimated, then there is a possibility that the contractor will receive an incentive payment for doing business in the usual way. Additionally, the I/D time must be determined and documented in a way that would stand should a claim be filed against the contracting agency.

FHWA defines I/D time as "the time (Calendar days or completion date) established for the contractor to complete critical work on identified roadway(s) and/or structure(s). This time begins when traffic is impacted by the project and normally ends when unrestricted traffic is permitted on the identified roadway(s) and/or structure(s). This is the time upon which the I/D payment will be based. The I/D time and contract time may be the same in situations where traffic impact exists for the full duration of the project or I/D time may be for a shorter period

when traffic is impacted only during a certain phase or phases of contract work" ("Incentive/Disincentive" 1989).

As with the other aspects of the I/D contract provisions, it is up to the individual states to determine the methods used for determining the I/D time. Some states have developed fairly complex systems of determining the I/D time while others have not.

## **GENERAL GUIDELINES FOR USE OF I/D PROVISIONS**

The following guidelines provide the contracting agency with a series of questions as a guide through the decision of whether or not and how to include an I/D provision in a contract.

### **Why Is It Important to Expedite Completion of This Project?**

This question asks the contracting agency to justify the use of the I/D contract clause for the project. This question should take into consideration what will be the effect of the construction on the road user and the general public. The response should clearly state what situation(s) the contracting agency is hoping to minimize by expediting the construction. This will encourage the contracting agency to evaluate the impact of the proposed construction on the traffic flow and business in the construction area. Two examples of how the question might be answered are:

1. The Westover Bridge is the main river crossing from the residential neighborhoods east of the river into the central business district of Morgantown, W. Va. The average daily two-way traffic volume is estimated to be 2,500 vehicles.
2. Commitments were made by contracting-agency representatives to area legislators, restricting construction on the structure to one construction season. At public meetings, businessmen and citizens were promised they would be inconvenienced for only a limited period of time.

Because of these conditions, the contracting agency feels that it is necessary to expedite the project, possibly with the use of I/D provisions.

I/D provisions are appropriate for, but not limited to, the following situations:

- Severe economic impact on local businesses due to construction.
- Emergency services are impaired to an area for an extended period of time.
- Safety of the road users and/or the contract workers is in jeopardy.
- Traffic is severely impacted on a main road artery.
- A lengthy detour or a detour on subpar road surfaces is necessary.

### **What Particular Aspect of This Project Would Reduce/Eliminate Situation(s) as Described?**

This question is aimed at helping the contracting agency to determine whether the I/D provisions should be placed on the entire project or only on a particular phase of the project. It is important that the I/D provisions be used to influence only those aspects of the project that will result in the removal or alleviation of the problems described in the first question. An example of a response would be: "In order to alleviate the problems that demonstrated the need to expedite the project, the Westover Bridge must be open to all lanes of traffic. Because individual phases of the project will not result in a reduction of public inconvenience, the entire project should be expedited."

### **How Much Time Can Be Saved by Using I/D Procedures?**

To answer this question, the contracting agency must determine the completion time of the project based on an accelerated work schedule and an I/D work schedule. An accelerated schedule consisting of a two-shift, 96-h work week and an I/D schedule consisting of a two-shift, 120-h work week is recommended, according to Christiansen (1987). The difference between the two completion dates represents the amount of time that the use of an I/D provision might save the road user and the general public. To determine the two completion times, calculations should be performed in accordance with the contracting agency's procedures for determining contract completion time. Attention should be given to whether or not use of a detour during construction would be beneficial. Special consideration should also be given to the various factors that will affect production rates, such as traffic through the work zone, extra crews, and machines, and reduced setup times resulting from longer shifts.

## Can Cost of Incentive Payments to Contractor Be Economically Justified by Reduced Road-User Costs?

In general, the use of an I/D contract requires the contractor to reduce project completion time to receive a per-diem bonus not to exceed a certain maximum value. The bonus is paid to the contractor by the contracting agency as a reward for completing the contract ahead of schedule. This reward or bonus is usually representative of a portion of the road-user savings that results from the early completion. The following algorithm will provide a criterion for determining if the contract in question would qualify as a candidate for an I/D clause.

The algorithm is based on the construction being expedited by some number of days,  $X$ . To complete the algorithm, an estimate of the number of days that the construction can be expedited must be made. The third guideline question requires the contracting agency to determine how many days could be saved by the use of an I/D provision in the contract. For the purposes of the algorithm, the resultant answer should be used as the value for  $X$ .

For the contractor to complete the project ahead of schedule, extra equipment and crews will be needed to speed up production. The extra crews and equipment will result in extra costs to the contractor. These costs will be defined as:  $A$  is the fixed one-time cost for marshalling extra crews and equipment to expedite the work and ordering of materials for early delivery; and  $B$  is the variable cost per day of using the additional crews and equipment to expedite the project. Thus, if the project is to be expedited by  $X$  days, the total cost to the contractor for expediting the work would be  $A + BX$ .

The values for  $A$  and  $B$  may be different for each contractor. However, if the contracting agency examines its past experiences with bidding, it should be able to determine a range of values that could be used to represent both fixed and variable costs to the contractor. Obtaining accurate estimates for  $A$  and  $B$  may not be an easy task. However, this is a useful practice for future contracts and the amount of confidence in estimating these values should increase with experience. If most bids tend to come from smaller local companies, then the costs to the contractor to rent additional equipment and hire extra crews may be more than they would be for a larger national firm that could pull equipment and crews from other areas if necessary. If past experience has shown that a wide variety of companies bid on the I/D contracts, then the contracting agency may want to develop both high and low values for  $A$  and  $B$ .

When considering the variable costs to the contractor to expedite the work, the contracting agency should consider extra shifts, overtime, and rent for extra equipment.

The reason for expediting a contract in the first place is to reduce the costs and inconvenience to the general public and the road user resulting from the construction. Road-user costs are costs that the road user incurs due to the traffic disruption caused by the construction. These costs consist of items such as increased gasoline consumption, increased safety risks, and time lost to long detours and delays. In this algorithm, the additional cost to the road user per day due to the construction will be called  $C$ . The value of the road-user cost may be determined using QUEWZ, a computer software package developed by the Texas Transportation Institute and distributed by McTrans, the Center for Microcomputers in Transportation at the University of Florida, or by manual methods depending on the type of road closures that will be applied.

QUEWZ determines additional road-user costs based on delays, speed-change cycling costs, and the change in vehicle-operating costs due to the construction (Memmott and Dudek 1982). QUEWZ was developed to calculate the change in the preceding costs when a construction project restricts traffic in the road user's direction or when the road user must cross over into the opposite direction of travel, thus reducing traffic flow in both directions. QUEWZ is not capable of determining the additional costs of the road user as a result of a detour. Additionally, QUEWZ does not take into consideration increases in accident costs due to the construction. If a detour is to be used or if the contracting agency wishes to include the increased accident costs to the road user, the calculations for determining these costs should be performed according to the procedures in *Planning and Scheduling Work Zone Traffic Control* (1981).

Once the daily additional road-user costs  $C$  have been determined, the total reduction in road-user costs resulting from the project being expedited must be determined. Thus, if a project were shortened by  $X$  days due to an I/D clause, the total road-user savings would be equal to  $CX$ .

The bonus that is paid to the contractor for early completion under the I/D provisions is justified by savings in road-user costs. So, to determine whether an I/D provision is warranted, the following inequality must be examined.

$$CX \geq A + BX \quad (1)$$

or total road-user savings is greater than or equal to total cost to the contractor.

If (1) is true, then the contract may be worthy of an I/D provision. However, if this inequality is not true, the cost to the contractor for expediting the work is greater than or equal to the road-user savings, then the I/D provision should not be used. In this case the contracting agency cannot justify the incentive for completing the job early based on the savings to the road user.

In an I/D contract, the contractor has the ability to increase his profits by expediting the project completion date. The increased profits come in the form of bonuses that are stated in the I/D clause. The bonuses are awarded on a per-diem basis for each day the contractor is finished before the completion date, not to exceed a predetermined maximum amount. The per-diem bonus as stated in the I/D clause of a contract will be referred to as  $R$ .

For the contractor to be motivated to bid on the I/D contract and actively work to expedite the completion date by  $X$  number of days, total bonus amount to be paid must be greater than or equal to the net extra costs that are incurred to expedite. In mathematical terms:

$$RX \geq A + BX \quad (2)$$

Dividing both sides of the inequality by the number of days the contract is to be expedited,  $X$ , gives:

$$R \geq \frac{A}{X} + B \quad (3)$$

or the per-diem bonus is greater than or equal to extra costs. If (3) is not true, the contractor will not be motivated to actively participate in the expediting effort, as he or she will have nothing to gain except perhaps some goodwill from the public or the contracting agency.

The bonus amount per day,  $R$ , is determined by the contracting agency and represents a portion of the road-user savings to be passed on to the contractor. The portion of the road-user savings to be shared with the contractor will be called  $p$ , where  $0 < p \leq 1$ . Thus, the magnitude of the bonus amount will not exceed the portion of the road-user savings that the contracting agency wishes to share:

$$RX \leq pCX \quad (4)$$

Dividing both sides of the inequality by the number of days the contract is to be expedited by yields:

$$R \leq pC \quad (5)$$

At this point there are two inequalities involving the bonus amount to be paid for each day of early completion:  $R \geq A/X + B$  and  $R \leq pC$ . The first inequality represents the amount of the bonus necessary to motivate the contractor to bid on the I/D contract; the second inequality represents the amount of the bonus necessary to protect the public interest.

Combining the inequalities results in:

$$\frac{A}{X} + B \leq R \leq pC \quad (6)$$

or the extra costs are greater than or equal to the per-diem bonus, which is greater than or equal to the portion of road-user savings. There is now a range in which the bonus per day must fall for the I/D provision to be practical. If the bonus is determined to be outside this range, the I/D provisions will not be practical.

For example, a project is under consideration for an I/D provision. The I/D provision is being considered as the contracting agency would like to reduce the project completion by 10 days. The agency estimates that the fixed cost (one-time cost) to the contractor to expedite the work is \$2,000 and the daily cost to expedite is \$5,000. The road-user savings have been determined to be equal to \$10,000 per day. The contracting agency is willing to pass 15% of the road-user savings on to the contractor. Should this contract use an I/D provision?

Using the algorithm to derive an answer, the following terms are defined:  $A$  = \$2,000, one-time cost to the contractor to expedite;  $B$  = \$5,000 per day, daily cost to the contractor to expedite;  $C$  = \$10,000 per day, daily road-user savings;  $p$  = 0.15, portion of the road-user savings that the contracting agency is willing to pass on to the contractor; and  $X$  = 10 days, number of days the contract is to be expedited.

The first step is to determine if the road-user savings are great enough to warrant further investigation. This is done by testing (1). If this inequality is true, then the I/D provision is a possibility. Using the values given in the problem gives: \$10,000 per day (10 days)  $\geq$  \$2,000 + \$5,000 per day (10 days), or \$100,000  $\geq$  \$52,000. If the road-user savings are greater than the increased contractor costs, then the I/D provision may be useful in expediting the project completion date.

Now the bonus range will be examined. Substituting values in (6) leads to \$2,000 per 10 days + \$5,000 per day  $\leq R \leq 0.15$  (\$10,000 per day), which reduces to \$5,200 per day  $\leq R \leq$  \$1,500 per day.

This is not a valid range of values. This tells the contracting agency that using a rate of 0.15 for  $p$ , no contractor will have the incentive to bid on the project. If the contracting agency wishes to justify the I/D provisions based upon the road-user costs, a different  $p$  value must be

used. Table 1 demonstrates the various ranges of the bonus as the value of  $p$  is changed. For this example, the value of  $p$  should be at least 0.52, which could be rounded up to 0.55 or 55%.

#### If I/D Provisions Are Economically Justified, What Are Daily and Maximum Incentive Amounts?

The daily amount of the incentive and disincentive should be determined based on the steps performed in the algorithm. Using the range of practical incentive daily amounts that were calculated, a value within the range should be selected as the daily amount. When selecting the daily amount of the incentive, the accuracy of the estimate of the contractor's costs should be considered. If the contracting agency is confident in the estimate of the contractor's additional costs, then a value that is in the bottom of the range should be selected as the minimum possible incentive amount that could be used. If the contracting agency is not very confident of the estimates of the contractor costs, then a mid- to high-range value should be selected as a minimum incentive value so as not to negatively influence the smaller firms from bidding on the contract. The final value of the daily incentive must be based on the amount of profit the contracting agency is willing to provide the contractor for assuming the extra risks associated with expediting the construction. The same value should be used for both the daily incentive and disincentive.

After determining the amount of the daily incentive and disincentive payment, the maximum number of days that the incentive payment will be paid should be determined. To find this number, the difference in the number of days required to complete the project using an accelerated schedule versus an I/D schedule should be used. This is the value of  $X$  found in the algorithm. The maximum incentive amount will be equal to the number of days saved by the difference in the schedules multiplied by the daily incentive amount.

The maximum incentive payment should be based on how much time can be saved and how much the contracting agency can afford to pay to the contractor. If the contracting agency determines that it does not have the funds to cover the maximum incentive payment that has been determined, then the daily amount should be adjusted downward to the lowest possible figure that would still provide incentive to the contractor.

As mentioned earlier, FHWA recommends that the maximum incentive be capped at 5% of the total project cost (*Incentive/Disincentive* 1988): "The 5 percent was based on the NEEP [National Experimental and Evaluation Program] study averages of incentive payments made on experimental I/D projects and provides no firm basis for determining a maximum incentive payment. In fact, the 5 percent figure is being misused as a back door approach to establishing I/D daily amounts and incentive times. The maximum incentive payment may be more or less than 5 percent of the contract depending upon how critical the project is." For these reasons it does not make sense to jeopardize the success of the I/D project to force the incentive payment to fit into an artificial cap.

It is better to determine the maximum incentive as a function of the time that the project can save, the dollar amount needed to motivate the contractor, and the amount the contracting agency can afford.

#### What Options Exist if Additional Road-User Costs Do Not Justify Use of I/D Provisions?

At this point, the contracting agency must decide if it feels that the project still needs to be expedited. If the contracting agency wishes to expedite the project in spite of the fact that it cannot be justified by the increased road-user costs, three possibilities exist: I/D provisions,  $A + B$  bidding procedure, and lane rental.

There are times when I/D provisions should be used in spite of the fact that they cannot be justified by the road-user costs. If a situation arises that is endangering the safety of the community, road users, and/or the employees of the contractor, then the project should contain

TABLE 1. Ranges of Daily Incentive Payments

Value of $p$ (1)	Road-user savings, $C$ (dollars per day) (2)	Contractor costs, $A/X + B$ (dollars per day) (3)	Range of daily incentive payment (dollars) (4)
0.10	10,000	5,200	$5,200 \leq R < 1,000$
0.20	10,000	5,200	$5,200 \leq R < 2,000$
0.30	10,000	5,200	$5,200 \leq R < 3,000$
0.40	10,000	5,200	$5,200 \leq R < 4,000$
0.50	10,000	5,200	$5,200 \leq R < 5,000$
0.60	10,000	5,200	$5,200 \leq R < 6,000$
0.70	10,000	5,200	$5,200 \leq R < 7,000$
0.80	10,000	5,200	$5,200 \leq R < 8,000$
0.90	10,000	5,200	$5,200 \leq R < 9,000$
1.00	10,000	5,200	$5,200 \leq R < 10,000$

I/D provisions even if the road-user costs are not severe. For example, if a bridge linking a community to its vital services is structurally unsafe, then an I/D provision should be considered for safety reasons. These reasons could include things such as a disruption of emergency services to the area or a danger of serious injuries to construction employees or road users due to the deteriorated condition of the bridge.

If the situation is not severe enough to warrant an I/D provision, then  $A + B$  bidding and lane rental may be considered.  $A + B$  bidding and lane rental are special bidding procedures that emphasize the project completion time. In both procedures, the contractor must include the time necessary for completion in his bid.

In general, from a cost point of view,  $A + B$  bidding is recommended over lane rental as the contract award will be lower. In  $A + B$  bidding the contracting agency only pays contractors for their construction work.  $A + B$  bidding uses the number of days the contractor requires to complete the project solely for the purpose of determining the low bidder. Once the bid is awarded, the completion date is set according to the number of days bid by the contractor and the contract is awarded a bid amount equal to the amount of money required for the construction only.

With lane rental, the contractor is assessed a daily rent for each day traffic is disrupted. Because the rent will actually be paid to the contracting agency by the contractor, the daily rent for each day that the contractor expects to be working will be built into the bid. Therefore, when the bid is awarded, it is awarded for the construction costs plus the anticipated rents. Theoretically, in lane rental, the contracting agency should receive all of the rent back that is built into the bid, but should the contractor complete the job early, the contracting agency will lose the rent that would be due had the project been finished on time.

### **What Additional Considerations Must Be Addressed to Ensure that Project Can Be Expedited?**

To ensure the successful completion of the I/D project, it is important for the contracting agency to do everything possible to eliminate delays and disruptions in the construction. Therefore, the contracting agency needs to anticipate potential trouble spots and develop methods for dealing with them. The following points must be carefully considered in the preparation and execution of I/D contracts.

- Extra time and effort must be given to project development so as to avoid costly field changes once the project begins. Predesign field reviews are important at this stage as the actual construction at the site may be different from that indicated on old construction plans.
- It is important that the contract clearly specifies the procedures that will be in place should any changes in the scope of the work take place. Additionally, the contract should state under what circumstances the I/D completion date will be extended and under what circumstances the contractor is responsible for delays.
- The contract must clearly define when the I/D time will begin and end, as this may be different from the start and completion date of the rest of the project. It is important that the contract defines in detail what is expected of the contractor to earn the incentive payment. This would include a detailed list of items that may be completed after the I/D completion date, such as shoulder and cleanup.
- All parties that will be involved with the construction, including local officials and police, should participate in preconstruction meetings. This will help uncover any unusual features of the project, as well as any restrictions that may affect the construction such as a restriction on jackhammering at night due to noise problems.
- Prior to awarding the contract, there should be a written agreement between the contracting agency and utility companies addressing what work needs to be done and when it will be done. This should minimize delays once the construction begins and reduce the potential for conflicts between the contracting agency and the contractor.
- Prior to construction, arrangements for the moving of right-of-ways must be confirmed and completed. Failure to do this could result in a lengthy delay in the construction process.

### **CONCLUSIONS**

The purpose of this research was to examine the use of contract incentives and disincentives in highway construction and to develop guidelines for determining when the I/D provisions are most useful and how they should be applied to individual projects. Because each construction project is unique, the guidelines developed must be broad enough that they can be applied to a wide variety of situations. In addition to developing guidelines for the use of I/D provisions, the research also addressed alternatives to the use of incentives and disincentives.

The information gathered during this research from both state agencies and contractors in-



indicated that the use of I/D provisions is good for projects that need to be completed in the shortest possible time. The I/D provisions enabled the completion time to be reduced by up to 50%. The I/D provisions did not appear to have any adverse effect on the quality of the work that the contractors performed. Actually, some of the people contacted felt that the projects with I/D provisions were of a higher quality than normal projects since the contractor could not risk having to redo a portion of the project.

The use of I/D provisions is not a guarantee for success. On several occasions the states contacted had been involved in disputes with contractors that resulted from the I/D project not being completed on time. In some cases, the dispute was settled in favor of the contracting agency, but usually the contractor received the favorable settlement. The disputes and how to eliminate them were a major concern of the parties that were contacted.

The guidelines presented here can assist the contracting agency in determining whether or not the I/D provision is appropriate. If the use of an I/D provision is appropriate, then the guidelines provide a means of developing the important characteristics of the provisions that will be used. If the use of I/D provisions is not appropriate, then the guidelines offer alternatives that may be used to achieve the goal of an expedited project completion.

Alternatives to the use of I/D provisions are limited when the contracting agency is a government body. Government agencies are required to accept the low bid on construction projects, which eliminates the use of many nonmonetary methods for expediting project completion. Two special bidding procedures—*A + B* bidding and lane rental—incorporate the time required to complete the project into the contractors' bids. By including the completion time in the bid, the contracting agency can emphasize the importance of project completion to the contractor.

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