INCENTIVE/DISINCENTIVE PROVISIONS IN HIGHWAY CONTRACTS

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ABSTRACT: The objective of the study reported in this paper is to compare contracts that include incentive/disincentive (I/D) provisions against contracts that do not include I/D provisions, with regard to the consequences of these measures. The study involves both completed and ongoing highway and bridge renovation/rehabilitation projects undertaken by the Illinois Department of Transportation (IDOT). After a general overview of I/D implementation, the results of a study that covered 28 I/D contracts (contracts that included I/D provisions) and 29 non-I/D contracts undertaken by IDOT during the five-year period 1989–93 are presented. The major finding of this study is that the majority of the I/D contracts are completed on time or sooner, which supports the use of I/D provisions in these contracts. However, this saving in contract duration seems to be accompanied by increased project costs most of the time.

INTRODUCTION

Contractual incentives stem from the emphasized objectives of a project, which are: cost, schedule, and performance, including quality, safety, technology, and management. An owner would like a project to be completed at minimum cost, in minimum time, with an acceptable quality and safety in the finished product, and with state-of-the-art technology and management in the construction process. Attaining all of these goals is difficult in the construction industry. This causes tradeoffs to be made among the owner's objectives. Depending on the requirements of a project, certain objectives are emphasized and the contractor is expected to take the necessary action to realize them. It is at this stage that contractual I/D provisions may be used by an owner to achieve the major project goals. If more than one project objective is emphasized in a project this is referred to as a "combined incentive/disincentive" application (Ibbs and Abu-Hijleh 1988).

Disincentive clauses are not the same as the liquidated damages clauses that are a basic tool of current construction contracting practice. The enforcement and threat induced by liquidated damages is very subtle when compared to that of disincentives. Disincentives are generally larger in amount and accompany incentives in order to motivate the contractor to complete the work on or ahead of time. Liquidated damages, however, are charges to collect for the losses incurred by an owner in the case of delays caused by the contractor.

The objective of the study reported in this paper was to compare contracts that included incentive/disincentive (I/D) provisions against contracts that did not include I/D provisions, with regard to the consequences of these measures. Data were compiled on completed and ongoing highway and bridge renovation/rehabilitation projects undertaken by the Illinois Department of Transportation (IDOT) in the period 1989–93. After a general overview of I/D implementation, the results of an investigation that covered 28 I/D contracts (contracts that include I/D provisions) and 29 non-I/D contracts are presented.

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INITIATION OF I/D CLAUSES IN IDOT

The use of I/D in contracts of the various departments of transportation (DOTs) was authorized in 1984 by the associate for engineering and operations of regional Federal Highway Administrations, for regions 1–10. I/D provisions could be used whenever they were considered to be cost-effective and beneficial to the travelling public. Several studies carried out by the Federal Highway Administration (FHWA) and the DOTs led to the preparation of *FHWA Technical Advisory T 5080.10* "Incentive/Disincentive (I/D) for Early Contract Completion" ("Incentive" 1989). As a result of these developments, in March 1990 IDOT issued *Design Memorandum No. 90-53* ("Incentive" 1990) in order to establish a policy to ensure appropriate contracts are selected for inclusion of I/D clauses and that the I/D clauses are developed in a uniform manner. The memorandum is conceptually the same as *FHWA Technical Advisory T 5080.10*, using the same terminology and definitions. IDOT *Design Memorandum No. 90-53* restricts I/D applications to the following:

- High-volume roads, high-volume truck traffic and/or structures involving high road user costs, extended inconveniences and hazards to the motoring public, or severe disruption on adjacent businesses
- Lower-volume roads and river structures involving long adverse travel and area economic impact
- Projects, such as utility relocations, with direct effect on the start and/or interruption of progress on major freeways, arterials, or structures (when late completion is more critical with respect to early completion, use higher liquidated damages based on other department costs per *Code of Federal Regulations—Title 23* rather than I/D provisions)
- River structures in or adjacent to central business districts
- Nighttime construction (rehabilitation and/or resurfacing) on major urban freeways

The memorandum allows I/D clauses to be applied to a single project or portions of a project that can be contracted out to multiple contractors (also known as cooperative project application). When I/D provisions are included in a single project, the contractor is awarded a predefined incentive amount per day for each day he/she completes the project earlier than the scheduled completion. In the case of a cooperative project application where portions of a large-scope project are contracted out to multiple contractors, an individual contractor is entitled to receive (50% of the daily incentive associated with his/her portion of the project) × (number of days his/her portion of the project is completed ahead of schedule). In addition to this, the individual contractor will receive (the remaining

50% of the daily incentive associated with his/her portion of the project) × (number of days the project is completed ahead of schedule by all the contractors). For example, for a combined project that has been assigned $1,000/day incentive upon early completion, if contractors A, B, and C complete their respective contracts 28, 10, and 18 days earlier than scheduled (i.e., the number of days the project is completed ahead of schedule by all the contractors is 10), the contractors will receive the following amounts as incentives:

- Contractor A: (28 × 500) + (10 × 500) = $19,000
- Contractor B: (10 × 500) + (10 × 500) = $10,000)
- Contractor C: (18 × 500) + (10 × 500) = $14,000

The I/D amount per day is based on the sum of the road-user delay cost and liquidated damages. On single projects with I/D applied to a portion of the project, only road-user delay costs are used in calculating the I/D amount. The completion of the entire project is subject to normal liquidated damages. On single projects where I/D applies to the entire project, road-user delay cost and liquidated damages are used together. Road-user delay cost is a function of the change in travel time during construction, average number of passengers per vehicle (set at 1.25 for Illinois, based on a current research study by the Chicago Area Transportation Study), and the hourly cost per passenger ($10.00/hr/passenger in Illinois, based on average earnings issued by the Department of Employment Security). Liquidated damages are based on construction costs. Section 108 of the *Standard and Supplemental Specifications for Road and Bridge Construction* (*Standard* 1993) contains a table specifying the rates of liquidated damages. The memorandum requires that the final I/D amount provide a favorable benefit/cost ratio where "benefit" is defined by the calculated daily savings in road-user and construction costs due to early completion, and "cost" is the final daily I/D amount to be paid to the contractor. This I/D amount should be large enough to motivate the contractor. The maximum incentive amount is limited to 5% of the total construction cost. The common practice in IDOT is to limit incentive payment days to a maximum of 30, whereas no such limit is used for disincentives.

The completion date of an I/D project must be based on a realistic and completely expedited work schedule. Expedited work schedules should involve one or more of the following schemes: six-day workweek with double shift and night illumination, extended work hours with 12–24 h per day, an expedited work schedule with 228 working days per calendar year, or multiple work crews in multiple areas.

RESEARCH METHODOLOGY

A "preliminary checklist" was originated that consisted of a listing of items about which data was to be sought in the study. The items in the checklist were developed on the basis of the factors identified throughout the literature survey that were thought to have an impact on the use of I/D provisions. The research team conducted a pilot study on two IDOT projects, one being a pavement and the other a bridge project. The contract documents of these projects were reviewed to check if information regarding checklist items were available in IDOT offices and archives. Also, professionals experienced in I/D contract applications in IDOT were consulted regarding the use of I/D clauses and the current practices in IDOT projects. The contents of the checklist were modified, based on the information available in IDOT offices and on the recommendations of the IDOT's technical review panel. The IDOT technical review panel consisted of the engineer of physical research, the engineer of construction operations, the chief of project development and implementation, and the director of the Illinois Transportation Research Center. The items in the "final checklist" are listed in Table 1.

A list of contracts that included I/D clauses undertaken in the period 1989–93 was obtained from IDOT. The technical review panel agreed that the many I/D projects in districts 1 and 3 were representative of I/D projects in the state of Illinois and therefore decided to select them as the target districts for the review. District 1 consists of Lake, McHenry, Kane, Cook, DuPage, and Will counties and is an urban area surrounded by many highways and expressways. District 3 is a rural area consisting of Kendall, LaSalle, Grundy, Livingston, Kankakee, Iroquois, Ford, McLean, Woolford, Marshall, and Putnam counties.

Out of the 31 I/D projects that were available for analysis in District 1 and that were undertaken in the five-year period 1989–93, 20 with the most complete data were selected. Also, 19 projects were selected from a list of 63 non-I/D contracts undertaken by District 1 in the same period. In District 3 eight I/D contracts and 10 non-I/D contracts showing similar characteristics were completed in the 1989–93 period. These documents were available in District 3 offices.

The items in the checklist (Table 1) were filled out by the third writer by studying the project files and by consulting both the Bureau of Design and the Bureau of Construction. The information not found in the office files was tracked down in the archives. Attempts were made to contact the resident engineer and/or the supervisor of the project to obtain any data that could not be located in the archives. The input of the resident engineer and/or supervisor was used to resolve inconsistencies that sometimes existed in the documentation.

Considering the 20 I/D and 19 non-I/D projects reviewed in District 1 and the eight I/D and 10 non-I/D projects in District 3, the total number of projects in the sample added up to 28 I/D and 29 non-I/D projects. Both I/D and non-I/D contracts were classified by type of construction (pavement or bridge) and district (District 1 or District 3). Pavement projects consisted of all the work carried out on highway projects that did not include a bridge construction or reconstruction. Bridge projects included all highway projects that included at least one bridge construction or reconstruction within the scope of the contract work. Of the 28 I/D contracts, there were 14 pave-

TABLE 1. Checklist on I/D Provisions and Their Implementation

Checklist Items			
Basic project information (1)	Project duration information (2)	Project cost information (3)	Incentive/disincentive information (4)
Name of contractor	Contract duration/date	Contract amount	Incentive amount per day
Type of contract	Construction start date	Additions	Disincentive/liquidated damages per day
Type of project	Actual duration/date	Deductions	Total incentive received (if any)
Design ADT[a] on work zone	Essential completion date	Actual amount	Total liquidated damages paid (if any)
—	Final completion date	Engineer's estiamte	Maximum incentive duration
—	—	Number and dollar amount of change orders	B/C[b] ratio

[a]Annual daily traffic.
[b]Road-user cost to be saved per day ("benefit") compared to daily I/D amount to be paid to the contractor ("cost").

TABLE 2. Characteristics of I/D and Non-I/D Contracts Used in Sample

Characteristics (1)	Minimum (2)	Maximum (3)	Average (4)
(*a*) I/D Contracts			
Contract amount	$116,621	$17,146,177	$6,037,821
I/D amount allowed per d	$1,500/d	20,000/d	$7,810/d
I/D duration allowed per contract	4 d	30 d	25 d
Contract duration (I/D days of project)[a]	12 d	402 d	194 d
ADT[b]	1,200	150,200	60,024
(*b*) Non-I/D Contracts			
Contract amount	$172,140	$17,107,052	$6,909,118
Contract duration[c]	88 d	705 d	278 d
ADT[b]	4,750	113,200	35,526

[a]In calendar days.
[b]Annual daily traffic in vehicles.
[c]In working days.

ment and 14 bridge projects. Of the 29 non-I/D contracts, there were 15 pavement and 14 bridge projects. The district classification was included in the study to reflect the different nature of the regions represented by districts 1 and 3. Other characteristics of the contracts in the sample are shown in Table 2.

DATA ANALYSIS

Figs. 1 and 2 describe the definitions used throughout this discussion. In these figures scenarios are developed for I/D (Fig. 1) and non-I/D (Fig. 2) contracts showing possible contract completion alternatives on a timescale. Fig. 1 shows an I/D contract scheduled to be completed on a specific contract date, indicating the contract duration and the I/D duration allotted for that contract. The contract duration for an I/D contract is specified by the scheduled essential completion date of the project, which is defined as the roadway being open to traffic by IDOT. In Scenario 1 the contractor completes the contract earlier than the scheduled essential completion date (contract date) and is entitled to receive the corresponding incentive. In scenario 2 the contractor completes the contract later than the scheduled essential completion date and is charged disincentives. In scenario 3 the implications of time extensions in I/D contracts are shown.

The scheduled "essential completion" of an I/D project, as referred to in this study, is defined as the time when traffic can flow safely and efficiently on the part of the roadway that was under construction (Fig. 1). In the analysis the date the roadway was opened to traffic was taken as the scheduled "essential completion" date. The scheduled "essential completion" date generally constitutes a benchmark for calculating incentive payments or disincentive charges as the case may be. Additional time for "nonessential" activities such as cleanup, planting, seeding, and painting is granted whenever deemed necessary. The actual "final completion" of a project is the date when all of the work included in the contract is completed by the contractor, including punch list items, seasonal seedings, plantings. paintings, and general cleanup.

Fig. 2 shows a non-I/D contract scheduled to be completed on a specific contract date, indicating the contract duration and the inferred essential completion date. The inferred essential completion date is suggested by the researchers to provide a measure to compare I/D and non-I/D projects. In the non-I/D projects studied the "essential completion date" coincided with the date marked as "99% completion date" as noted in weekly reports 95% of the time (Yasamis 1994). Therefore, in cases where the date the roadway opened to traffic was not recorded in the documents, the date that corresponded to 99% completion was extracted from the weekly time reports and

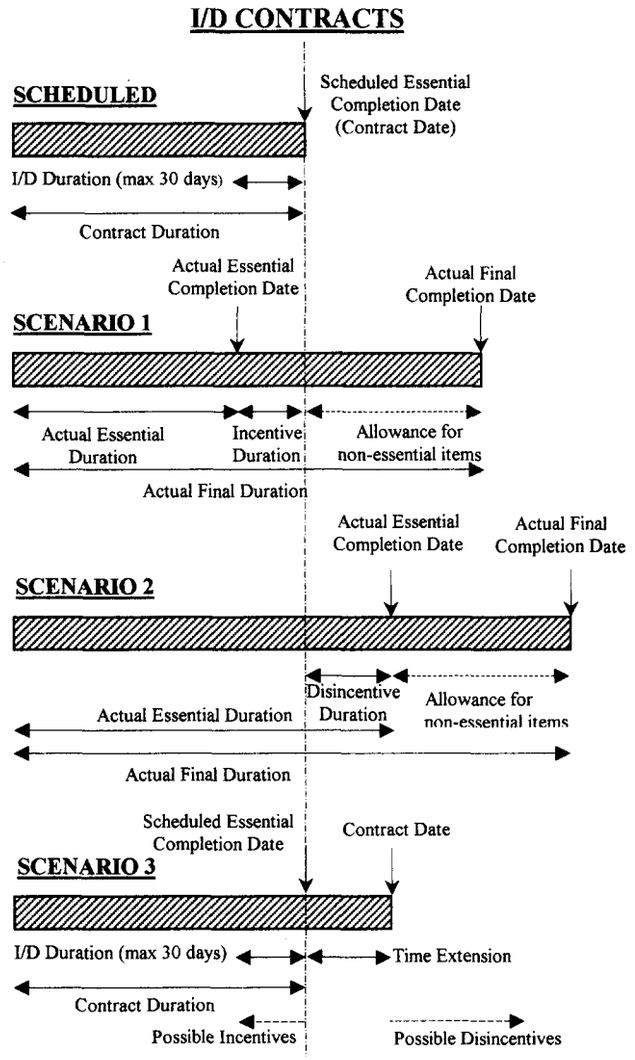

FIG. 1. Project Milestones for I/D Contracts

was recorded as the inferred "essential completion" date. In scenario 1 the contractor completes the non-I/D project earlier than scheduled. In scenario 2 the contractor completes the non-I/D project later than the contract date and is charged liquidated damages, not disincentives for the duration overrun. In scenario 3 the implications of time extensions in non-I/D contracts are shown.

The time extensions granted in the sampled contracts were based on the scheduled "essential completion" date for I/D projects, and on the contract date for non-I/D projects (scenario 3, Figs. 1 and 2). Time extension in an I/D project could only be granted by IDOT if a significant amount of extra work was added to the project or to the part of the project where I/D provisions were being used, which was a very rare practice. A time extension could also be granted in case of force majeure. However, these types of time extension did not apply to "scheduled essential completion" dates that were used as basis for incentive payments. In other words, if due to some inevitable factor the I/D projects were to last longer than the original contract duration, an adjustment in contract date, not in the scheduled "essential completion" date was made. This procedure protected the contractor from being penalized with disincentives for failing to meet the original contract date due to factors beyond his/her control by extending only the contract date, the date on which disincentive payments are based. It also relieved the owner from paying extra monies when it had not received the benefit of early opening of the roadway

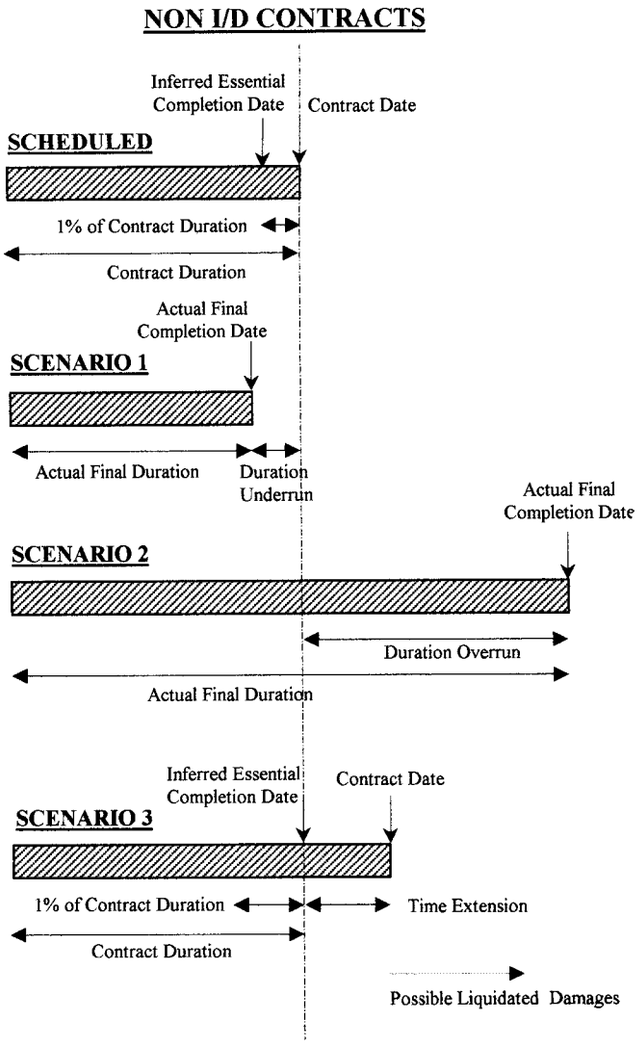

FIG. 2. Project Milestones for Non-I/D Contracts

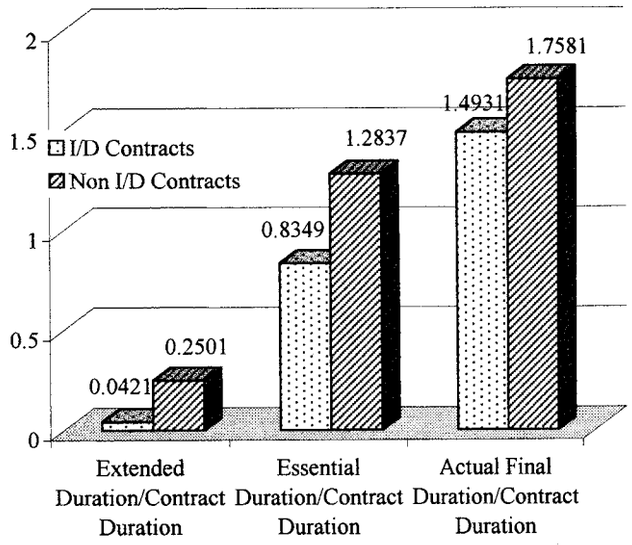

FIG. 3. Contract Duration Comparison

to traffic by keeping the incentive payment date constant (scenario 3, Fig. 1). In non-I/D contracts the contract date and not the inferred "essential completion" date constitutes a benchmark for calculating liquidated damages (scenario 3, Fig. 2). This way the time extensions granted in non-I/D contracts and those awarded in I/D contracts can be compared on an even basis.

Considering the overall analysis of all contracts as shown in Fig. 3, I/D contracts received an average extension of 4.21% on original contract duration whereas non-I/D contracts received an average of 24.01%. I/D contracts achieved scheduled "essential" and actual "final" completion faster than similar non-I/D contracts (Fig. 3). Even though an average of 4.21% extension was awarded in I/D contracts, the proportion of actual "essential duration" to "contract duration" was 34.96% smaller in I/D projects than the same ratio in non-I/D projects with similar scope and amount of work (Fig. 3). On the other hand, the actual "final completion" of a project took on the average 49.31% and 75.81% longer than the contract duration in I/D and non-I/D contracts, respectively. Also from Fig. 3 it can be seen that for non-I/D projects, the extensions awarded corresponded approximately to delays in essential completions. However, the delays in final completions of these non-I/D projects were at least three times larger than the extensions awarded. Common reasons for this difference included suspension of work by IDOT or disputes in the approval of extensions. Suspensions and resumptions affected mainly the portion of the project subsequent to essential completion. It should be noted here that after essential completion the roadway was open to traffic and only minor adjustments such as seeding, landscaping, cleaning, and punch list items were made thereafter.

Sample projects are sorted by districts to reveal any variation that can be inherent in the application procedures of rural (District 1) and urban (District 3) areas. It appears that all the projects that received time extensions were in District 1 (Table 3). This may suggest that District 3 has performed better on I/D contracts, as they granted no extensions of time and accomplished a ratio of essential duration to contract duration that was 41.44% smaller than the same ratio for non-I/D contracts. The ratio of actual duration to contract duration in District 3 non-I/D contracts was 1.63 whereas the average for all districts 1 and 3 non-I/D contracts was 1.76.

The annual daily traffic (ADT) in the construction zones of the two districts should be mentioned and are presented in Table 4. ADT on a typical construction route in District 1 was more than five times larger than construction sites in District 3 (ADT District 1/ADT District 3 is 5.21). The longer essential

TABLE 3. Comparison by Districts

	DISTRICTS			
	District 1		District 3	
Ratio (1)	I/D contracts (2)	Non-I/D contracts (3)	I/D contracts (4)	Non-I/D contracts (5)
Ext/cont. dur.[a]	0.0589	0.2610	0.0000	0.2002
Ess/cont. dur.[b]	0.8383	1.2368	0.8263	1.4109
Fin/cont. dur.[c]	1.4572	1.8279	1.5905	1.6255
Act/cont. am.[d]	1.1072	1.0481	1.1249	1.0963
Cont. am./est[e]	0.9259	0.8957	1.0805	0.9468
Act/est[f]	1.0279	0.9394	1.2405	1.0347
CO/cont. am[g]	0.1072	0.0480	0.1249	0.0963
#CO/cont. dur.[h]	0.2001	0.0968	0.1768	0.1810

[a]Extended duration/contract duration.
[b]Essential duration/contract duration.
[c]Actual final duration/contract duration.
[d]Actual contract amount/original contract amount.
[e]Original contract amount/engineer's estimate.
[f]Actual contract amount/engineer's estimate.
[g]Dollar amount of change orders/actual contract amount (magnitude of change orders).
[h]Number of change orders/contract duration (frequency of change orders).

completion durations in District 1 can therefore be attributed to the high volume and visibility of the roadways and the more urban location of the district. The main reason for using I/D provisions in District 3 contracts was that these contracts involved primarily the construction of new decks on bridges over the Illinois River. These projects resulted in extreme adverse travel to the public, and therefore could not tolerate time extensions. Also, being a more rural district and due to the smaller contract amounts, the I/D projects in District 3 may have been defined relatively better in scope, not necessitating major changes in the amount of work, and consequently resulting in no extensions of time.

When sorted by project type as pavement or bridge projects it can be seen that pavement projects received 8.14% extension, whereas few, if any, of the other projects including major bridge work were granted any extensions (Table 5). It is difficult to explain why bridge-related works did not receive any time extensions. The delays in essential completion and final completion of non-I/D bridge projects have been the smallest among other district and project type classifications. The ratios of essential duration to contract duration and the ratio of final duration to contract duration in non-I/D bridge projects were 1.13 and 1.55, respectively, whereas the corresponding averages of over the entire sample including bridges and pavements were 1.28 and 1.76, indicating the earlier completion of bridge projects. A similar trend was observed in the ratio of essential duration to contract duration for I/D contracts in the bridge related works category (Table 5).

At the beginning of this study it was expected that due to the critical nature of the projects, I/D contracts would have a clearer definition of the scope of work, resulting in smaller

TABLE 4. Average Daily Traffic in Construction Zones

District (1)	Project type (2)	Average/daily traffic (ADT) (3)
1	I/D projects	78,370 vehicles
	Non-I/D projects	53,027 vehicles
	All projects	66,023 vehicles[a]
3	I/D projects	7,607 vehicles
	Non-I/D projects	16,275 vehicles
	All projects	12,676 vehicles[a]

[a]Weighted average.

TABLE 5. Comparison by Project Types

	PROJECT TYPES			
	Pavement		Bridge	
Ratio (1)	I/D contracts (2)	Non-I/D contracts (3)	I/D contracts (4)	Non-I/D contracts (5)
Ext/cont. dur.[a]	0.0814	0.2538	0.0027	0.2253
Ess/cont. dur.[b]	0.8553	1.4375	0.816	1.1299
Fin/cont. dur.[c]	1.446	1.9491	1.5402	1.5534
Act/cont. am.[d]	1.1211	1.0534	1.1034	1.0769
Cont. am./est[e]	0.9488	0.9145	0.9784	0.912
Act/est[f]	1.0706	0.9644	1.088	0.9807
CO/cont. am[g]	0.1211	0.0534	0.1034	0.0769
#CO/cont. dur.[h]	0.1822	0.1229	0.2047	0.129

[a]Extended duration/contract duration.
[b]Essential duration/contract duration.
[c]Actual final duration/contract duration.
[d]Actual contract amount/original contract amount.
[e]Original contract amount/engineer's estimate.
[f]Actual contract amount/engineer's estimate.
[g]Dollar amount of change orders/actual contract amount (magnitude of change orders).
[h]Number of change orders/contract duration (frequency of change orders).

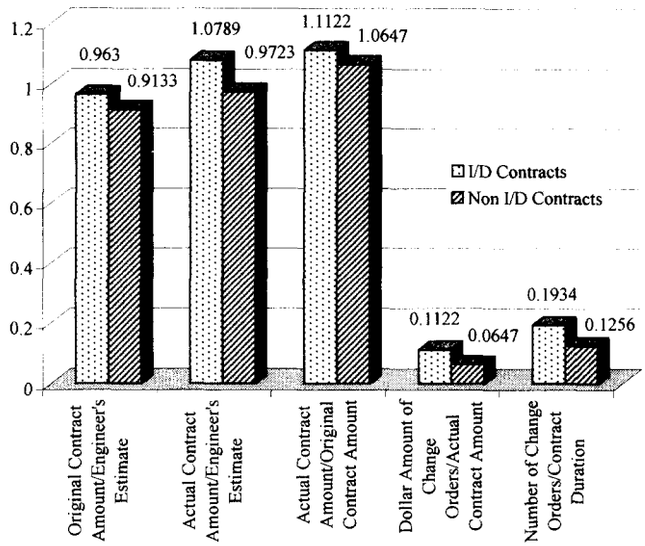

FIG. 4. Estimate and Change Order Comparison

dollar value and lower frequency of change orders. However, when the survey data was analyzed, the opposite trend was observed. As seen in Fig. 4 the frequency of change orders was 0.13/d in non-I/D contracts and 0.19/d in I/D contracts. The magnitudes of these change orders were 6.47% of the contract value in non-I/D contracts and 11.22% in I/D contracts (Fig. 4). One explanation may be that expressway reconstruction projects, for example, were contracted on an I/D basis and were usually "rushed" such that the design consultants were not given adequate time to prepare a complete set of plans. It appears, therefore, that accelerating a project increases the number and dollar amount of change orders. When the data is analyzed by districts, it was interesting to note that in District 3 the dollar amount of change orders per project was larger than in District 1, both in I/D and non-I/D contracts. Furthermore, in District 3, against the overall trend, the frequency of change orders in I/D contracts was lower than the frequency in non-I/D contracts (Table 3).

I/D contracts in the sample always exhibited higher budget overruns than non-I/D contracts, presumably because of the higher frequency and magnitude of change orders. I/D contracts cost 11.22% more than the contract amount whereas non-I/D contract budget overrun was only 6.47% (Fig. 4). So, while the ratio of essential duration to contract duration in I/D contracts was 34.69% smaller than the same ratio for non-I/D contracts, the budget overrun in I/D contracts was 4.27% more than the budget overflow in non-I/D contracts. When sorted by districts (Table 3) and by types of projects (Table 5), the same trend is seen for I/D contracts over non-I/D contracts. However, considering the time savings in the speedy opening of the highway to traffic in I/D contracts, it is not surprising to see this difference in I/D and non-I/D contracts' actual costs.

Of the 75 I/D contracts that IDOT completed in the period 1989–93, only five (6.7% of all I/D contracts in the mentioned period) were charged disincentives. Four of them were in District 1 and one in District 8. Contracts in District 8 were not included in the study, but the four contracts in District 1 were investigated. Unfortunately, at the time of investigation, those contracts had not been finalized and there were disagreements regarding the amount of these disincentives.

Among the I/D contracts that were investigated in this study contractors received on the average 4.71% of the contract amount as incentive payments. This number is in compliance with the 5% cap requirement in IDOT *Design Memorandum 90-53*. The 5% cap was placed as a cushion to limit the in-

centive payments in case there was an error in the establishment of the contract duration ("Incentive" 1989). However the study shows that the average actual amount of incentive allowed in a project was 5.13% of the contract amount (Yasamis 1994). The maximum and minimum percentages paid to contractors as incentive were 21.66% and 0.26%, respectively.

Eight out of 28 I/D contracts allowed incentives that were more than 5% of the contract amount. This explains why the average incentive allowed (5.13%) exceeded the cap of 5%. The incentives that were larger than the 5% cap specified in *Design Memorandum 90-53* were justified by IDOT personnel by the fact that the projects in question were small in size and that adherence to the 5% cap would have resulted in very small incentives that would not serve the motivational purpose.

The ratio of the total incentive amount received by contractors to the maximum allowable incentive amount was 91.81%. In other words, contractors succeeded in earning 91.81% of the available incentive amount. Another approach in measuring the performance of the contractors was to calculate an average of the ratios of the incentive days earned per project to the maximum allowable incentive days per project. This ratio came out as 87.90% (Yasamis 1994). The difference in these two percentages, 91.81 and 87.90%, stemmed from the utilization of cooperative incentive payments in some contracts. In those contracts where cooperative incentive I/D provisions were used, the allowable incentive duration was kept constant, but if all the cooperative contracts succeeded in attaining the schedule target established, the daily incentive amount per day was doubled for each of them.

The benefit/cost (B/C) ratio in I/D contracts averaged 2.46 (Yasamis 1994) where "benefit" is defined as the cost savings to the public in terms of road-user delay costs and "cost" is defined as the money paid as incentive to the contractor. The averages of B/C ratios with respect to district and type of work were found to be 2.57 in District 1 contracts, 1.92 in District 3 contracts, 2.97 in pavement work, and 1.89 in bridge work.

It has been suggested in the IDOT experimental feature final report [for project BHF-10(46) at FA Route 10, Section 86 BR, Cass and Schuyler counties, Ill.] that I/D clauses may be expected to lower the bids received from contractors. The reason for this anticipation was attributed to the savings in manpower and equipment that would be achieved because of the early completion of such projects. Yet, it can also be argued that when the project duration is to be compressed, more resources in terms of manpower and equipment have to be utilized in an average I/D project to meet the early completion target. The research shows that I/D contracts tend to receive slightly higher bids than similar non-I/D contracts with an average of 96.30 and 91.33% of the engineer's estimate for I/D and non-I/D contracts, respectively (Fig. 4). The overall analysis with respect to districts and types of projects also agree with the finding that bids received for I/D contracts were consistently higher than for non-I/D contracts of similar scope and size (Tables 3 and 5). The same trend is observed in the actual costs of projects with respect to engineers' estimates. The ratio of actual cost to engineer's estimate in I/D contracts is 10% larger than the same ratio in non-I/D contracts (Fig. 4). One explanation may be that IDOT's estimates for I/D projects were on the conservative side.

One result that deserves emphasis is that in all projects (except in projects undertaken in District 3) the size of the awards made in both I/D and non-I/D contracts were on the average lower than the respective estimates. In District 3 the I/D contracts were awarded to bids that were on the average 1.08 times more than the engineer's estimate. Following this the actual costs of District 3 I/D projects exceeded the estimates by 24.05%, and the contract amounts by 12.49%, making them stand out as the most expensive contracts. On the other hand, this increase in cost was accompanied by a reduction in the essential duration/contract duration ratio for I/D contracts.

CONCLUSIONS

The findings of the study can be summarized in the following way.

Most (93.3%) of the I/D contracts that were undertaken by IDOT during the 1989–93 period were completed on time or sooner. Very few (6.7%) of these I/D contracts were to pay disincentives, but a dollar settlement had not been reached at the time of the study. All of the I/D contracts included in the study sample were completed ahead of schedule whereas only 41.4% of the 29 non-I/D contracts were completed ahead of or on schedule. Of the 28 I/D contracts included in the study sample, 78.6% received full and 21.4% partial incentives.

I/D contracts received less time extension than non-I/D contracts. All of the time extensions were in District 1, none in District 3. Almost all time extensions were in pavement projects; bridge projects received negligible extension for contract duration.

I/D contracts achieved "essential" and "final" completion faster than non-I/D contracts.

The frequency and magnitude of change orders were larger in I/D contracts than in non-I/D contracts.

Budget overflows were larger in I/D contracts than in non-I/D contracts.

The average maximum incentive amount allowed per project was 5.13% of the contract amount. The average incentive amount paid per project was 4.71% of the contract amount, i.e., 92% of the maximum allowable incentive amount in I/D contracts.

I/D contracts received higher bids than non-I/D contracts.

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