DEVELOPMENT OF A MEANS TO CALCULATE PROJECT-SPECIFIC LIQUIDATED DAMAGES (LDs)

ON ALDOT PROJECTS EXCEEDING $20 MILLION

by
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ABSTRACT

This research effort sought to create a justifiable means for developing a project-specific liquidated damages (LD) calculation method for high value projects to be adopted by the Alabama Department of Transportation (ALDOT). The procedure outlined is to be used biennially to update the project-specific methodology for LD rates for highway construction projects exceeding $20 million. After conducting a literature review of LDs and other common contract provisions (i.e., incentive/disincentives (I/Ds) and road user costs (RUCs)) a survey was administered to 51 State Highway Agencies to establish a state-of-the-practice regarding the application, development, project staffing requirements, audit and review, and enforceability of LDs, I/Ds, and RUCs. The survey response rate was 88% (45 out of 51). This state-of-the-practice knowledge was taken into account when comparing LD calculation methods from other states to the current ALDOT LD methodology. This report presents a comparative quantitative analysis of three different LD methodologies: 1) a method currently used the Florida Department of Transportation (FDOT); 2) a methodology implemented by the Washington Department of Transportation (WSDOT) and Oregon Department of Transportation (ODOT)); and a project-specific LD calculation model using multiple regression analysis. The multiple regression model, created using IBM© SPSS Statistics, allowed for a list of project-specific factors to consider initially to monitor the sensitivity of including a different number of years in model creation. At the conclusion, the study found a similar LD estimating performance between the WSDOT/ODOT methodology and the multiple regression model, outperforming both the FDOT approach and

ALDOT's current LD estimating practice. Different configurations of the WSDOT/ODOT method and regression model yielded LD estimating accuracy ranging between -12% and +10%, while the accuracy obtained by ALDOT with its current schedule of LDs is around -29%. Likewise, an assessment conducted at the agency-level showed that, with its current LD provisions, ALDOT has only recovered 73% of the additional engineering and inspection (E&I) damages incurrent by the agency due to the late completion of high value projects between 2008 and 2015. Better percent recoveries around 106% and 93% were obtained with the WSDOT/ODOT and regression models, respectively.

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

Construction, rehabilitation, and maintenance of roads, highways, and bridges are necessary activities for societal and economic growth. However, the performance of these activities often become a hindrance to the motoring public due to disruptions of traffic by lane closures and detours. Even though state transportation departments (STDs) and the general public seem to recognize that traffic disruptions are unavoidable in most transportation projects, their impacts to the traveling public can still be controlled and minimized. STDs efforts towards the minimization of traffic disruption impacts are made continually throughout the project life cycle. These efforts include strategic decision-making during planning and design, the implementation of effective procurement and contracting processes, and a thoughtful selection of construction means and methods to increase productivity, shorten construction schedules, and reduce the need for partial and total lane closures in construction work zones (FHWA 2013; FHWA 2009). This need is expected to be higher as project size and complexity increase, making it more challenging for STDs to ensure reasonable levels of traffic impact. This paper is aimed to help the Alabama Department of Transportation (ALDOT) handle this issue through the effective implementation of key contract provisions in high value contracts. More specifically, this study has assessed the state-of-the-practice for liquidated damages (LDs), incentive/disincentives (I/Ds), and road user cost (RUC) provisions.

The contractual agreement between a State transportation department (STD) and a general contractor requires that work performed must be completed by a specific, contractual completion date. If construction is not completed by the agreed upon date, liquidated damages (LDs) are assessed as deductions, for each day of overrun of contract time, from payments otherwise owed to the contractor. LDs are justifiable, pre-breach estimates of anticipated average daily costs required to manage STD projects beyond the contract completion date. These expenses, at a minimum, typically include construction engineering (CE) costs as part of the owner's project responsibilities. However, "limiting LDs to the cost of agency oversight captures only a fraction of the costs associated with delays" (*Hoffer, 2013*). Additional expenses directly tied to contract oversight and administration resulting from contractor caused delays may be included (e.g., STD contract administration and oversight, extended public safety services, etc.). Large projects can cost the owner thousands of dollars per day in CE costs and additional expenses when a project is not executed in accordance with the contract provisions associated with time. STDs must develop budgets for planning purposes and funding requests, therefore any money spent to extend one project decreases funds originally planned for other projects; thereby affecting the ability of STDs to effectively use taxpayers' money.

While LDs are intended to recover damages to owners as a result of completing the project late, in some critical projects with anticipated high traffic impacts, STDs might decide to also offer additional compensation to contractors to incentivize early project completion. That is done through the use of I/D provisions that allow for additional compensation to the contractor if the project is completed ahead of schedule and obligate the contractor to pay a given fee to the owner for each day of delay beyond the contract completion date (Sun et al. 2012). It must

be noted that disincentive provisions are not the same as LDs. These two provisions are intended to compensate STDs and taxpayers for different types of damages resulting from delays in project completion, and this difference must be clearly stated in the contract documents (Sun et al. 2012).

Finally, RUCs refer to the monetary estimate of the costs incurred by road users due to traffic disruptions and detours. RUCs are commonly used in the calculation of LDs or I/Ds amounts, and rarely used as a separate contract provision. In this study, RUCs are considered as a separate contract element because of their critical role in the estimation of LD and I/D provisions.

Large, high contract value projects can cost owners thousands of dollars per day in CE costs and additional expenses when a project is not executed as planned. STDs must develop budgets for planning purposes and funding requests, therefore any money spent to extend one project decreases funds originally planned for other projects; thereby affecting the ability of STDs to effectively use taxpayers' money. This is where an effective assessment of LDs, I/Ds, and RUCs becomes critical, with effectiveness referring to the degree to which incentive payments for early completion and fees charged to the contractors for schedule overruns reasonably reflect actual benefits and damages, respectively.

When determining the cost of liquidated damages (LDs), daily monetary rates for construction engineering (CE) costs are typically established based upon historical project costs. The Alabama Department of Transportation (ALDOT) Standard Specifications for Highway Construction (*2018)* contains the following LDs provision (*§108.10*) and a schedule of LDs (*§108.11*) based on a range of contract dollar amounts, as shown in Figure 1-1. ALDOT's current

method for the development of LD rates is a statistically sound procedure that uses historical data, which are justifiable pre-estimates for construction engineering and inspection costs for projects with contract values that are $20 million dollars and less (Zech et al., 2008).

"§108.10 Failure to Complete Work Within Contract Time.

Should the Contractor, or in case of default, the surety, fail to complete the work within the time stipulated in the contract or the adjusted time as granted under the provisions of Article 108.09, a deduction for each calendar day or work day that any work shall remain uncompleted, an amount indicated by the Liquidated Damages Schedule shown in Article 108.11 or provided in the contract documents shall be deducted from any monies due to the Contractor on monthly estimates. Any adjustments due to approved time extensions or overruns in the contract amount will be made on the monthly, semi-final or final estimate as may be appropriate.

Liquidated damages assessed as provided in these Specifications is not a penalty but is intended to compensate the State for increased time in administering the contract, supervision, inspection and engineering, particularly that engineering and inspection which requires maintaining normal field project engineering forces for a longer time on any construction operation or phase than originally contemplated when the contract period was agreed upon in the contract.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may be extended, will in no way operate as a wavier on the part of the Department of any of its rights under contract.

§108.11 Schedule of Liquidated Damages.

Original Contract Amount		Liquidated Damages Daily Charge	
More Than	To and including	Calendar Day or Fixed Date	Work Day
$ 0	$ 200,000	$ 550	$ 1100
200,000	500,000	750	1500
500,000	1,000,000	950	1900
1,000,000	2,000,000	1250	2500
2,000,000	5,000,000	1650	3300
5,000,000	10,000,000	1850	3700
10,000,000	----------	2500	5000

When the contract time is on the calendar day or date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used."

Figure 1-1: Schedule of Liquidated Damages per ALDOT Standard Specification (*ALDOT, 2018*)

However, ALDOT currently does not have an accurate means of established rates for projects with high contract values, due to lack historical data as can be seen in Figure 1-2. It can be seen in Figure 1-2, that historical data is limited beyond the $20 million project value range.

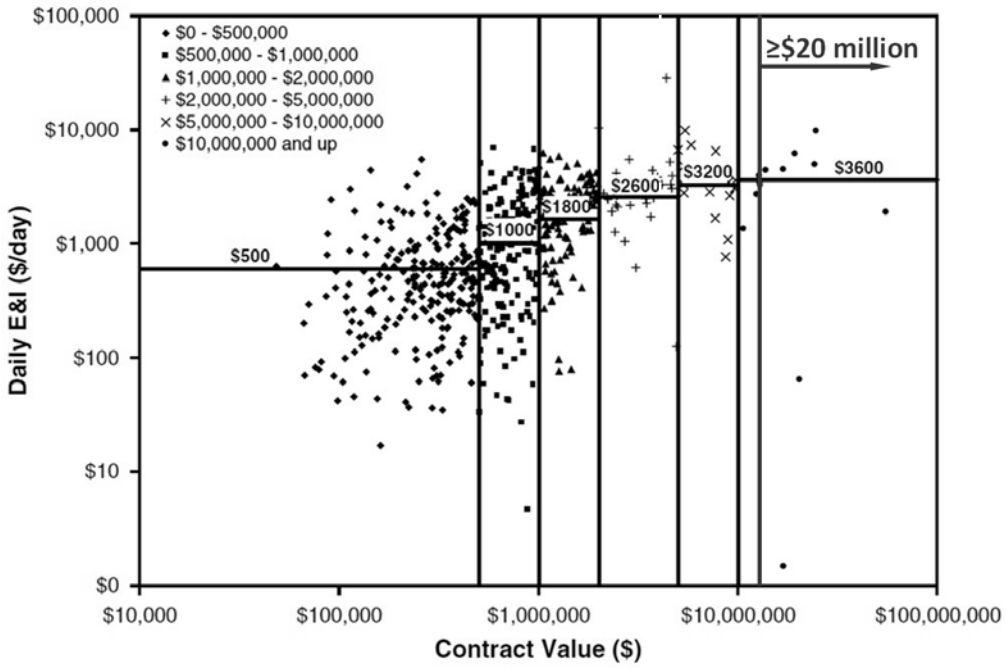


Figure 1-2: ALDOT's Workday LD Rates by Contract Value (*Zech et al., 2008*)

1.1.1 Current ALDOT Challenges

Currently, ALDOT assesses LDs on these large contract value projects based on the stipulated daily monetary rate specified in *§108.11 Schedule of Liquidated Damages* shown in Figure 1-1. As contract values increase well beyond $20 million (possibly in the $100 million range), the LD rates assessed, simply by referring to the schedule of LDs, are no longer statistically relevant. This is due to the small sample sizes of historical project data for high contract value projects.

The challenge of dealing with LDs for projects exceeding $20 million is one that ALDOT is currently facing and will continue to face since the frequency of high contract value projects being forecasted for future construction is increasing.

1.1.2 Research Objectives

It appears that the issues in developing LD rates for large projects with contract values exceeding $20 million are prevalent throughout the U.S. There is an overall lack of research quantifying LD rates for high contract value projects. Therefore, the objectives of this research are to: (1) Gain a comprehensive understanding of the current body of knowledge of LD, incentive/disincentive (I/D), road user cost (RUC) provisions, and legal challenges associated with implementation, (2) determine the state-of-the-practice in the U.S. regarding DOTs and SHAs development and implementation of LD, I/D, and RUC provisions on high contract value construction projects, and (3) develop a repeatable, project-specific methodology for determining and calculating LD rates on projects with contract values exceeding $20 million. The specific tasks to satisfy the abovementioned research objectives are as follows:

- **Task 1:** Conduct a literature review on the state-of-the-practice of LDs, I/Ds, and RUCs and the relationships between one another.
- **Task 2:** Develop a state-of-the-practice survey to be sent to other DOTs and state highway agencies (SHAs) to gain insight into how these agencies create and use LD provisions alongside I/D and RUC provisions.
- **Task 3:** Collect data from the ALDOT Project Database and Tabulation of Bids for relevant data about project specific factors (i.e., duration, original contract value, bidding costs, total E&I costs, project type, and project length).
- **Task 4:** Review, correct, and organize ALDOT (E&I) data and ALDOT bidding data into usable dataset for creation of a LD methodology

- **Task 5:** Develop of a Project-Specific Method that ALDOT can use to determine project-specific LD rates using SPSS software.

1.2 ORGANIZATION OF THESIS

This thesis is divided into seven chapters that organize, illustrate, and describe the steps taken to meet the defined research objectives. Following this chapter, Chapter Two: *Literature Review*, provides an overview of LDs and their enforceability, as well as the basic principles of I/D provisions and RUCs; and how these relate to one another. Chapter Three: *State-Of-The-Practice for Liquidated Damages On High Value Contract Projects Survey,* reviews the state-of-the-practice for LDs, I/Ds, and RUCs and their incorporation for high value projects. Chapter Four: *Data Collection and Processing*, reviews the collection and processing of the database of ALDOT projects. Chapter Five: *Application of Other States' Liquidated Damage Methods*, provides discussion on LD calculation methodologies from other states and measures their accuracy with the ALDOT Project Database. Chapter Six: *Liquidated Damage Calculation with SPSS Linear Regression*, describes the SPSS software and the process used to create a project-specific methodology for LD calculations. Chapter Seven: *Conclusions and Recommendations*, provides a summary of the tasks accomplished, and summarizes and identifies further research that can be conducted to further advance this research effort.

CHAPTER 2: LITERATURE REVIEW

2.1 DEFINITIONS

There are several key contractual terms that must be defined when dealing with liquidated damages (LDs) and the recovery of construction engineering (CE) costs. The clear distinction between LDs and incentive/disincentives (I/Ds) must be understood due to each provision having similar mechanisms, but different purposes and functions (*FHWA, 1989*). Secondly, both provisions have the potential to include road user costs (RUCs) when establishing LDs and I/Ds, therefore, this idea must be defined before further discussion can occur.

2.1.1 Liquidated Damages (LDs)

LDs are contractual provisions that establish a daily monetary rate deducted from monies owed to the contractor due to late performance. LDs are determined prior to contract solicitation as pre-breach estimated rates intended to recover costs of damages to State transportation departments (STDs) occurring from late performance on a contract (ALDOT, 2018).

2.1.1.1 Code of Federal Regulations, Title 23, Part 635

The United States Code of Federal Regulations (CFR) provides guidance for LDs on any project administered for the Federal Highway Administration (FHWA) in *23CFR§635.127, Agreement provisions regarding overruns in contract time*. 23CFR§635.127(a) states:

> *"Each State transportation department (STD) shall establish specific LDs rates applicable to projects in that State. The rates may be project-specific or may be in the form of a table or schedule developed for a range of project costs and/or project types. These rates shall,*

> *as a minimum, be established to cover the estimated average daily construction engineering (CE) costs associated with the type of work encountered on the project. The amounts shall be assessed by means of deductions, for each calendar day or workday overrun in contract time, from payments otherwise due to the contractor for performance in accordance with the contract terms" (NHTSA and FHWA, USDOT, 2018).*

It is important to note that, LD rates must cover, at a minimum, daily CE costs associated with the type of work encountered on the project.

23CFR§635.127(c) discusses the inclusion of additional costs in the calculation of LDs. These additional costs include "anticipated costs of project related delays or inconveniences to the STD or the public" (NHTSA and FHWA, USDOT, 2018*)*. These additional costs, which are often overlooked and not considered, can potentially pose significant cost implications, which may not be recovered in the event of schedule overruns. This section also notes that RUCs may be included in the LD rates for the contract.

23CFR§635.127(d) deals with I/D provisions. I/Ds are used to influence a contractor to complete a project ahead of the established construction deadline. "The incentive/disincentive amounts shall be shown separately from the liquidated damages amounts" (NHTSA and FHWA, USDOT, 2018).

Furthermore, 23CFR§635.127(b) states that STDs shall establish LD rates that must be approved by the FHWA. Project-specific LD rates must be approved on a "project-by-project" basis. If a table or schedule of rates is used, it must be initially approved by FHWA and then updated by the STD at least every two years (*NHTSA and FHWA, USDOT, 2018*). Finally, part 635, section 127(e)-(f) details the federal-aid reimbursement when LDs or I/Ds are charged.

2.1.1.2 Federal Acquisition Regulation

The Federal Acquisition Regulation (FAR) covers LDs in Subpart 11.5. Contracting officers should carefully consider the impact of LDs on "pricing, competition, and contract administration" (*GSA, 2005*). LDs should be used only when "the Government may reasonably expect to suffer damage if the delivery or performance is delinquent" (*GSA, 2005*). These damages can occur through additional CE costs or other costs resulting from the delay of contract completion. In addition, LDs must only be used when "the extent or amount of such damage would be difficult or impossible to estimate accurately or prove" (*GSA, 2005*). Due to variances in daily CE activities required on a construction project, the actual cost of the CE charges is very hard to estimate before contract award; therefore, LDs are used to provide the estimate of probable damages. The LD rate is established as "a reasonable forecast of just compensation for the harm that is caused by late delivery" (*GSA, 2005*) on the contract. The FAR also states that construction contracts should deduct LDs per day of delay, and LD "rates should include the estimated daily expense associated with the delayed completion" (*GSA, 2005*).

2.1.2 Incentives/Disincentives (I/DS)

I/Ds are typically used as part of contracts based on performance or delivery and designed to minimize impacts of road users. "I/D clauses are applied to unique projects, which pose considerable inconvenience to the motoring public, to minimize potential construction delays with the intention of achieving significant monetary savings" (*Crowley et al., 2008*). The use of I/D provisions is typically based on the impact or inconvenience a construction project has on the motoring public.

These contract types are covered under FAR Subpart 16.4. A performance incentive can be used to influence contractor performance by relating profit received to results achieved by the contractor, compared to specific targets (*GSA, 2005*). The delivery incentives are commonly used in situations "when improvement from a required delivery schedule is a significant Government objective" (*GSA, 2005*).

STDs may use a standard I/D provision along with or without LD provisions. STDs may also use alternative contract methods to incentivize performance or delivery of contractors. I/Ds must be shown separately from LDs in accordance with 23CFR§635.127(d) (*NHTSA and FHWA, USDOT, 2018*). If the STD includes RUCs in the LD rate, "the delay costs should be excluded from the disincentive amount of an I/D project, so a contractor is not subjected to a double assessment of the same costs" (*FHWA, 1989*). It is vitally important that I/Ds and LDs are distinctly different figures. "LDs should in no way be perceived as punitive damages inflicted on the contractor by the SHA as a means of coercing the contractor into timely performance" (*Crowley et al., 2008*).

2.1.3 Road User Costs (RUCs)

Traffic delays and diversions result in road user impacts commonly quantified as increased RUCs borne by the motoring public. These costs typically include "travel time, vehicle operation, crashes, and air quality" (FHWA, 2014). RUC values can be used during project planning to determine relative benefits of construction improvements, and they can be used during construction to assess the impact to the public. In accordance with 23CFR§635.127(c), road user delay costs may be included in LD amounts (*NHTSA and FHWA, USDOT, 2018*). RUCs may also be included as the basis for I/D provisions (Sillars, 2007). RUCs are not typically found as a separate provision in construction contracts and seem to most commonly be incorporated into I/D

provisions on large, critical projects. Since "any RUC that provides the basis for an I/D clause must be a reasonable approximation of the actual cost experienced by the road user, and not an arbitrary value that is used to punish the contractor for causing construction delays… RUC method must use valid unit costs, have repeatable results, and be appropriate to the project" (*FHWA, 2014*).

2.2 LIQUIDATED DAMAGE (LD) PRINCIPLES

It has become standard practice for most public and private owners to use LD provisions as an attempt to avoid delay-related litigation in construction contracts (*Thomas et al., 1995*). LDs are used in lieu of general damages (or unliquidated damages) in contracts to avoid legal requirements of proving that an actual loss occurred as a result of a contractual breach and that the loss was a direct resultant of the breach (*Turner & Townsend PLC, 2009*). The inclusion of LD provisions in contracts preclude the STD from attempting to recover actual damages resulting from contractor caused delays; therefore, the enforceability of LD provisions is of vital concern to STDs.

2.2.1 Basic Principles

Thomas et al. (*1995*) provides an in-depth review of the rules associated with the enforceability of LD provisions in construction contracts. The most basic principle of LD enforcement is that the owner forfeits all rights to recover LDs if they are responsible for the delay (*Thomas et al., 1995*). In turn, an owner's rights to LDs occur when nonexcusable delays (i.e. delayed mobilization, delayed procurement, delayed important document submission) occur as a result of the contractor. "By legal definition, a nonexcusable delay provides the owner with an opportunity to claim damages for that period of time in which same is unable to utilize the

contracted for structure for its intended purposes" (*Jervis and Levin, 1988*). This means that nonexcusable delays allow the owner to pursue damages because the structure under contract still cannot be used for its designated purpose. Some additional foundational principles of LD provisions include: (1) delays attributed to the contractor, (2) apportionment of damages, (3) LD amounts, (4) period of assessment, (5) relationship to actual damages, and (6) LDs versus penalties. These six foundational principles are discussed below.

2.2.1.1 Delays Attributable to Contractor

LDs can only be charged when nonexcusable delays are attributable to the contractor. On the other hand, excusable delays will add to the contract completion date and reduce the total amount of LDs to be collected (*Thomas et al., 1995*).

2.2.1.2 Apportionment of Damages

If delays are attributed to the contractor and the STD, such as during a concurrent delay, LDs must also be apportioned or allocated to the causing entities (*Thomas et al., 1995*).

2.2.1.3 Liquidated Damage Amounts

STDs must establish pre-breach estimates of damages that may result from contract time overruns. In construction contracts, these factors may account for "lost revenue or rental values, user costs, engineering and administrative costs, interest, and extended management and overhead fees" (*Thomas et al., 1995*). For STDs, the most significant costs tend to be CE costs and RUCs, if they are used as a basis for LD calculations. STDs often use LDs from a rate schedule based on a range of contract values; however, STDs may develop project-specific LDs based on complexity or phasing (*FHWA, 2014*). The FHWA specifically states that "for projects that do not

have an I/D clause, the LD rate may include elements that are commonly used to establish the I/D rate" (*FHWA, 2014*).

2.2.1.4 Period of Assessment

Another basic principle for LD enforceability is the period of assessment. STDs must clearly define the assessment period in the contract language to avoid disputes. These periods are often defined by work days or calendar days. STDs should also ensure that clear contract language defines whether holidays and weekends are included in the assessment period (*Thomas et al., 1995*).

2.2.1.5 Relationship to Actual Damages

As discussed previously, LD provisions generally limit the STD's ability to pursue recovery of actual delay damages. The LDs are assessed in lieu of actual damages; however, LD provisions do not prevent the STD from pursuing recovery of actual damages "resulting from negligence, poor workmanship, willful misconduct, termination, abandonment, or numerous other defaults by the contractor" (*Thomas et al., 1995*). Typically, courts rule that one can receive either LDs or actual damages, but a door has been opened through a unique scenario between Chautauqua County and Tiller Construction, where given specific contractual language allowed both to be pursued (*McCormick, 2003*). The construction company defaulted, and another contractor finished the job. This allowed for the pursuit of LDs listed in the contract, but also for actual damages "based on the slow response by the surety to the default of the contractor and was asserted under the performance bond (*McCormick, 2003*). By ruling in favor of the owner, the New York Supreme Court established a precedent for similar contracts in the future. While LD provisions provide STDs a mechanism to recover any increases in cost associated with the

additional time, there are some occasions where it is beneficial to pursue actual damages in court. These occasions include: (1) if it is likely that actual damages will be greater than the original estimated LDs, or (2) if the confidence within the estimated value of LDs is weak, it is better to pursue actual damages at the project end in a court of law. If damages are easy to measure, the focus should switch to pursuit of actual damages because the odds are good for the owner to recover all damages caused by a contractor delay (*McCormick, 2003*).

2.2.1.6 Liquidated Damages versus Penalties

Most of the principles discussed previously for the enforceability of LDs are straightforward; however, the differentiation between LDs and penalties seems to yield most of the problems with LD enforcement. Overall, most court decisions have ruled that LDs are enforceable when they are "fair and reasonable estimates of anticipated losses caused by unexcused delays" (*Thomas et al., 1995*). This interpretation of LDs supports the idea of LD provisions being used as a mechanism for owners and contractors to settle differences stemming from delays without resorting to costly legal remedies (*Thomas et al., 1995*). The Supreme Court ruled that damages are not a penalty:

> *"Where the amount stipulated for is not so extravagant, or disproportionate to the amount of property loss, as to show that compensation was not the object aimed at or as to imply fraud, mistake, circumvention or oppression. There is no sound reason why persons competent and free to contract may not agree upon this subject as fully as upon any other, or why their agreement, when fairly and understandingly entered into with a view to just compensation for the anticipated loss, should not be enforced" (Wise v. United States, 1919).*

As a contrast to LDs, "a 'penalty' is the sum a party agrees to pay in the event of a contract breach, but which is fixed, not as a pre-estimate of probable actual damages, but as a punishment, the threat of which is designed to prevent the breach" (*Westmount Country Club v. Kameny, 1964*).

A penalty may have no apparent relationship to the damages incurred due to the time overruns of a contract, but rather is chosen by the owner to coerce a contractor into timely performance (*Thomas et al., 1995*). STDs should avoid adding any unsubstantiated costs to the LD estimate in an attempt to "get that little extra back" due to the risk of invalidating the LDs as a penalty (*Turner & Townsend PLC, 2009*). It is critical for STDs to understand local court decisions and fully document all LD decisions for future reference.

2.2.2 Primary Rules of Inquiry

When reviewing disputes between owners and contractors related to time overruns on contracts, numerous courts have relied on four primary inquiries when reviewing disputes concerning LD provisions (Thomas et al., 1995). The four primary inquiries are: (1) Is an LD clause present?; (2) What were the owner's intentions?; (3) Were the actual losses difficult to predict?; and (4) Is the stipulated sum reasonable? (Thomas et al., 1995) The Supreme Court of Alabama used all four primary inquires in Milton Const. Co., Inc. v. State Highway Dept. (*1990*). After determining that a LDs provision was present (inquiry 1), the court used the remaining three to provide reasoning behind their decision. Quoting from a previous decision in Camelot Music, Inc. v. Marx Realty & Improvement Co., the court wrote that:

> *"We cited three criteria by which a stipulated damages clause may be characterized as liquidated damages as opposed to a penalty: 'First, the injury caused by the breach must be difficult or impossible to accurately estimate; second, the parties must intend to provide for the damages rather than for a penalty; and, third, the sum stipulated must be a reasonable pre-breach estimate of the probable loss'" (Milton Const. Co, Inc. v. State Highway Dept., 1990).*

With the inclusion of contract clause requirement, these four questions are presented and discussed below.

2.2.2.1 Is There a Liquidated Damages Clause?

This is the most basic inquiry from the court and one of the easiest to anticipate from an owner's perspective. If there is no LD provision in the contract, the owner's only recourse will be to pursue recovery of actual damages (*Thomas et al., 1995*). After determining the contract in question did contain LDs, the court system can move forward to the other inquiries to make an accurate ruling.

2.2.2.2 What Were the Intentions of the Owner?

When settling disputes, courts will scrutinize the intention of the STD when developing LD provisions and rates. The *Robinson v. U.S.* (*1923*) case stated that, "in construction contracts a provision giving liquidated damages for each day's delay is an appropriate means of inducing due performance, or of giving compensation, in case of failure to perform" (*Robinson v. U.S., 1923*). While LDs may be "an appropriate means of inducing due performance," the intent of LDs must remain to recover estimated costs to the STD. In fact, "performance acceleration and damage minimization are categorically different" (*Sun et al., 2013*). As stated in *Milton Const. Co., Inc. v. State Highway Dept.*, "a penalty is in essence a security for performance designed to punish one party for breach of contract, whereas a liquidated damages provision is a sum to be paid in lieu of performance (a sum that the parties agree upon as an adequate assessment of damages that would result from a possible breach)" (*Milton Const. Co, Inc. v. State Highway Dept., 1990*). The LDs must have been established as "a good-faith effort to pre-estimate actual damages suffered by the owner for delayed completion" (*Thomas et al., 1995*). A clear example of this inquiry in a case can be seen in *Bethlehem Steel Co. v. City of Chicago* (*1964*) where the court's opinion stated that:

> *"Viewing this contract from the time it was entered into, it is evident that the provision for $1,000 for a day's delay was a reasonable provision and that it was the parties' intent that that be the sum recoverable for each day's delay in order to forestall legal proceedings for a determination of the precise amount of damages" (Bethlehem Steel Co. v. City of Chicago, 1964).*

Also in the court's opinion, it was noted that:

> *"Liquidated damages provision in a contract for construction is to be judged as of the time of making the contract, and the fact that actual damages suffered are shown to be greater or less than the liquidated damages fixed by the parties is not determinative of the unreasonableness of the stipulated damages nor fatal to their validity" (Bethlehem Steel Co. v. City of Chicago, 1964).*

Since the owner's intention was deemed favorable when developing the LD rates, the fact that no actual damages were incurred was irrelevant to the enforceability of the LDs. However, even when owner intent abides by the laws and contract terminology, the courts do not always rule in favor of them. Clarkson et al. (*1978*) provides a counter argument of the intent ruling, in Massman Construction Co. v. City Council, Massman had agreed to a LD rate of $250 for each additional day the construction of a bridge across the Mississippi River took beyond the contractual completion date. The bilateral contract demonstrated good intentions, yet the court ruled to dismiss the clause because reasonableness could not be found without actual damages (*Clarkson et al., 1978*).

2.2.2.3 Were Actual Losses Difficult to Predict?

In defining when LDs provisions should be used, the FAR states that LDs should only be used when "the extent or amount of such damage would be difficult or impossible to estimate accurately or prove" (*GSA, 2005*). When damages are more certain or easier to calculate, there is less incentive for owners and contractors to negotiate LD provisions in contracts (*Thomas et al., 1995*). Due to the practicality of the situation, there would be little to no reason for a LD

clause when damages are already known when developing a contractual agreement (*Clarkson et al., 1978*). However, LDs "serve a particularly useful function when damages are uncertain in nature or amount or are unmeasurable, as is the case in many government contracts" (*Priebe & Sons v. U.S., 1947*). LDs serve a valuable role when harm caused by a delay is difficult to define or when a project may have significant intangible benefits (*Thomas et al., 1995*).

LDs have been upheld even when arbitrary values have been chosen due to the inability of ascertaining damages prior to the breach. "Damages were clearly incapable of being ascertained at the time the contract was entered into and the sum of $250.00 per day is not excessive under the circumstances" (*Osceola County v. Bumble Bee Const., Inc., 1985*). While justified in legal precedence, it would be inappropriate for STDs to arbitrarily choose LD rates due to the high potential for unrecoverable costs to the agency and the public.

Uncertainty and difficulty in predicting actual losses are critical factors when determining LDs, however even the reasoning behind the uncertainty aspect allows for broad enforcement. Clarkson et al. (1978) discusses a Florida Supreme Court case, Hutchison vs. Tompkins, in which land vendors pursued a deposit from the purchasing party, who defaulted on their payments. Lower court systems ruled against the vendors, stating *inter ali,* meaning the damage to the vendors was "easily discernible at the time of the breach under settled legal principles" (*Clarkson et al., 1978*). The Florida Supreme Court ultimately stepped in, and overturned the ruling stating a better ruling was to grant the vendors the ability to recover LDs since damage costs were not easily estimated during the contract development (*Clarkson et al., 1978*).

2.2.2.4 Is the Stipulated Sum Reasonable?

Finally, all courts will also view LD enforceability based on the "reasonableness test" relating to the time when the contract was drafted, and LD rates were established (*Thomas et al., 1995*). "The consensus seems to be in favor of upholding and enforcing such provisions, even absent proof of any actual damages, where it was reasonable at the time of making the contract" (*Bethlehem Steel Co. v. City of Chicago, 1964*). The reasonableness of LD rate determinations must generally be viewed "in light of known circumstances at the time of contract execution" (*Thomas et al., 1995*). While most jurisdictions have firmly established legal precedence for determining that the estimate of LDs should be considered valid at the time contract is signed, some minority jurisdictions require some "reasonable approximation between actual loss and probable loss" (*Sun et al., 2013*).

While not a highway construction project, one example of this can be seen in the *Hovas Const., Inc. v. Bd. of Trustees of W. Line Consol. Sch. Dist.* (*2012*), where several opinions were offered as to the comparison of probable and actual damages. The majority opinion upheld that the school district had incurred actual losses, and the concurring option rejected the concept of even conducting a comparison between LDs and actual damages (*Caudle, 2015*). Caudle (*2015*) states that the dissenting opinion of the court argued that since the owner had no damages, any LD provision enforcement would simply be a penalty. (*Hovas Const., Inc. v. Board of Trustees of Western Line Consol. School Dist., 2012*). LDs must be fair and reasonable to remain enforceable through disputes. "Historically, LDs that are disproportional to actual damages have been deemed penalties and unenforceable by the court of law" (*Zech et al., 2008*). An example of poor LD rate determination by a local public agency (LPA) was shown in the court opinion on *Rohlin*

Const.co., Inc. v. City of Hinton (*1991*). Due to the lack of justification of the LDs, it was determined that the city was using LDs as a penalty.

> *"There is no valid justification for the individual liquidated damage amounts… [T]he person who set the $400-per-day amount in each contract is unknown and was not called as a witness. Additionally, no witness was called to justify the suggested liquidated damage amounts contained in the DOT manual schedule. The county engineer did not conduct studies or present any other data suggesting that defendants anticipated that the government entities and the public could sustain damages equivalent to the $400-per-day liquidated damage amount contained in… the… contracts. Furthermore, [the] plaintiff called the school superintendent as a witness to give evidence that the school experienced no problems due to the road work. The county engineer also indicated that a Hinton grain elevator company had not complained that delayed completion of the road work caused the company or its patrons any damages or losses" (Rohlin Const. Co., Inc. v. City of Hinton, 1991).*

One of several potential methods for increasing the enforceability of LD clauses is the concept of negotiating LD rates between the owner and the contractor. The act of negotiating the LD rates, helps to establish the reasonableness of the values and document the intent behind the provisions. In *Milton Const. Co. v. State Highway Dept.* (*1990*), the opinion stated that the STD "unilaterally decided to include a disincentive clause in its contracts prior to any negotiations with Milton and prior to Milton's involvement in the I–65 or I–59 Projects. Thereafter, contractors bid on the projects with the disincentive clause included as part of the bid documents, not as a negotiated term or condition" (Milton Const. Co, Inc. v. State Highway Dept., 1990). This opinion would suggest that alternative contracting methods, such as "A+B bidding with I/D contracts might be considered less unilateral" (*Sun et al., 2013*). By "retaining evidence of how the pre-determined sum was calculated and evidence demonstrating that the figure was negotiated," owners strengthen the enforceability of their LD provisions (T*urner & Townsend PLC, 2009*). In a sealed bidding environment common to STDs, negotiating LD rates may not be

feasible, but it should be considered when using other contracting methods (i.e., D/B and private construction contracts).

Another key component of "reasonableness" is the allocation of damages among contract provisions. Under the opinions of *Milton Const. Co., Inc. v. State Highway Dept.* (*1990*) and *State of Ala. Highway Dept. v. Milton Const. Co., Inc.* (*1991*), the state upheld the idea that "any double inclusion of damages in multiple clauses could render one clause as redundant and unenforceable." In *State of Ala. Highway Dept. v. Milton Const. Co., Inc.* (*1991*), the LD clause was deemed to account for delays, so no RUCs could be used as the basis for the disincentive provision (*Sun et al., 2013*). "That is, the Highway Department's recovery under the contract's default provisions and liquidated damages provisions provide it with full compensation. Whether the additional damages are characterized as disincentives or as user costs, they would pass the 'limit of reasonableness'" (*State of Ala. Highway Dept. v. Milton Const. Co., Inc., 1991*). Since the FHWA allows RUCs to be included in LDs, delay-related costs could be included in LDs and disincentives, thereby making disincentives a subset of LDs (*Sun et al., 2013*).

While the reasonable test is a major factor in the court of law for determining LD enforceability, it cannot be the sole way to make decisions, given the following examples. Some LD contract clauses demonstrate reasonability at the time of the contract drafting but may not seem reasonable at the conclusion of the project. However, some clauses are the complete opposite, where the original LD provisions are not at all reasonable when the contract is drafted, but at the end of the project, become very reasonable. Another possibility is that LD clauses were drafted to limit damages, but the values were significantly lower than the already foreseen.

(*Clarkson, 1978*). These three scenarios demonstrate the need for additional testing besides that of the reasonableness test.

When it comes to following through on liquidated damages enforcement, some owners will opt against it in fear of creating stress between themselves and contractors, which could negatively impact the future of the current project or future planned projects (*McCormick, 2003*). McCormick (*2003*) states that when these situations occur, the owner's credibility can be brought into question at a later time, and negatively affect the completion of their project. "The bottom line is the owner has bought the right to exercise liquidated damages clauses in the contract and by not enforcing them they have tilted a level playing field in terms of contract administration and negotiation of issues in favor of the contractor." (*McCormick, 2003).*

Another common problem within LD enforceability is when milestones of an event are shifted or removed due to unforeseen events, which could affect follow-on projects. As long as delays in the preliminary project are not excusable, there is no reason an owner should not be allowed to collect LDs based on the contract that was agreed upon at the beginning (*McCormick, 2003*). McCormick sums up this entire problem, "in simplistic terms, the owner bought that date and the right to assess LDs if the work is not completed by that date, excluding of course any excusable delays."

2.3 INCENTIVES/DISINCENTIVE (I/D) PRINCIPLES

I/Ds within a contract can be based on many different things, such as schedule, quality, safety, and innovation. Sometimes it is appropriate to determine an I/D provision for only a particular portion of the project at hand, not the entire project as a whole (*Jaraiedi et al, 1995*). I/D contracts can offer a variety of benefits but are also problematic in some areas. Scheduling

difficulties, contract interpretation difficulties, drawing review delays, change order approval delays, and the decrease in quality to increase project speed are some of the problems that are commonly associated with I/D contracts (*Bubshait, 2001*). Additionally, there is some concern that the desire for incentives might pose additional safety risks to workers. In order to complete the job faster and decrease the impact on road users, many contractors are having employees work more hours per week and longer hours into the night. Fick et al. (*2010*) describes a study by Dembe et al. conducted from 1987-2000 that concluded working 60+ hours a week increases the risk of injury by 23% and working 12+ hours a day increases the risk of injury by 37%.

Despite the obvious risk to worker's safety, some of the other listed concerns might be unnecessary. One study performed by the Transportation Research Board concluded that I/D provisions increased not only innovation, but also quality of the projects completed by contractors that were given time incentives. Specifically, in this study, there was no significant difference between the quality of I/D projects and non-I/D projects. For instance, 19% of non-I/D projects acquired a quality deduction, while only 18% of the I/D projects acquired quality deductions. Furthermore, the net quality adjustment (the sum of quality incentive and disincentive), was slightly higher for I/D projects, therefore indicating slightly higher quality in I/D projects (*Fick et. al, 2010*). However, it remains unclear if this study is representative of the majority of contractors.

Owners' main goals for projects are: completion ahead of or at the deadline, high quality workmanship, compliance with all rules and regulations, and currency savings if possible (*Bubshait, 2001*). These four types of incentives are placed into contracts depending on the owner. Incentive-based construction contracts are different based on the area that an owner

wants to focus on. These different types of contracts include: (1) fixed price incentive, (2) cost reimbursable with or without an incentive, (3) performance incentive, and (4) safety incentive (*Bubshait, 2001*). The fixed price incentive contract can be a guaranteed maximum amount, used when a contractor has some say in the design aspect of a design-build project; or one with bonus/penalty incentives, which is based on completion. The cost reimbursable with or without an incentive contract should only be used for a low cost, short duration, or emergency situation because it provides the contractor with an incentive to increase the total price. The performance incentive contract is used based on criteria (i.e., quality of work, safety, productivity, etc.) established by the owner within the contract. The safety incentive contract is used when emphasis on safety is stressed but is not a guarantee of an injury free project (*Bubshait, 2001*).

Fick et al. (*2010*) mentions the need for further research in three main categories for I/D provisions moving forward. Specifically, more research is needed to: (1) address the lack of legal precedence on the enforceability of no-excuse clauses; (2) investigate the safety risks associated with satisfying road user demands in relation to I/D provisions, including increased incidence of night work and numerous shift schedules; and (3) explore risk sharing strategies between STDs and contractors to find a more effective and fair compromise on associated risk within I/D allocations.

2.3.1 Applications

I/D contracting methods are best suited for situations where the goal is to keep both user delays and traffic impacts at a minimum (*FHWA, 1989*). To offer additional help in deciding when I/Ds are appropriate within a contract, the FHWA (*1989*) created a short list of characteristics for consideration: (1) projects on high traffic volume facilities, generally in urban areas, (2) projects

that will complete a gap in a significant highway system, (3) major reconstruction or rehabilitation on an existing facility that will severely disrupt traffic, (4) major bridges out of service, and (5) projects with lengthy detours. Using I/D clauses motivate contractors to finish early, which benefits all roadway users.

When agencies are considering the use of I/D provisions within contracts, several points must be addressed: when to use I/D provisions, the balance to ensure both sides can benefit, measuring success of the I/D policies, addressing problems that can arise later, and if nonmonetary benefits can assist the situation (*Jaraiedi et al., 1995*)

The application of I/D provisions have been shown to yield an average net reduction in contract days by 19% (*FHWA, 2014*). The I/D provisions compensate contractors for early completion and provide deductions for each date that critical work is delayed past an agreed upon period. According to FHWA, I/D provisions should not be used routinely. I/D provisions should be used on appropriate projects that have high traffic volumes, will complete a gap in a highway system, have the potential to severely disrupt traffic, are on major bridges, or have lengthy detours (*FHWA, 2014*). These types of projects have the greatest chances of having high RUCs for the basis of the I/Ds. The use of I/Ds has been motivated by the difficulty in establishing RUCs as an enforceable component of LDs (*Sun et al., 2013*).

To effectively implement I/Ds, the STD should develop a compressed schedule for the basis of the I/Ds. By compressing the schedule and carefully establishing I/Ds, the STD can "encourage the contractor to be innovative" and "compensate the contractor for the additional expense of accelerating the work" (*FHWA, 2014*).

Daily I/D amounts are often therefore calculated on a project-specific basis using CE costs and RUCs. When establishing I/D rates, "engineering judgment may be used to adjust the calculated daily amount downward (not upward) to a final I/D amount" (*FHWA, 1989*). These adjustments are often made through the use of a discount factor to define the portion of the RUC savings that the STD is willing to share with the contractor. Selection of the discount factor is based on market conditions, confidence in RUC estimates, work zone factors, and time sensitivity of the project. When selecting a discount factor, the engineer must determine if the LD clause still applies to the contract, and then determine the impact of the discount factor on the risk mitigation for the STD. "The contractor is encouraged to accelerate the completion schedule further with increasing discount factors" (*FHWA, n.d.*). The I/D amount should be documented as accounting for savings to the motoring public and large enough to motivate the contractor. FHWA provides guidance that daily incentive rates should be equal to or less than daily disincentive rates. The recommended maximum incentive is also provided as five percent of the total contract amount (*FHWA, 1989*).

Currently, most I/D structures are symmetric due to a perceived higher likelihood of enforceability; however, since the "legal foundations for incentive and disincentive clauses are quite different," STDs run the risk of working against enforceability by promoting symmetry (S*un et al., 2013*). There may be merits of decoupling incentives from disincentives. Then incentives could be priced based solely on savings from RUCs and LDs would simply be intended to recover costs in the event of contract time overruns. Following this model, LDs "would include all potential types of damages, including engineering costs, construction costs, administration costs, road user delays, and safety impacts" (*Sun et al., 2013*).

When I/Ds and LDs are included in a single contract, the STD must clearly define when I/D assessments start and conclude. There is a potential that critical portions of a project covered under an I/D provision may finish early entitling the contractor to all incentives, while if the entire project is not substantially complete, the contractor may still be liable for LDs even though incentives were earned (*FHWA, 1989*).

2.4 ROAD USER COST (RUC) PRINCIPLES

RUCs focus on three separate components to create an equation: value of time (VOT), vehicle operating costs (VOCs), and accident costs (ACs) (*Zhu et al., 2009*). In Figure 2-1 below, Ellis et al. (*1997*) categorizes RUCs between quantified and unquantified effects. Within quantified effects are monetary and non-monetary factors. The monetary factors focus on the three components of the RUC equation while non-monetary focuses on the environment and comfort effects on the population (safety, pollution, noise). The unquantified effects are those based on social welfare and ecology (Ellis et al., 1997) Time costs weigh four different types of time: working time, commuting time, leisure time, and commercial time (*Zhu & Ahmad, 2008*). VOCs include fuel, tires, engine oil, maintenance, and depreciation. ACs are a total of fatal, non-fatal, and property damage accidents. In addition to these three components, cost of emissions and impacts of nearby projects should also be taken into account (*Mallela and Sadasivam, 2011*).

While the environmental costs are significant toward motorists, they have not been included due to the limited experimental data and the complexity of nature itself. Ellis et al. (*1997*) states that research concerning environmental costs for RUCs has only been occurring for the last 20 years, so its presentable data is very limited. It is also stated that the varying type and amount of pollutant released, as well as, the conditions it is released into make it difficult to truly

calculate the effects on the environment. Ellis et. al (*1997*) proposes a possible solution that includes retrieving a physical measurement of automobile pollution, adding it to the already existing pollution within the atmosphere and determining the overall effect "by multiplying the percentage change in mortality by the statistical value of life and by the percentage change in housing values against a standardized house value," (*Ellis et al., 1997*).

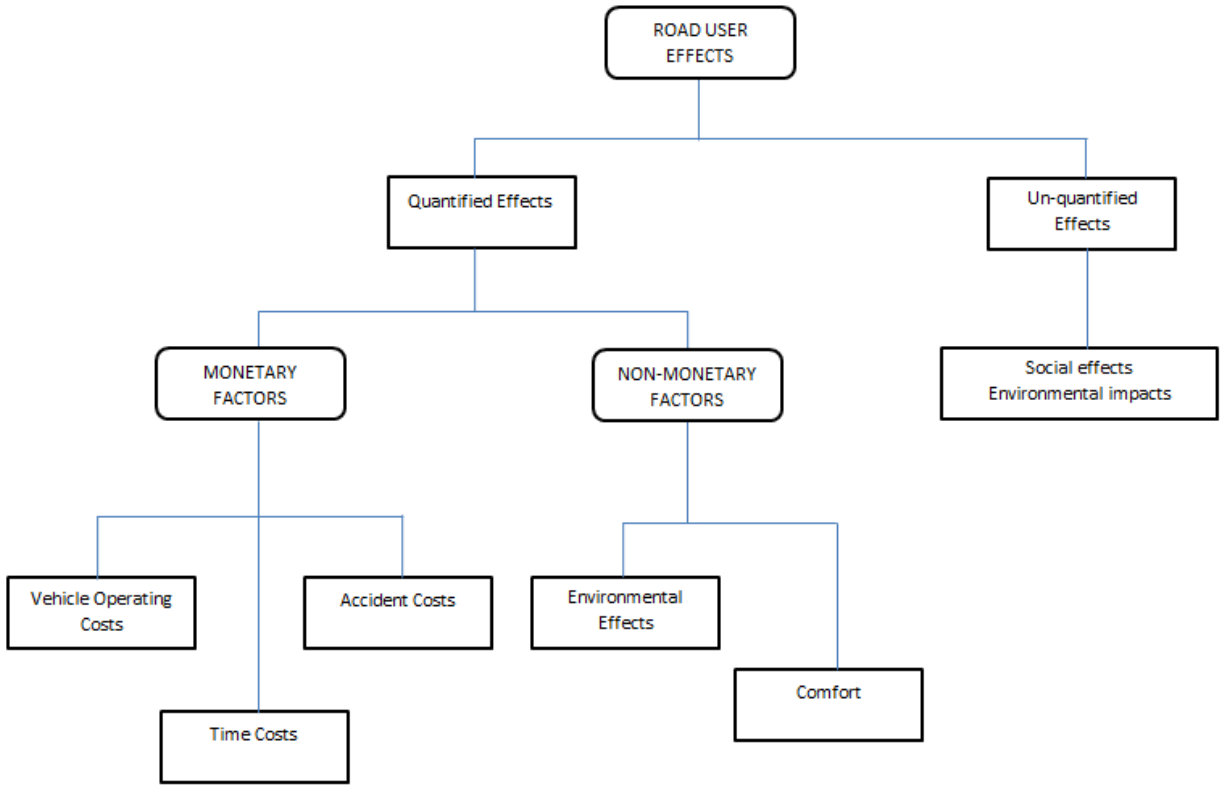


Figure 2-1: **Classification of Road User Effects, Ellis et al. (*1997*).**

2.4.1 Applications of RUCs

RUCs are accounted for due to costs incurred by the traveling public when affected by construction. Within the state of Texas, these costs are caused mainly by: (1) detours/reroutes that add time, (2) result in roadway capacity reduction, which causes slower speeds and greater travel times, and (3) delays in opening of new or improved facilities, which prevent drivers from travel time benefits (*Daniels et al., 1999*). In Figure 2-2, Daniels et al. (*1999*) demonstrates a

roadmap for incorporating RUCs into a project. He begins with determining if the project even satisfies the RUC criteria to the calculation of values for RUC determination. The criteria are as follows: a project must add capacity, have an economic impact on local businesses and communities, or be a rehabilitation project in a very high traffic volume area.

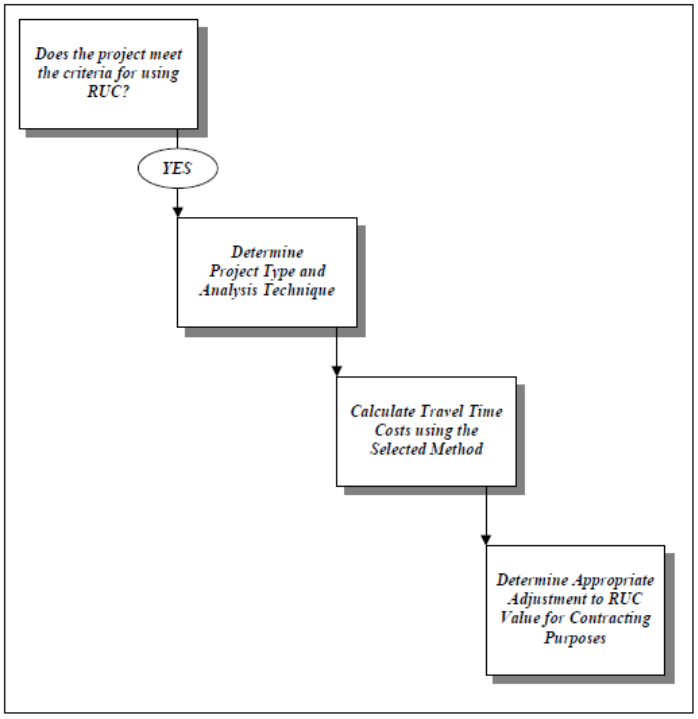


Figure 2-2: **Procedure for Estimating Road User Costs, Daniels et al. (*1999*).**

2.4.2 RUC Calculation Analysis Methods

Daniels et al. (*1999*) discusses three types of analysis techniques that can be used with RUC calculations: (1) phase by phase, (2) during versus after, and (3) before versus after. By comparing RUC values during each of these stages, estimations for future roadway projects will become more accurate.

Daniels et al. (*1999*) takes it a step further by suggesting a categorization within highway projects to help better facilitate analysis. Four categories (I, II, III, IV) were developed, each with specific project descriptions and analysis techniques. Category I deals with high impact urban

freeway construction or rehabilitation such as severe capacity reduction, phase completion time critical, and interaction with other freeway or arterial projects. Category II deals with urban arterial roadways, such as signalized intersections and diamond interchanges. Category III deals with other added capacity projects (i.e., highway widening projects not classified as I or II (i.e., rural highways, suburban arterials, urban freeways)), as well as new facility construction. Category IV deals with rehabilitation and other non-capacity-added projects. Some examples include paving projects without a capacity increase, bridge replacements, and detour routing (*Daniels et al., 1999*).

2.5 ALTERNATIVE CONTRACTING METHODS

In the *Contract Administration Core Curriculum Manual*, the FHWA provides some operational methods of alternative contracting that can allow STDs to incorporate time as a factor into contract award. These alternative contracting methods may encourage contractor performance through the use of I/Ds and may also help to recover CE costs similarly to LDs. The FHWA provides a matrix for schedule-focused contracting strategy selection in *Work Zone Road User Cost – Concepts and Applications, Chapter 4, Application of Work Zone RUC Analysis in Contracting/Project Delivery Methods*. Under the current LD model, the use of LDs is recommended only when early completion of a project is not a goal. For any time when early completion is a goal, other strategies are recommended. Some of these contracting strategies include: cost-plus time (A+B) contracts, lane rental, and liquidated savings, which are discussed below (*FHWA, n.d.*).

2.5.1 Cost-plus-time (A+B) Contracts

In cost-plus-time (A+B) contracts, time and cost are considered as factors when awarding the contract. Submitted bids are evaluated using two components to determine the low bidder. The "A" component is the contractor's traditional bid based on unit prices and quantities. The "B" component is the contractor's estimate of time required to complete the project. For consistency, the "B" component is typically expressed in calendar days. In order to determine a low bidder, a formula similar to Equation 2-1 is used (FHWA, 2014).

$$A + (B \times \text{Daily Road User Cost}) = \text{Bid value} \quad \text{(EQ. 2-1)}$$

where,

A = traditional bid cost, in dollars ($)
B = time to complete construction, in calendar days

When A+B bidding is used, STDs should incorporate I/Ds in the contract to ensure fair and adequate contract competition (FHWA, 2014). If using Equation 2-1, this I/D rate is distinctly different from any applicable LD rate. Final compensation to the contractor is not based on component "B" in any way; only the traditional bid and any contractual adjustments will be used for making total payments to the contractor. The use of A+B contracts can provide contractors with flexibility in establishing completion times and reward contractor innovation and efficiency (*FHWA, 2014*). LD provisions may be used in addition to A+B contract I/D provisions as long as RUCs are not counted twice.

Some of the many benefits associated with A+B bidding include: reducing RUCs and inconveniences to the public, minimizing pollution and environmental impacts as a result of construction, and encouraging contractors to develop more advanced, cost-effective strategies along with more comprehensive, strategic construction plans to reduce the total amount of work days needed to complete a project (*California DOT, 2002*).

California DOT (*2002*) advises that while there are many benefits to A+B contracts, there are some situations when they are inappropriate. An example would be in a project where there are documented conditions that could inhibit bidding contractors from accurately estimating the total work days for the project at hand or for projects in which third-party conflicts are probable.

A+B+I/D contract bidding is a strategy that allows for numerous contractors to bid amongst themselves for a reasonable amount of days needed to complete a project. This method drives competition and therefore shortens the cost and the total contract time for the contractor. In this method of bidding, the cost is not the only consideration for the contractor. It is the cost in addition to the time cost that determines which bid is selected (*Shr et al., 2004*).

Using A+B+I/D contract bidding encourages contractors to take advantage of different construction techniques to decrease the total amount of time needed to complete a project and is especially helpful for projects in which shortened work duration is critical. Examples of when A+B+I/D bidding is ideal would be for projects that disturb neighboring business and home owners, or that cause traffic disturbances, detours and/or increases safety to the public. Specifically, bridge and urban reconstruction projects benefit from this bidding method (*Shr et al., 2004*).

Projects that have a higher impact on road user delays are ideal for the A+B+I/D contract bidding method. This is true because the A+B+I/D contract accounts for time, and therefore bidders are motivated to propose timely project completion projections. The contractor strives to minimize construction time in order to earn more incentives. Often times, their time estimates are much less than the estimates of the engineer. One downside to this bidding method is that bidders might try to inflate their work time estimations closer to where they believe the

engineer's estimate is in order to earn extra incentive pay. However, this is typically not an issue, as excessive time bids place a disadvantage against other competitors. Additionally, the inclusion of a clause into the contract ensuring that bids can be rejected if a bidder's time estimate is larger than the engineer's time estimate can help alleviate this concern (*Sillars, 2007*).

The FHWA recommends implementing an I/D provision in conjunction with an A/B contract as opposed to using straight competitive bidding. With straight competitive bidding, the DOT decides the contract time and therefore does not motivate the contractor to work under the designated time frame (*Sillars, 2007*).

In I/D only contracts, the completion time for the project is determined by the DOT, whereas in A+B+I/D contracting, the contractor determines the schedule of the project. Therefore, using an A+B+I/D contract minimizes the risk of the contractor claiming that the schedule for the project was made unfairly or unreasonably. In turn, the DOT has more control over the scheduling of the project and any changes that might ensue (*Sillars, 2007*).

2.5.2 Lane Rental

Lane rentals are another alternative contract method used to account for RUCs. The purpose of a lane rental contract is to incentivize contractors to schedule work during non-peak periods and to encourage minimal use of traffic lanes for construction activities (*FHWA, n.d.*). The STD develops a rate to charge a contractor when lanes are closed or encroached upon during construction. Sometimes the rates are simple (a set cost whenever lanes are out of service) or they can be very complex (varying rates based on amount of capacity decrease or time of day/week when traffic is impacted). The contractor's bid may be required to include an initial line item, based on an anticipated schedule, from which lane rentals will be deducted (*FHWA,*

2014). Lane rental contracts are generally beneficial when detours are long or impractical, or peak traffic impacts would cause major disruptions. For some long-term projects, combining lane rentals and A+B contracts may be very advantageous (*FHWA, n.d.*).

2.5.3 Liquidated Savings

In contracts with liquidated savings provisions, contractors receive an incentive in the same amount as the savings to the STD for CE and other typical LD charges (FHWA, n.d.). LD provisions are also included in the liquidated savings contracts. The same methods are used for determining the liquidated savings and damages (*FHWA, n.d.*). Liquidated savings contracts have the advantage of using LD calculations to develop symmetrically calculated, but not symmetrically valued I/D models.

2.6 STATE OF THE PRACTICE FOR LIQUIDATED DAMAGES

Highway construction projects provide unique circumstances of construction coalescing with multiple stakeholders that are impacted by the project. The Michigan Department of Transportation defines a stakeholder as, "a person, group, or entity that has an investment, share, or interest in a [STD] project, program, or policy" (*MDOT, 2009*). STDs are therefore required to not only plan for ways to balance social growth with transportation activities, but also act as representatives for the tax payers that provide the funding for infrastructure expansion. This task requires holding all parties accountable for contractual obligations, including LDs.

Due to stipulations in the CFR, STDs are required to develop LDs that require FHWA approval prior to implementation. The CFR defines elements that can be included in the LD rates (i.e., CE costs, other anticipated costs of project related delays, and RUCs) and how to structure

them, but it does not define how states develop the rates. As determined through this literature review, there seem to be very few models for estimating LDs. Some STDs base LDs on historical analysis, statistical analysis, RUCs, and project-specific engineering estimates. A state-of-the-practice is beneficial for analyzing how different STDs have approached LD rate development.

2.6.1 Overview of Previous State-of-the-Practice Study

The state of the practice for the application of LDs was studied in depth by Crowley et al. (*2008*). Through this study and an associated survey of all STDs, it was determined that STDs use LDs as their primary methods for recovering costs associated with contractor delays. Currently, limited research is being conducting on the application of LDs, I/D provisions, and use of RUCs. In 2006, Auburn University conducted research through a comprehensive survey of STDs on behalf of ALDOT. The results stated that 85% responding STDs used both LDs and I/D clauses in their contracts. It was also determined that 57% surveyed STDs use a table or schedule for establishing LD rates for projects (*Crowley et al., 2008*).

The estimating practices of the STDs were also analyzed. Through the survey, it was determined that over half of STDs, 62%, only included the minimum required costs to cover CE in their LD rates; however, some STDs, 38%, included some additional costs, such as RUCs on a project-specific basis. The CE costs were based on averages within each STD and were more on an order-of-magnitude estimate. Very few, 19% of STDs used staffing plans to develop project-specific rates (*Crowley et al., 2008*).

Another interesting discovery from the survey was the lack of formal audits of LDs. Only 19% of STDs reported that they conducted formal audits on projects to determine the accuracy of their LD pre-breach estimate of damages compared to actual damages (*Crowley et al., 2008*).

This lack of auditing could be attributed to shortages in personnel to accomplish such audits or a concern of litigation if actual damages were determined to be significantly less than the LD pre-breach estimates.

2.6.1.1 Typical Method of Calculating Liquidated Damages

Since most STDs use a table or schedule of values for developing LD rates, a standard method for computing a LD schedule has been routinely adopted. This typical method consists of: (1) determining requisite historical data, (2) collection and organization of data, (3) calculation of workday LD rates, and (4) calculation of calendar-day LD rates (*Zech et al., 2008*). Three primary problems exist when STDs use this method for determining LD rates. There is often a lack of accurate historical data for formulating the rates, the development of reviewing rates can be very time consuming, and the procedures used for calculating the rates may not be completely sound (*Zech et al., 2008*).

In "*Make Liquidated Damages Work*", McCormick (2003) presents 6 different questions as an owner guideline for forming and calculating liquidated damages: (1) If the contract is delayed, what additional costs am I going to incur?; (2) How much lost revenue and profit am I going to lose per day?; (3) What are my project administration costs going to be if I have to keep them on longer (which include support staff, inspectors, rent, equipment, and overhead)?; (4) What is the probability of environmental fines being assessed, or additional permitting costs being incurred if the project is not completed on time?; (5) What is the interest cost on any loan to finance the project?; and (6) What follow-on or third-party contracts will be impacted if this contract is not completed on time?. It is crucial for owners to weigh each one of these questions and determine costs, which will allow coverage if needed. Lost revenue and profit come to mind

easily, but staff costs, fines, loan interest, and other impacts on other contracts should be weighed. Also, in a multi-prime project (one with multiple contracts), it is necessary to understand subsequent contractor delays stemming from the contractor that performed work prior, and how LDs should be assessed.

2.6.1.2 Statistical Methods of Calculating Liquidated Damages

Some of the problems with the typical methods for calculating LD rates include the lack of statistical justification, challenge of repeatability, and poor accuracy due to significant levels of engineering judgment and subjectivity required when determining contract size groupings and analyzing contract data sets (*Zech et al., 2008*).

In the 2006 timeframe, ALDOT was experiencing a high degree of legal challenges to its LD rates. Auburn University was engaged to research a robust method for determining LD rates that would be defendable during claims. This research developed a proposed procedure for calculating a schedule of LD rates using statistical techniques linking historical CE expenditures per day to contract values. The method uses the same historical data from the traditional method, but the analysis of the data provides a much more justifiable approach and schedule of damages. To develop a statistically justifiable based schedule of LD rates, the STD must: (1) determine requisite historical data, (2) collect and organize the data, (3) determine daily CE amounts, (4) eliminate outliers in the data, (5) determine project size groups using statistical procedures, and then (6) calculate workday LD rates and convert them to calendar-day LD rates (*Zech et al., 2008*). A plot of this data with project groups and workday LD rates is shown in Figure 2-3.

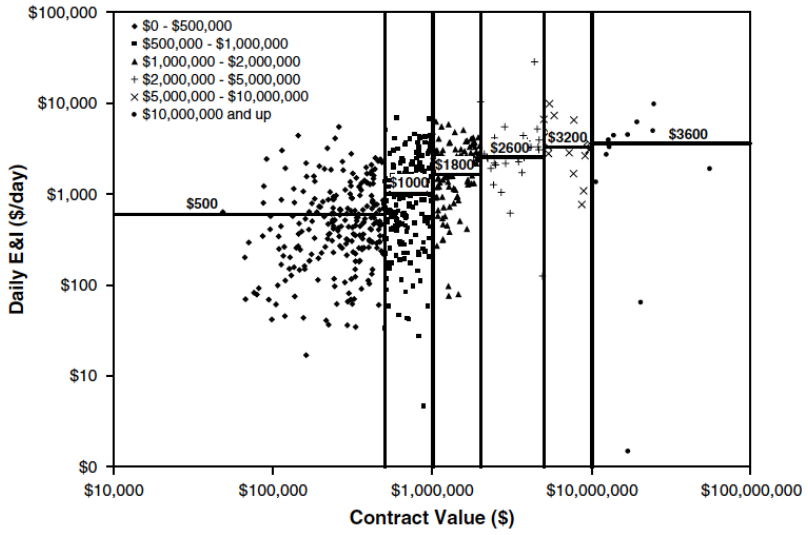


Figure 2-3: ALDOT's Workday LD Rates by Contract Value (*Zech et al., 2008*).

This revised method is not significantly different from the typical FHWA method, but by eliminating subjectivity, it provides a robust method for determining LD rates designed to withstand legal scrutiny (*Zech et al., 2008*). ALDOT later implemented the statistical method for determining LDs and has continued to update their construction specifications using this method biennially. This method has proved valuable based on its repeatability, simplicity, and applicability to any STD's data. The Oklahoma Department of Transportation (ODOT) has validated this type of statistical method using contract information and costs from the ODOT database with locally generated statistical parameters (*McTernan & Cross, 2009*).

The current problem lies with the lack of historical cost data for contracts exceeding $20 million. Defendable data is necessary for courts to uphold the LDs sought by owners. However, due to the lack of historical data available, this becomes increasingly difficult to forecast LDs for projects exceeding $20 million and increasingly more complex for projects over $100 million (*Crowley et al., 2008*). As contract value significantly increases, CE requirements per day do not increase on a linear scale, but it is reasonable to expect CE expenditures will increase to some

extent. A simple "best fit" regression of the limited dataset would not provide a justifiable prediction of LD rates as contract value continued to increase. The statistical model based solely on CE costs per day also neglects to include "other anticipated costs of project related delays or inconveniences to the STD or the public" (*NHTSA and FHWA, USDOT, 2018*) such as additional uniformed traffic officers or flaggers, which may increase as contract value increases.

2.7 STATE OF THE PRACTICE FOR INCENTIVES/DISINCENTIVES

2.7.1 I/D Enforceability

Both incentives and disincentives face some trouble within the court system; incentives can be seen as an enemy to competitive bidding code, which is in place to prevent favoritism and fraud and keep bidding fair (*Sun et al., 2012*). Disincentives are sometimes construed as unlawful penalties, which violate public policy and makes their enforceability difficult at times. Instead of just using a disincentive alone, the use of an incentive for finishing a project before the deadline has a significant impact on contract enforceability. According to Gillespie (*1998*), legal research shows that a combined I/D provision is less likely to be challenged legally. This is because in these types of combined provisions, disincentives penalties are less likely to be interpreted as arbitrary. Sun et. al (*2012*) discusses multiple cases which suggest the problems that I/D enforcement faces within the court system.

Milton vs Alabama State Highway Department (1990): Milton, a contracting company, was in charge of two roadway construction operations within Jefferson County, Alabama, I-65 and I-59. The I-65 project cost $7.7 million and was to be completed within 330 calendar days while I-59 costs $4.4 million and was given 210 calendar days for completion. Both roadway projects had LD and I/D provisions in place, and by the completion of both, roughly $125,000 in

LDs and $540,000 in disincentive costs were owed. Milton only disagreed with the disincentive cost, arguing that it was a penalty. In initial court proceedings, the ruling was in favor of the state DOT, but the decision was overturned by the Supreme Court in favor of Milton, citing many different reasons. The first is that the injury amount caused by the delay was already enforced through LDs and any additional injury was covered under the default clause. Second, the delay related costs were counted in both the LD and the disincentive provisions, causing costs associated with the delay to be charged twice. These costs must only be present in one of those provisions, not both. Thirdly, it was determined that the daily amount and the project completion time limit were set arbitrarily and had no connection to the damages sustained by the State Highway Department (*Milton Const. Co. v. State Highway Dept., 1990*).

Milton vs Alabama State Highway Department (1991): In 1991, after not being able to collect disincentives from Milton, the state of Alabama attempted to collect user costs. This attempt was denied as the contract's provisions and liquidated damages were sufficient to sustain damages incurred by the State. User costs were seen as a penalty and not as a means to recover costs to the traveling public. Milton attempted to collect interest of the outstanding disincentive amount to be paid by the Alabama State Highway Department. Originally, both potential collections were not allowed, but the Supreme Court ultimately ruled in favor of Milton and sent the case back to trial court to determine the award of interest, citing Ala. Code 1975, § 8-8-8

> *"All contracts, express or implied, for the payment of money, or other thing, or for the performance of any act or duty bear interest from the day such money, or other thing, estimating it at its money value, should have been paid, or such act, estimating the compensation therefor in money, performed" (Code of Alabama, 1975).*

Since the State Highway Department withheld the disincentive payments from Milton, which were deemed as unenforceable penalties, Milton was entitled to retrieve interest on those withheld payments (*Milton Const. Co. v. State Highway Dept., 1991).*

Ray Bell vs Tennessee Department of Transportation (2006): In 2006, construction was occurring along the I-40/I-240 interchange. Upon completion, the contracting company, Ray Bell, believed the state owed them maximum incentives. The state declined to pay, stating a late finish as the reason. The Court of Appeals stated that the contractor was entitled to the full amount. The decision was overturned by the Supreme Court, stating that the incentive date within the contract (December 15, 2006) was not to be changed and since work was not completed by this day, no incentives were owed (*Sun et. al, 2012*).

James Construction vs Department of Transportation & Development (DOTD), Louisiana (2003): In 2003, a project along I-10 was completed by James Construction. Upon completion, the construction company decided to pursue damages against the DOTD of Louisiana. The DOTD also felt it had a claim for disincentive collection. In court, disincentives were allowed to be collected by the DOTD. The reasoning behind this decision was that the contract had damage clauses to minimize roadway user costs impact and the amount was based on daily road user costs. James Construction showed no proof that these values were unreasonable (*Sun et. al, 2012*).

Bonacorso Construction vs Department of Public Works (DPW), Massachusetts (1996): In 2006, construction on a bridge along I-93 was delayed, so the DPW went after disincentives in response. The contractor refused, and the case went to court. Both the trial and appellate courts agreed that the state had a right to collect damages for delays. In order for the contractor to

recover costs, a written order to delay construction from the DPW had to be produced, and the contractor had no such record (*Sun et. al, 2012*).

Vrana & Sons vs Department of Roads (DOR), Nebraska (1998): In 1998, the DOR pursued disincentives against Vrana & Sons after the reconstruction of two bridges and a road in Nebraska. The LD and I/D provisions in question were seen as penalties and the case went to court. The original ruling went in favor of the contractor, stating that disincentives were indeed penalties. The appellate court stepped in, but ultimately did not make a ruling because the order in the case was not the final order, so they had no jurisdiction (*Sun et. al, 2012*).

Anjo vs Pennsylvania DOT (1995): In 1995, repair work was being done on a bridge. The completion date was pushed back due to an engineering error and the contractor (Anjo) completed the project for incentives but was not paid acceleration costs. It was ruled by both the board of claims and the appellate court that the contractor was owed monies for acceleration because it was asked for by the DOT. Interest was also included in this amount to account for time spent dealing with this claim. As a matter of law, since the state ordered the contractor to accelerate work, they should be awarded extra monies for its acceleration (*Sun et al., 2012*).

Sun et al. (*2012*) states a common recommendation for contractual provisions, which calls for the elimination of disincentives and inclusion of all damages under LD clauses. This removes the possible overlapping road user cost damages in LDs and I/D provisions and would still offer the symmetry for contracts with liquidated damages and incentives.

2.7.2 Savings and Benefits

To show the substantial benefits that RUCs and I/Ds bring to construction projects, a study was conducted at the University of Missouri, using contract data from the Missouri Department

of Transportation for analysis. Twenty different contracts were selected and data concerning contract days, contract amount, incentive period and amount, and type of work was tabulated (*Sun et al., 2012*). RUCs were calculated according to three variables: travel delay costs, vehicle operating costs, and crash costs with the results showing advantages of including I/D and RUC provisions. Seventeen of the 20 projects were completed ahead of schedule and none were late. The total construction duration amount was reduced by 214 days and almost $9 million in RUCs was saved. Even with the incentives paid out, the net savings was still $7.2 million (*Sun et al., 2012*). While this particular study concluded that I/D provisions proved to be successful, this is not necessarily true for all cases. One study conducted with data from the Michigan DOT revealed the need to create a more specific process to determine the real savings resulting from I/D contracts. Data analysis determined that there is improvement in long-term project performance for incentive projects over normal projects. It also determined that even with increased project costs, incentives are still less than the averted road user costs. However, it is important to note that the limited data sample size in Michigan might have impacted the results and might not be representative of other areas (*El-Gafy & Abdelhamid 2015*). Therefore, more research needs to be conducted to deduce the effectiveness of I/D contracts.

2.7.3 Methods of Calculation

Incentives are rewards for projects that are finished early, whereas disincentives are deductions from total pay for work completed beyond the agreed deadline. An I/D contract is worthy only if road user savings are greater than or equal to the cost to the contracting company. If the contractor's costs to expedite the completion of work is more than that of road user savings, an I/D contract is not appropriate because incentives cannot be justified. (*Jaraiedi et al.,*

1995). Simply put, incentives and disincentives are calculated by multiplying the established daily rate by the number of days the project is completed early or late, respectively (*Fick et al., 2010*). However, there are many different factors that should be considered to arrive at an appropriate established daily rate. It is important to note that the amount of "days" in regard to incentives and disincentives can differ between contractors. Some contractors designate the days simply as the number of calendar days needed to complete the project, where every day is counted regardless of whether or not work was completed on some of the days. On the other hand, some contractors prefer to count only "working days," which typically exclude weekends and holidays (*Fick et al., 2010*).

The reward calculations for I/Ds differs depending on who is responsible for the work being done. According to a study completed by Arditi and Yasamas, based in Saudi Arabia, most companies do not have a set equation for the computation of I/Ds, while other companies just calculate I/D values as a percentage of total contract cost (*Bubshait, 2001*). When determining I/D provisions, it is necessary to categorize projects before determining parameters. The Oregon DOT uses three project categories: roadway, interchange, and bridge because of how they vary based on materials and construction means applied (*Sillars & Riedl, 2007*). To assist with I/D calculations, the FHWA (1989) lists multiple costs that should be included: established construction engineering inspection costs, state related traffic control and maintenance costs, detour costs, and road user costs. Sillars & Riedl (*2007*) suggest using the cost of acceleration along with RUCs to achieve a balance in determining a reasonable I/D value.

Another important consideration into the I/D provision calculation is associated risk. I/D agreements typically have a significant impact on risk allocation between parties of the contract.

In some cases, the risk for unforeseeable factors such as poor weather and site conditions is shifted onto the contractor. This scenario naturally increases the I/D cost factor for the STD because the contractor, in some cases, cannot quantify or do anything to mitigate the risk. In some cases, the STD will implicate a no-excuse clause, which involves the contractor assuming responsibility for deadline completion regardless of unexpected factors. This situation often results in increased cost for the STD, because the contractor will acknowledge potential damages and preemptively budget for them to occur. In the event that damages do not occur, the contactor ends up benefitting financially. However, since unforeseeable damages sometimes do occur, contractors have a tendency to play it safe and not assume all the risk for a project. The FDOT has developed an "excusable no-excuse" clause, which allows for the consideration of time extension for excusable delays that have a total impact of over 15% of the time remaining to complete the project. Therefore, contractors could potentially still achieve some incentive pay when faced with unforeseen circumstances. While this might attract more contractors, it is important to note that this type of clause does not account for the accumulation of numerous small delays (*Fick et al., 2010*). Again, risk remains an important consideration for both the contractor and the STA for settling I/D provisions.

2.8 INCENTIVE/DISINCENTIVES (I/Ds) AND ROAD USER COSTS (RUCs)

I/D and RUC values are very closely related. Generally, most state highway agencies use the daily RUC (DRUC) as a premise for establishing a suitable I/D amount (*Herbsman et al., 1995*). I/D provisions are derived from an approximation of the RUC increase that is a result of the project at hand (*Fick et. al, 2010*). However, with increased population and urbanization, RUCs are increasing. Therefore, I/D amounts will have to increase, as well and other methods for

determining I/D provisions should be considered (*Sillars & Riedl, 2007*). It is suggested that a discount factor of 0.2 to 1.0 of the RUC be used to establish an I/D value (*Mallela and Sadasivam, 2011*). This value is based on market conditions, confidence in RUC estimates, work zone factors, and early completion importance. The discount factor is multiplied by the calculated daily RUC value to get a value for an I/D provision (Mallela and Sadasivam, 2011).

2.9 INCENTIVE/DISINCENTIVES (I/Ds) AND LIQUIDATED DAMAGES (LDs)

On the surface, there are very few differences between LDs and disincentives, as they are both contracted provisions based upon estimated costs (*Fick et al., 2010*). McCormick states that incorporating LDs and I/Ds into the same contract typically occurs for one of three reasons, "(1) the liquidated damages provisions are significantly large relative to expected contract value; (2) when prospective damages are more uncertain than is usually the case for typical liquidated damages; and (3) there is a potential high cost to the public or private entity if the contract is not completed on time." A successful example of LD and I/D incorporation came in the Santa Monica Freeway bridge rebuilding project with the FHWA and California DOT working together. An LD value ($200,000/day) was written into the contract along with an incentive value ($200,000/day) and the result was a completed job ten weeks ahead of schedule. The contractor received a large incentive while additional DOT transportation costs were saved (*McCormick, 2003*).

Sometimes the inclusion of LDs and I/Ds into a single contract does not work well, as seen through the contract debates between the Alabama highway department and Milton Construction Co., Inc. The contract called for LDs and I/Ds, and when the contractor finished late, both were to be enforced. The Supreme Court of Alabama stepped in and ultimately ruled that the disincentive clause was merely an unenforceable penalty with no connection to actual

damages. The state department then tried to sue for RUCs, using multiple example cases where project owners had received actual damages after LD clauses were denied. This approach was rejected as the Supreme Court stated that this path is only allowed in cases where LDs had not been assessed (*McCormick, 2003*).

It is common practice for LDs and the disincentives to be assessed in conjunction with one another when a project is to be completed by the designated deadline (*Jaraiedi et al., 1995*).

2.10 PARAMETERS FOR DETERMINING PROJECT-SPECIFIC LIQUIDATED DAMAGES (LDs)

As construction contract values increase beyond the range of reliable historical data for statistically based LD rate development, STDs must use a method other than statistical analysis for LD determinations. This results in the need for STDs to require project-specific LDs to be developed for high contract value projects. The key costs that should be considered when developing project-specific LD estimates are CE costs and other project related expenses that may be directly attributed to contractor delays, such as additional public safety measures and RUCs. As explained previously, RUCs may fall under LD or I/D provisions of the contract. For these project-specific LD rates to be defendable in court, STDs must use a defined procedural methodology based on transparency, objectivity, and reasonable pre-breach estimates of anticipated costs.

2.10.1 Major Factors Influencing Project-Specific LD Estimates

Every project has unique requirements of construction that influence the costs of oversight and have the potential to impact secondary costs attributable to the STD. While primarily focused on forecasting highway construction staffing, *NCHRP Synthesis 450* provides evidence that project cost and project type are coupled due to the effort required by staff on the

project (T*aylor & Maloney, 2013*). These two factors also help to qualify impacts that are applicable and have influence on the determination of LD rates. Some of the other factors influencing project-specific LD rates are the duration of the project, economic factors, and geography.

2.10.2 Project Cost

Project cost is often directly tied to project scope, scale, and/or complexity. As project costs increase, the construction volume, complexity, and risk increases. With these increases, STDs generally need to increase CE support, which may lead to additional costs during time overruns. While not directly related, more complex or higher risk projects often have higher impacts on the public, which may lead to increased public safety requirements and higher RUCs. When project cost increases, the costs of all of these functions will increase, but probably not at a linear rate. These factors must be considered when developing LD rates since these additional costs would likely continue, if not increase, during a time overrun situation.

2.10.3 Project Type

The project type (i.e., bridges and approaches, widening, pavement marking, etc.) has significant influence over costs incurred by the STD due to CE and other support required from the STD. This may include additional safety measures, the presence of uniformed traffic officers, access to railway right-of-ways, additional public notifications, or loss of revenue (i.e., in toll or parking areas). The type of project may also significantly impact RUCs on a project. RUCs would be significantly different between a bridge replacement requiring a long detour than a resigning project only causing intermittent delays to spread out along the length of a roadway. All of these

added costs influenced by the project type have the potential to increase LDs in a time overrun situation.

2.10.4 Construction Engineering (CE) Staffing Models

As defined previously, CE refers to all project management, field engineering, and inspection activities associated with the oversight and management of construction activities. Most construction specifications are specific to projects and based on specific work elements. STD specifications often provide significant detail for contractors to develop construction staffing plans. On the other hand, the oversight of construction, except for possibly quality assurance, is rarely detailed in specifications. Very few STDs have metrics for the personnel duties in construction oversight based on project tasks performed, but many STDs do not clearly define CE requirements to this level of detail. This problem with limited guidance is also often seen when CE is performed by consultants. Differences between project types may have a significant impact on oversight costs incurred by the STD. For example, an STD contract for grass cutting will likely have significantly less requirements for CE than widening an existing road. The overall CE requirement is ultimately dictated by project type and scale (often expressed as a cost).

The most reliable method for estimating CE cost is through an estimate based on construction staffing requirements. The research provided in *NCHRP Synthesis 450* provides an overview of staffing models for STDs across the nation. In general, STDs did not have robust staffing estimation models, many different methods were used for determining staffing levels, and increasingly, STDs are using consultants to complete CE duties and responsibilities on a project.

To develop effective staff forecasting systems, STDs should develop a staffing forecast for resource levelling work and develop linkages between work being performed and staffing required (*Taylor & Maloney, 2013*). For the most accurate models, staffing models must be unique by project type, project scale, and project duration. The exact staffing will also be heavily influenced by whether the CE is completed in-house or out-sourced to a consultant. The staffing level may also be influenced by the amount of public interest and risk involved in the project.

As discussed, many agencies do not have a robust method for developing construction staffing models. The South Carolina DOT commissioned a study to "develop a manpower-forecasting tool that would predict construction manpower staffing requirements for upcoming projects of a given type and expenditure magnitude" (*Bell & Brandenburg, 2003*). While the focus was on optimizing SCDOT resources through proper planning, this same principle can be applied when estimating CE effort on a project to develop the pre-breach estimate of the CE component of LDs.

Historical data was used for total construction CE costs to determine an overall number of engineering and inspection labor hours spent on a certain type of project based on the contract price. Surveys and interviews were then used to determine the types of employees engaged in each project and the distribution of those labor hours (*Bell & Brandenburg, 2003*).

Bell and Brandenburg (*2003*) used two primary sets of data from SCDOT databases to develop a labor distribution based on 11,000 biweekly payroll charges across 130 construction projects. The project-related data included project categories, project cost, duration, and additional accounting information. The payroll entries provided employee identification, hours charged to particular projects, and different types of work that an employee may have completed

on the project based on professional certifications. These data sets were combined to develop a labor distribution showing the total labor hours expended for each project along with which employees worked on each project. After plotting this data, regression analysis was conducted to yield a relationship of CE labor hours to project cost (*Bell & Brandenburg, 2003*). The regression analysis for all project categories can be seen in Figure 2-4.

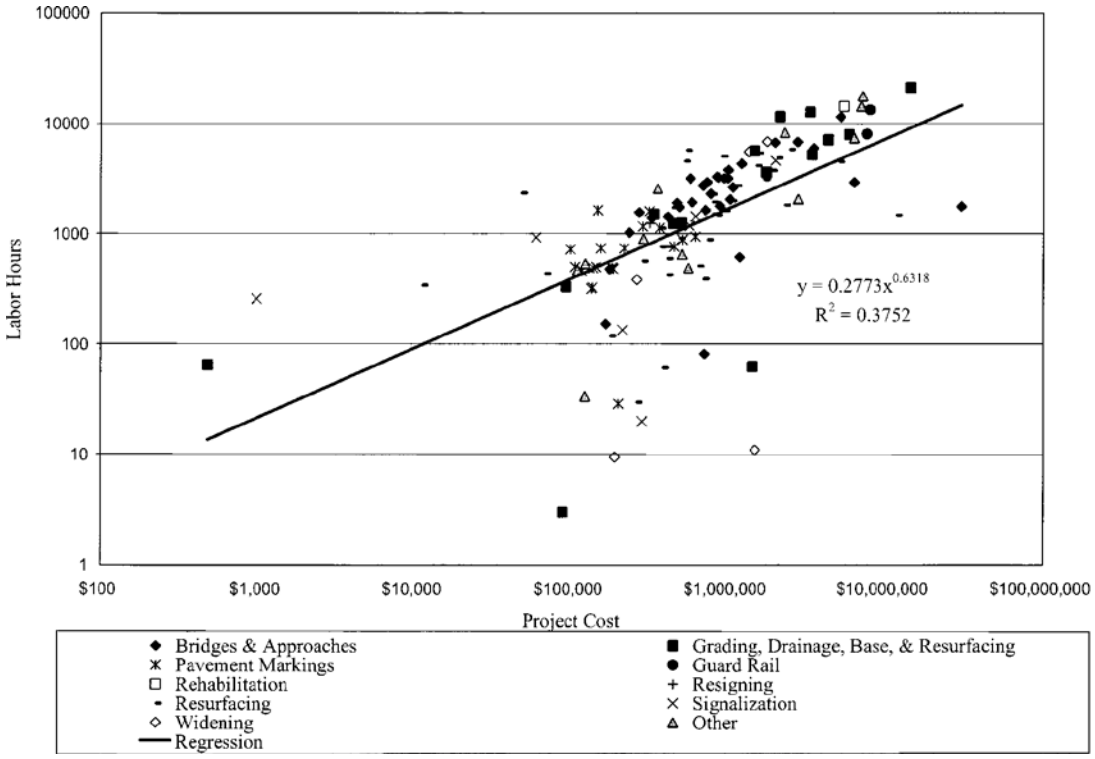


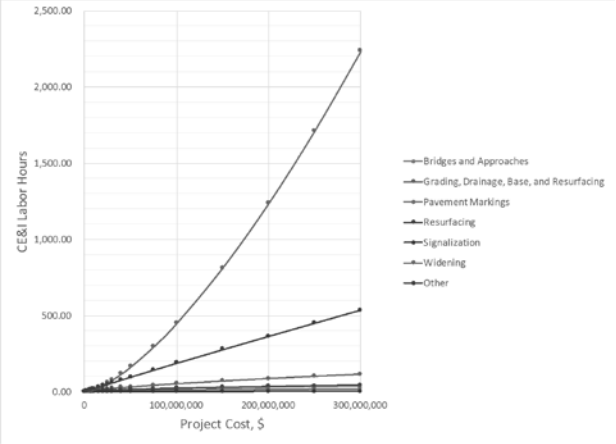
Figure 2-4: SCDOT Regression Analysis for All Projects (*Bell & Brandenburg, 2003*).

The data was divided into project categories and plotted as labor hours versus project cost to yield an individual regression equation for each project category. The resulting regression equations are shown in Table 2-1.

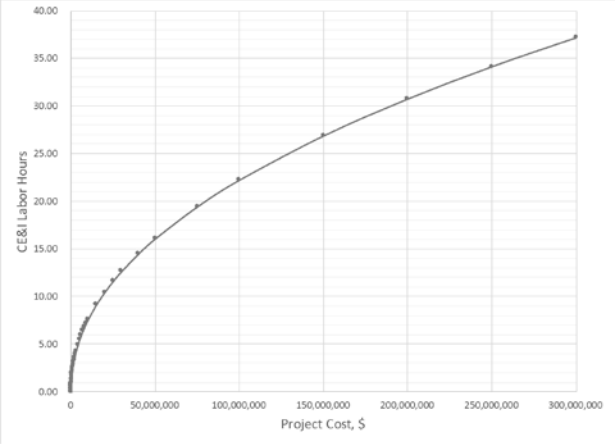
Table 2-1: SCDOT Staffing Regression Analysis (Bell & Brandenburg, 2003)

Project Category	Equation	R^2	N (number of data points)
All Categories	$y = 0.2773x^{0.6318}$	0.3752	134
Bridges and Approaches	$y = 3.2455x^{0.468}$	0.2488	32
Grading, Drainage, Base, and Resurfacing	$y = 0.1233x^{0.6926}$	0.4877	15
Guard Rail	--	--	2
Pavement Markings	$y = 1.7659x^{0.4753}$	0.0887	18
Rehabilitation	--	--	1
Resigning	--	--	1
Resurfacing	$y = 1.057x^{0.5319}$	0.2774	40
Signalization	$y = 29.261x^{0.2336}$	0.1028	8
Widening	$y = 8E\text{-}07x^{1.4574}$	0.2335	5
Other	$y = 0.0038x^{0.9503}$	0.7392	12

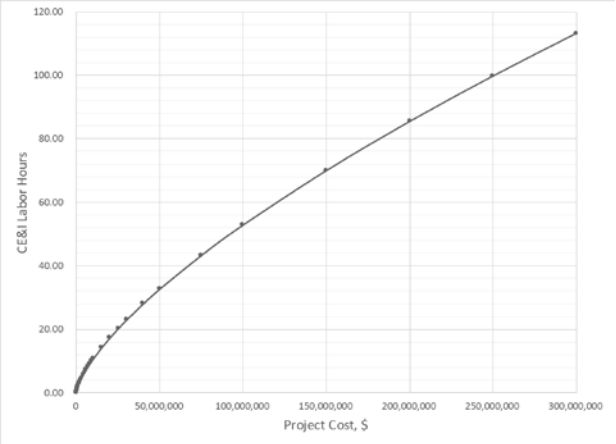
Given an anticipated project cost, these regression equations can be used to determine the total CE labor hours required for various project types (*Bell & Brandenburg, 2003*). Figure 2-5(a) shows a plot of labor hours per day for different project categories up to $300 million. Figure 2-5 (b,c,d) and Figure 2-6(e,f,g,h) shows the comparison across all project types. Even though the population size is small in some of the categories, it can be devised that project type may have a significant impact on the total CE labor hours required for a project and the rate at which the CE labor hours increase as project cost increases.



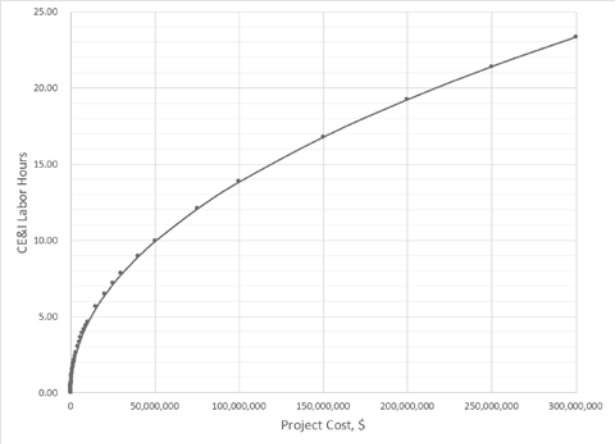
(a) Comparison of All Project Categories



(b) Bridges and Approaches

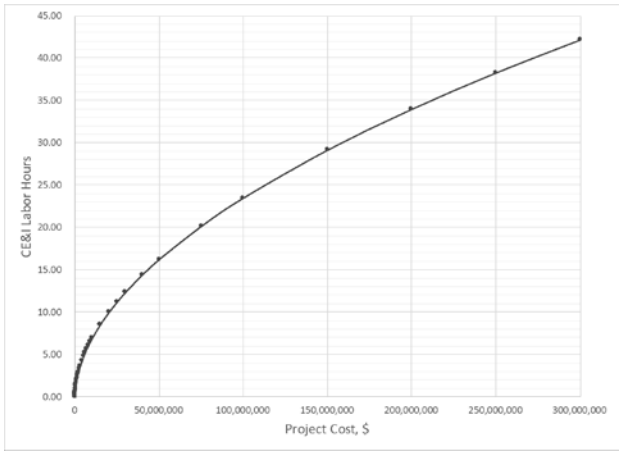


(c) Grading, Drainage, Base, and Resurfacing

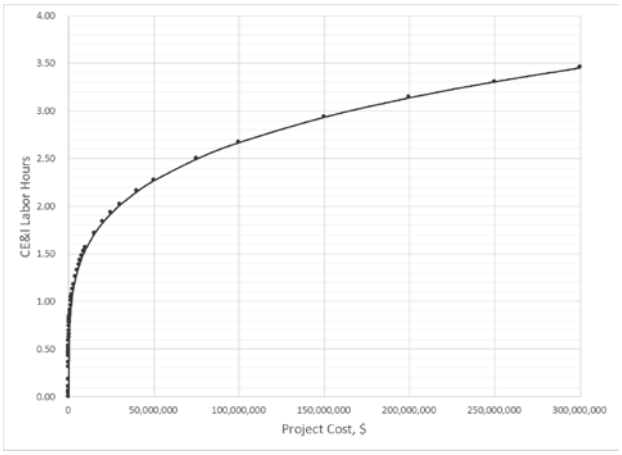


(d) Pavement Markings

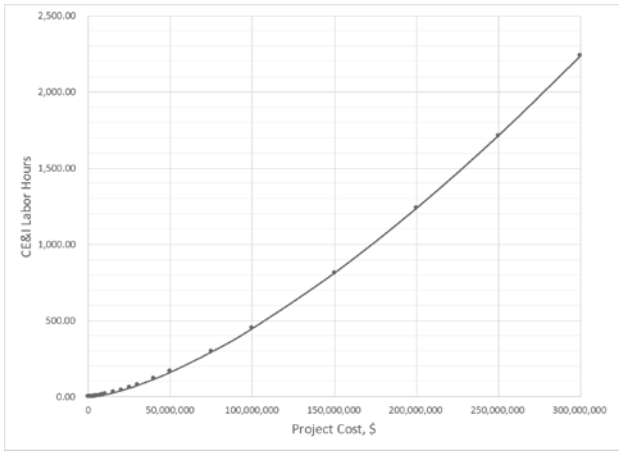
Figure 2-5: CE Labor Hours by Project Category versus Project Cost (a-d).



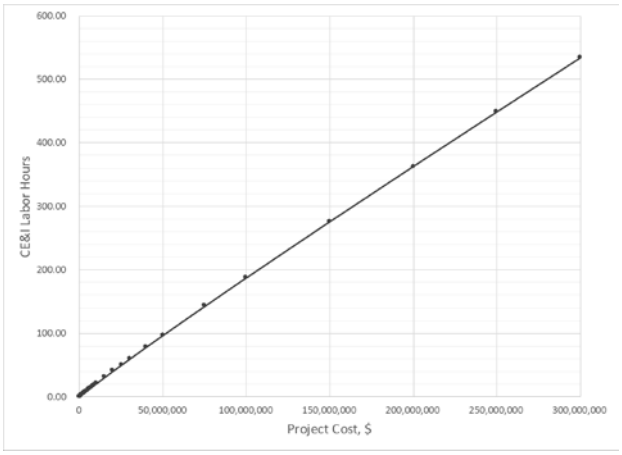
(e) Resurfacing



(f) Signalization



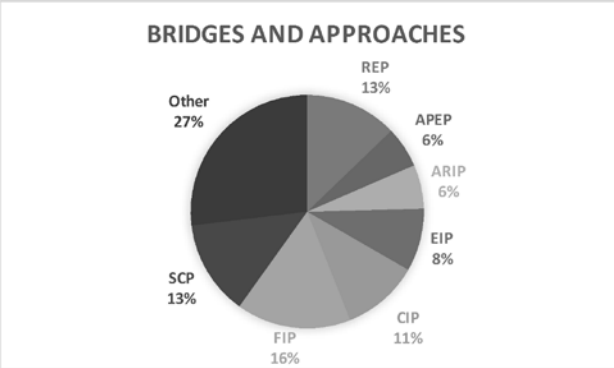
(g) Widening



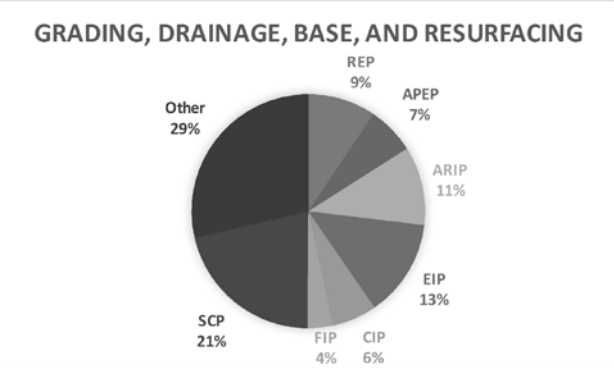
(h) Other

Figure 2-5: CE Labor Hours by Project Category versus Project Cost (e-h).

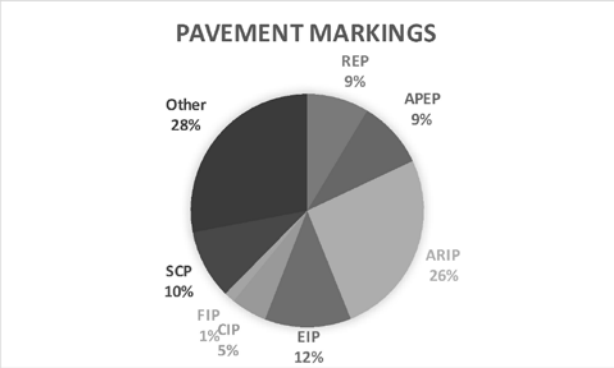
Next, to develop forecasts of CE tasks required on each project, Bell and Brandenburg surveyed SCDOT district engineers to determine the percent of time employees executed certain tasks on the projects (*Bell & Brandenburg, 2003*). A breakdown of tasks required, as a percent of total labor hours, is shown in Figure 2-6. This breakdown helps to define qualifications needed on a particular type of project.



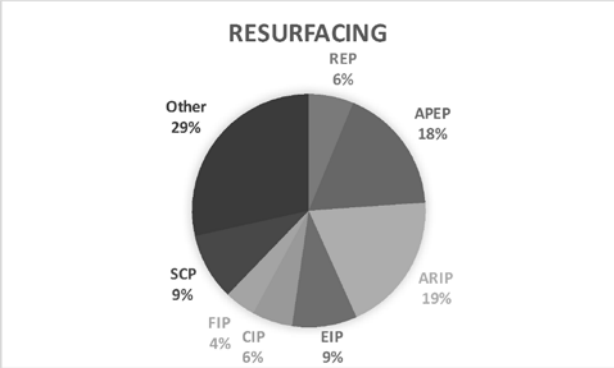
(a) Labor Distribution for Bridges and Approaches



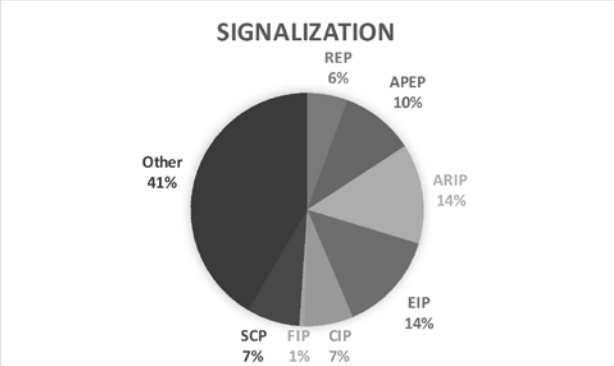
(b) Labor Distribution for Grading Drainage Base, and Resurfacing



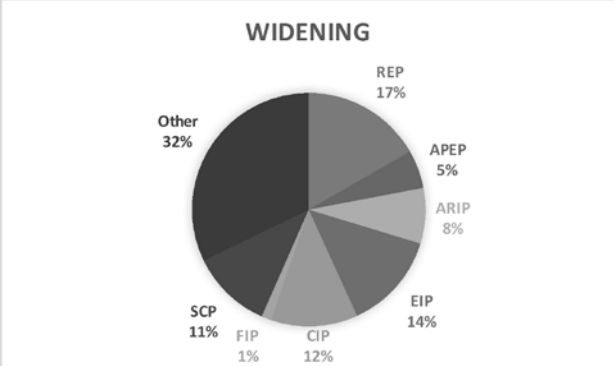
(c) Labor Distribution for Pavement Markings



(d) Labor Distribution for Resurfacing



(e) Labor Distribution for Signalization



(f) Labor Distribution for Widening

NOTE: REP=resident engineer percentage; APEP=asphalt plant engineer percentage; ARIP=asphalt road inspector percentage; EIP=earthwork inspector percentage; CIP=concrete inspector percentage; FIP=foundation inspector percentage; SCP=survey crewmember percentage; Other=all other employee percentages.

Figure 2-6: Select SCDOT Average Percent Total Labor Hours (*Bell & Brandenburg, 2003*).

Once all of the data was compiled, a model for predicting total CE staffing of projects based on project type and contract value was presented. These estimates of total labor hours

could be used to roughly allocate CE labor hours on a per day basis if the contract duration is known. Once staffing levels are defined, variables such as the project manager's salary, project inspector's salary or hourly rate, engineer salaries, oversight personnel from region/central offices, and overhead can be included to provide a total cost of labor required to staff the CE for a project.

2.10.5 Other Costs of Project Related Delays or Inconveniences

Other probable costs related to project delays, besides CE labor, include oversight of the consultant contract (if applicable), leases of project office/trailer space, utilities, project vehicle costs, laboratory retainer fees, notifications to the public, public safety expenditures (i.e., flaggers, railroad right of ways, uniformed traffic officers, state highway patrol, etc.), costs of delays to subsequent projects (i.e., claims from follow-on contracts), loss of revenues from toll or parking areas, and potentially, RUCs. Many of these costs are highly project-specific and would have to be evaluated based on the planned scope of the construction project. Some items may be included as reimbursable expenses in the contract and therefore should not be included in LD calculations.

Through a detailed audit of the New Haven Paving Project in Vermont, the State Auditor determined that the state failed to account for $33,000 in costs for flaggers and uniformed traffic officers when the contractor finished 24 days late on a $3.8 million project. The State Auditor also noted that the agency did not include the "loss of use of the roadway by the public due to traffic obstructions". The auditor recommended including all project-related delay costs in the LD calculations. Of note was the statement that taxpayers should not bear the cost of delays caused by the contractor (*Hoffer, 2013*).

The inclusion of RUCs as a component of LDs for all projects has not been well documented. Part of the reason for this exclusion is the perceived complexity of RUC calculations. Daniels et al. (*2013*) worked with the Texas Department of Transportation (TxDOT) to develop a simplified, manual technique for calculating RUCs using look-up tables to correlate project type and some other basic roadway attributes. TxDOT has been using RUCs as a component for LDs since approximately 2003 on some of their projects, but a simplified method would help to expand this program (*Daniels et al., 2013*).

For the simplified method, two sets of tables were developed for capacity increasing projects and rehabilitation projects. The added-capacity tables allow for a before-and-after comparison to determine total daily excess costs, caused by current construction, which would become the value used in LD calculations. For rehabilitation projects, a during-versus-after-construction model is used to calculate RUC benefits that are lost for the duration of the construction. These losses would contribute to the LDs. While most high-profile, urban reconstruction projects have relied on detailed simulation modelling to develop RUCs, simplified methods would allow application across a wider range of projects (*Daniels et al., 2013*).

2.11 MODEL FOR DEVELOPMENT OF PROJECT-SPECIFIC LIQUIDATED DAMAGES

As noted previously, most STDs use tables or schedules of values based on historical data for LD rate determinations. Due to the lack of historical data for projects with contract values in excess of $20 million, these tabulated values may not fully account for all CE costs and other costs potentially attributable to delayed completion of construction projects as contract values continue to increase. The uncertainty caused by the lack of this data can trigger the implementation of project-specific LD rate determinations.

While not generally covering the same magnitude of contract values as large STD contracts, several STDs have created programs to assist local public agencies (LPAs) in the development of LDs for use on FHWA or State funded construction projects. These procedures are intended to aid LPAs in the development of defendable LD rates.

ALDOT has recommended the use of the STD LD rates in LPA construction contracts (*ALDOT, 2015b*); however, this recommendation could be problematic from a judicial standpoint because the basis of STD LD rates would likely be different from the basis for the LPA LD rates. On the other hand, the State of California Department of Transportation (Caltrans) recommends a formula-based approach using project type, project costs, and duration along with an LD percentage factor based on project scale. The Caltrans method for LPA LD determination is shown in Figure 2-7. This method is based on CE costing a typical percentage of a contract value, but it could be harder to defend in court than truly project-specific LD rates.

Local agencies should use the following formula to avoid excessive, or unreasonable, liquidated damages:

(L% from table below) x (Engr. Estimate + RE Office Expense *) = Liq. Dam./calendar day
Working Days **

* Resident Engineer office expenses for the life of the contract should be added unless the cost is already included in the Engineer's Estimate.

** Working days used to calculate liquidated damages should not include water pollution establishment or plant establishment days.

LIQUIDATED DAMAGES TABLE (L%)

Project Type						
Project Estimate	**Resurfacing*/ Rehab**	**New Highway**	**Realignment/ Widening**	**Landscaping**	**Soundwall**	**Others**
Over $30 million	10%	10%	13%	15%	15%	15%
$10 million to $30 million	10%	12%	15%	15%	15%	15%
$5 million to $10 million	10%	15%	15%	15%	15%	15%
$750k to $5 million	15%	15%	15%	18%	18%	15%
Less than $750k	15%	20%	20%	18%	20%	15%
*** Resurfacing projects include asphalt concrete (AC) surfacing, seal coats, slurry seals, etc.**						

Figure 2-7: Liquidated Damages Model per Caltrans Local Assistance Procedure Manual (Caltrans, 2016).

Finally, the Texas Department of Transportation (TxDOT) provides the most detailed method for developing project-specific LD rates based on staffing plans and resources required to provide CE services on a construction project. The TxDOT sample LD calculations from the *TxDOT Local Government Projects Frequently Used Forms and Documents* is provided in Figure 2-8.

Sample Liquidated Damages Calculations

(A)	Number of Hours or Days (B)	Units (C)	Rate (D)	Indirect Rate (E)	Weekly Costs (B*D*E)	Monthly (Weekly*4)
Field Representative(s)	50	hrs	$ 25.00	1.75	$ 2,187.50	$ 8,750.00
Field Representative Truck	5	days	$ 80.00	1.00	$ 400.00	$ 1,600.00
Project Manager	20	hrs	$ 50.00	1.75	$ 1,750.00	$ 7,000.00
Program Manger or Director	5	hrs	$ 75.00	1.75	$ 656.25	$ 2,625.00
Administration Costs	10	hrs	$ 25.00	1.75	$ 437.50	$ 1,750.00
Consultant Engineer	4	hrs	$ 150.00	1.00	$ 600.00	$ 2,400.00
Testing Costs	15	each	$ 25.00	1.00	$ 375.00	$ 1,500.00
Trailer Rental	7	days	$ 150.00	1.00	$ 1,050.00	$ 4,200.00
				Total Monthly Cost		$ 29,825.00
				Average Days Per Month		30
				Liquidated Damages Per Day		$ 994.17

Based on these calculations, use $1,000/day in liquidated damages in the contract.

(A) construction adminstrative items
(B) unit used per week, such as you will have a full-time field representative(s) who will work an average of 50 hours per week
(C) unit of measure (i.e. hours, days, each)
(D) rate or the cost per unit
(E) indirect rate (sometimes called overhead rate) applied to the labor cost to cover the costs of benefits

The liquidated damages contract provision provides a mechanism for the local government (LG) to recover costs associated with the contract time overrun. Liquidated damages are required as a means of recovering, at a minimum, construction engineering costs from a contractor. The LG must monitor and assess liquidated damages according to specifications.

The LG needs to define liquidated damages in the bid documents. The LG is not allowed to use TxDOT liquidated damages rates. The LG must submit documentation of how it derived its liquidated damages rates, and TxDOT must approve the methodology.

Guidance from FHWA: http://www.fhwa.dot.gov/programadmin/contracts/core03.cfm#s3B07

Figure 2-8: Sample Liquidated Damages Calculations per TxDOT Local Government Projects Office (*TxDOT, n.d.*).

This TxDOT model has the potential to create a detailed, defendable estimate for LDs based on project-specific parameters. At the most basic level, a thorough staffing plan has to be developed for this type of a model to work.

2.12 LITERATURE REVIEW SUMMARY

In review, LDs are contractual provisions that establish a daily monetary rate deducted from monies owed to the contractor due to late performance. LDs are determined prior to contract solicitation as pre-breach estimated rates intended to recover costs of damages to State transportation departments (STDs) occurring from late performance on a contract. These rates must cover, at a minimum, daily CE costs associated with the type of work encountered on the project. Numerous courts have relied on four primary inquiries when reviewing disputes concerning LD provisions (Thomas et al., 1995). They are: (1) Is an LD clause present?; (2) What

were the owner's intentions?; (3) Were the actual losses difficult to predict?; and (4) Is the stipulated sum reasonable? (Thomas et al., 1995)

I/Ds are typically used as part of contracts based on performance or delivery and designed to minimize impacts of road users. "I/D clauses are applied to unique projects, which pose considerable inconvenience to the motoring public, to minimize potential construction delays with the intention of achieving significant monetary savings" (*Crowley et al., 2008*). The use of I/D provisions is typically based on the impact or inconvenience a construction project has on the motoring public. I/D provisions can be used with or without an LD provision present. Disincentives are sometimes construed as unlawful penalties, which violate public policy and makes their enforceability difficult at times. Instead of just using a disincentive alone, the use of an incentive for finishing a project before the deadline has a significant impact on contract enforceability.

RUCs are quantified road user impacts from traffic delays and diversions. These costs typically include "travel time, vehicle operation, crashes, and air quality" (FHWA, 2014). RUC values can be used during project planning to determine relative benefits of construction improvements, and they can be used during construction to assess the impact to the public. In accordance with 23CFR§635.127(c), road user delay costs may be included in LD amounts (*NHTSA and FHWA, USDOT, 2018*). RUCs may also be included as the basis for I/D provisions. RUCs are not typically found as a separate provision in construction contracts and seem to most commonly be incorporated into I/D provisions on large, critical projects.

Upon completion of the literature review, key considerations and various methods for evaluating current ALDOT LD practices will be identified, which will allow for the development of a formal, comprehensive state-of-the-practice survey.

CHAPTER 3: STATE-OF-THE-PRACTICE FOR LIQUIDATED DAMAGES ON HIGH VALUE CONTRACT PROJECTS SURVEY

3.1 CURRENT STATE-OF-THE-PRACTICE (SOTP)

Seemingly, issues in developing liquidated damage (LD), incentive/disincentive (I/D), and road user costs (RUC) rates for large projects with contract values exceeding $20 million are prevalent throughout the U.S., and there is limited literature focusing on quantifying rates for high contract value projects. Therefore, the focus of this chapter is to determine the current SOTP for incorporating LD, I/D, and RUC provisions on high contract value projects through a comprehensive survey (Appendix A).

3.2 SURVEY OF PROVISIONS ON HIGH VALUE CONTRACTS

Observations and results from a survey collaboratively developed with the Alabama Department of Transportation (ALDOT) and administered to all 51 State transportation departments (STDs) in the U.S., which included all 50 State DOTs and District DOT, will be discussed, section-by-section, reviewing: *Contractual Provisions*; *Estimating Methodologies*; *Project Staffing Requirements*; *Assessment Based Upon Project Status*; *Audit Process and Review*; and *Legal Issues associated with Contract Provisions*. For the purposes of this study, "high value contracts" are those with an original contract amount that exceeds $20 million. This amount has been considered by a panel of experts from ALDOT as the breaking point after which the agency should pay closer attention to LDs rates due to the higher risk of not recovering all actual damages

resulting from project delays caused by the contractor. This criterion seems to match the risk perception of the Florida DOT (FDOT), whose LD provision provides for the use of a standard equation to estimate LDs rates for contracts over $20 million (*FDOT, 2017*).

The goal of the survey was to obtain an understanding of ways different STDs incorporate LD provisions on high contract value projects to establish the SOTP. In addition, information on both I/Ds and RUCs were gathered to provide further insight into how supporting provisions are used in conjunction with LDs. The survey response rate was 88% (45 out of 51). Due to the survey logic, response rates vary and not all questions were answered by all 45 responding agencies. Summarized responses to individual survey questions are located in Appendix B.

3.2.1 Contractual Provisions

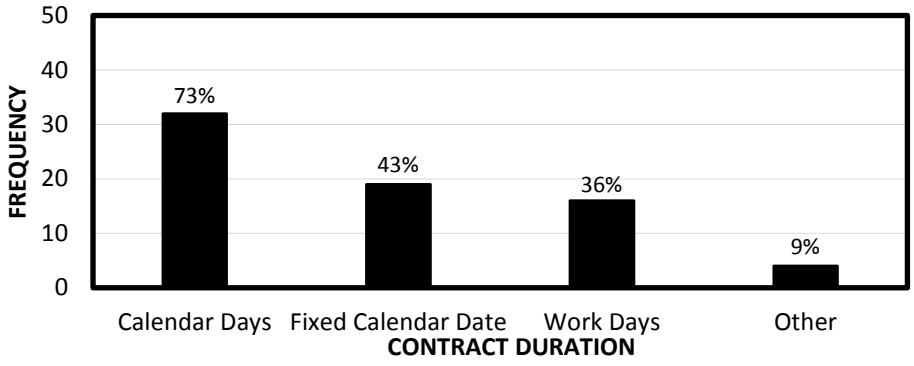
Provisions of STD contracts will stipulate LDs to be charged on a project. These rates often come from contract value range tables. The upper limit of value ranges within tables will be the limiting factor for recouping construction engineering (CE) costs. This upper limit is usually based on data availability for determining typical CE costs at certain contract values. However, for LD estimates to be considered accurate, there must be a large enough dataset to create a statistically relevant rate. From ALDOT's standpoint, the dataset for projects exceeding $20 million is limited and therefore a reasonable LD rate cannot be established. Therefore, the first element of the survey inquired whether agencies had construction oversight experience of projects exceeding $20 million. Approximately 98% of the responding agencies (44 out of 45) stated they have experience with high value contract administration. After reviewing the schedules of LDs for all agencies, it became apparent that many STDs did not include a category for high value contracts (e.g. greater than $20 million).

Of projects incorporating LDs, project durations were specified by 44 responding agencies as: *'Calendar Days'* (73%), *'Fixed Calendar Date'* (43%), and *'Work Days'* (36%) [Figure 3-1 (a)]. In addition, responses within the '*Other*' category included *'Hourly'* and *'Cleanup Days'*. The survey did not explore the reason behind the selection of different approaches to define project duration. However, a possible criterion used by STDs to select one of these approaches may be the reduction of risk related to misinterpretation of contract conditions and simplification of the process to develop contract documents, explaining the distribution of responses for this question. *'Calendar Days'* is a universal term that does not need to be defined in detail in the contract and is easily understood by all contract parties. *'Fixed Calendar Date'* is also clearly understood, but it implies that the number of days required to complete the project is known, and the STD must determine the expected completion date based on the project start date. Finally, the *'Work Days'* duration requires more clarification, due to holidays, weekends, and planned weather days recognized by the department, which may be the reason it is used less often.

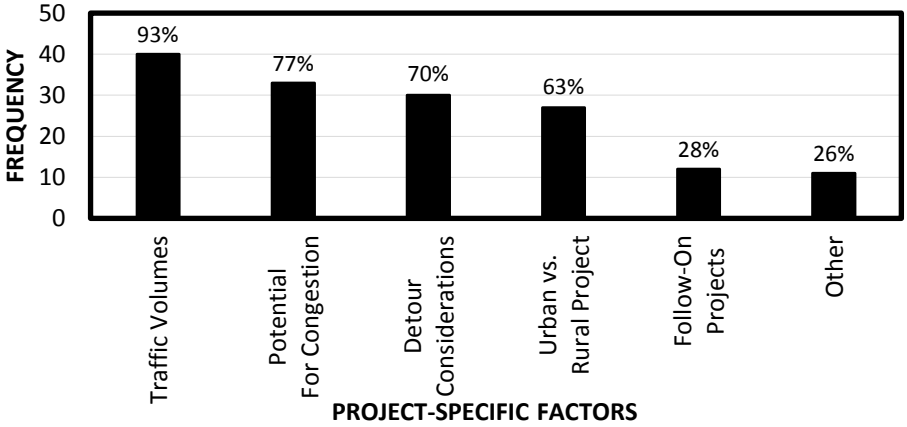
With regard to the use of I/D and RUC provisions, STDs were also asked about project-specific factors considered when deciding whether to include these provisions within construction contracts. Project-specific factors mentioned by STDs [Figure 3-1 (b)] include: *'traffic volumes'* (93%), *'potential for congestion'* (77%), *'detour considerations'* (70%), and *'urban versus rural projects'* (63%). Roadways of significant importance (i.e., major interstates) are more likely to experience high traffic volumes, congestion, and detour options, making them prime candidates for the inclusion of both I/D and RUC provisions. Other common responses included:

'major local events', *'utility relocations'*, *'weather season'*, *'environmental impacts'*, *'business impacts'*, *'school schedules'*, and *'emergency response'*.

Contractual LD rates stipulated within standard specifications as a schedule of damages varying by contract value are used by 98% of the responding agencies (42 out of 43). After reviewing these schedules, it was determined that some DOTs differentiate charges based upon project duration type, while others only use a daily rate for each contract value range. For example, Kansas and South Dakota DOTs, further differentiate by also using a schedule of damages based upon various stages of project completion (i.e. project open/not-open to traffic, clean-up time expired, and achievement of substantial completion).



(a) typical contractual durations for inclusion of LD provisions



(b) project-specific considerations for inclusion of I/D and RUC provisions

Note: Percentages may sum to greater than 100%, as participants could select multiple responses.

Figure 3-1: Contractual Considerations for the Inclusion of LD, I/D, and RUC Provisions.

The next section focused on standard, non-project-specific methods STDs use for determining RUCs for inclusion in construction contracts. Almost 77% of responding agencies stated that they use a standard procedure for calculating RUCs that include common variables such as: *'traffic volumes'*, *'travel distance'*, *'delay duration'*, *'drivers' time'*, *'detour lengths'*, *'speed reductions'*, *'vehicle type'*, and *'facility capacity'*. Many agencies employ the use of a spreadsheet, formula, or specific program to aid in calculating RUCs.

Agencies were then asked if LDs, I/Ds, and RUCs were assessed simultaneously on construction contracts with almost 77% of respondents answering that they simultaneously assess these provisions. Of the 33 respondents who answered '*Yes*', 31 of those agencies indicated that they are assessed under separate provisions. Agencies stated that each provision is triggered by a different event and based upon contract language. For example, Caltrans stated that LD provisions pertain to the entire contract time, I/Ds pertain to internal milestones, and RUCs pertain to whether lanes are opened when time expires. Other STDs indicated that these provisions are assessed separately since they are intended to address different types of risk. LDs recover additional administrative, management, and CE costs due to the contractor's failure to complete a project on-time and are intended to reduce cost-related risk. I/D provisions are used to accelerate a project's timeline or ensure high quality of work by reducing quality-related risk. RUCs offset the cost to the public for a contractor's failure to complete a project on time and reduce time-related risk. Two agencies combine LD and RUC rates as a single provision via a special project provision. Six percent of the agencies selected '*Other*', indicated that substantial completion and final completion are means to differentiate between provisions and cost

allocation. Both RUC and CE costs are included in their LD assessment up to substantial completion, and only CE costs are assessed for final completion.

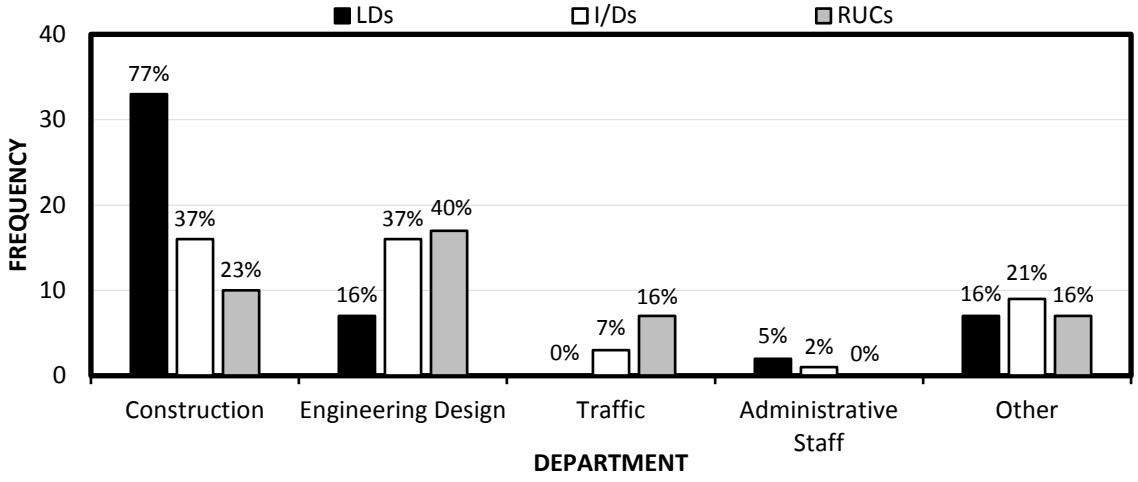
When asked about discounting or excluding LD provisions due to I/Ds or RUCs being drastically higher because of project-related circumstances, 34 out of 43 respondents responded '*No*'. The consensus is that LD provisions are included on every project. Another common comment from agencies is that the provisions are all separate provisions and account for different costs that do not overlap, therefore they would not be reduced or excluded. Mississippi DOT indicated that for high traffic volume areas or high-profile projects, the LD provision may be revised to account for greater RUC values. Another response stated that RUCs may be increased if the agency anticipates an unusually high risk associated with meeting interim completion dates and substantial completion dates. For these scenarios, special provisions are likely used in lieu of standard specifications.

Next, the survey inquired whether agencies required performance bonds to ensure coverage for LDs, disincentives, and/or RUCs in the event of a contractual breach. 53% of the 43 responding agencies stated that a performance bond is not required; while 47% stated that performance bonds are required to ensure coverage of LDs, disincentives, or RUCs in the event of contractor default.

3.2.2 Estimating Methodologies

Next, the survey focused on identifying methods used by STDs for determining LDs, I/Ds and RUCs. Figure 3-2 summarizes responses from agencies identifying the department(s) that develop contractual LD, I/D and RUC rates. *'Construction'* and *'Engineering Design'* were identified the most as the departments charged with developing LD, I/D, and RUC rates with

'Construction' (77%) being the most common department that oversaw LD rate development. Both *'Construction'* (37%) and *'Engineering Design'* (37%) were selected most often for the development of I/Ds. The most common selection for RUC development was *'Engineering Design'* (40%) followed by *'Construction'* (23%). Departments within the *'Other'* category included: *'Accounting'*, *'Alternative Contracting Engineer'*, *'Capital Program Support'*, *'Contract Office'*, *'Division of Planning'*, *'Highway Division-Contracts'*, *'HQ-Design and Construction Standards'*, *'Innovative Delivery (DB-P3)'*, *'Office of Investment Management'*, *'Performance Management'*, *'Program Delivery'*, *Project Support'*, and *'Technical Services/Office of Project Letting'*. No further information was provided by STDs regarding the criteria used to assign the responsibility of the development of LD, I/D and RUC rates. The selection of the most qualified department for this task may depend on the nature of the intended expenses or damages to be recovered (LDs or RUCs) or the type of benefits that may result from an early completion (I/D).



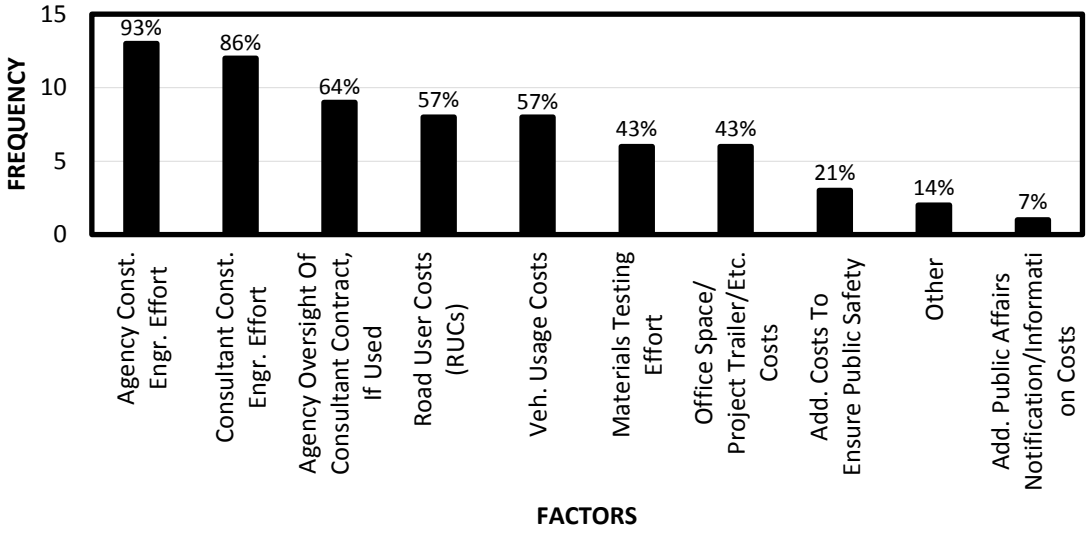
Note: Percentages may sum to greater than 100%, as participants could select multiple responses.

Figure 3-2: Departments that Develop Rates for LD, I/D, and RUC Provisions.

Next, agencies were asked about the development of project-specific LD rates for projects with contract values greater than $20 million. Roughly two-thirds of the agencies stated they do

not develop project-specific rates while one-third stated that they do. Of agencies responding *'Yes'*, it was observed that this practice is not only used by large states with large highway networks, but also small states that may not execute as many high value contracts as large states. Of the agencies who stated that they used project-specific rates for projects with contract values greater than $20 million, almost 86% follow an established cost estimating technique/methodology/worksheet during rate development.

Figure 3-3 summarizes cost factors that are considered when developing an estimate to determine LD rates for contracts exceeding $20 million. Of the 14 responding agencies, 92% selected the *'Agency's CE Effort'* and 85% selected *'Consultant CE Effort'* as major cost contributors when determining LD rates. Additionally, 64% of respondents selected *'Agency Oversight of Consultant Contracts'*, 57% selected *'RUCs'*, and 57% selected *'Vehicle Usage Costs'*. Some specific responses in the '*Other*' category were *'Administration Overhead'* and *'Debt Services'*.



Note: Percentages may sum to greater than 100%, as participants could select multiple responses.

Figure 3-3: Factors used to Estimate LD Rates for Contracts Exceeding $20 million.

Ninety-three percent of the 14 agencies responding stated that both *'Agency Personnel'* and *'Consultant Contracts'* perform the construction oversight, whether it be a mixture or alternating between both options. Rhode Island DOT stated that they used only *'Agency Personnel'*. This agency's state consists of a low total roadway mileage, and their schedule of LDs has a maximum contract value range of $10 million. Previous research has found that the lack of available in-house staff to meet staffing requirements is the main factor that led STDs to outsource construction oversight services (*Taylor & Maloney, 2013*). Therefore, it may be assumed that the reason why this agency does not use external inspectors is because it has enough staff to provide oversight of its construction contracts.

Sixty-percent of responding agencies stated they had a standard procedure for determining I/D values. Most commonly, agencies relied on RUCs as the basis for determining I/D values. Other agencies indicated that I/D provisions are used in emergency situations in which time is a major factor. Additionally, I/Ds are used for bid items, such as hot mix asphalt, where performance metrics on compaction and project mix compliance are critical factors.

3.2.3 Project Staffing Requirements

LD provisions should cover all CE costs, which includes project management, field engineering, and inspection activities associated with the oversight and management of construction activities. Many construction specifications are specific to projects and based on specific work elements. STD specifications often provide significant detail for contractors to develop construction staffing plans. On the other hand, the oversight of construction, except for possibly quality assurance, is rarely detailed in specifications. Very few STDs have metrics for the personnel duties in construction oversight based on project tasks performed, and many STDs do

not clearly define CE requirements to this level of detail. The problem associated with limited guidance is also often seen when CE duties are performed by consultants. Differences between project types may have a significant impact on oversight costs incurred by the STD. For example, an STD contract for mowing will likely have significantly less requirements for CE than widening of an existing road. The overall CE requirement is ultimately dictated by project type and scale, often expressed as a cost. However, 90% of the respondents (36 of 40) stated that they do not have a project staffing plan or methodology in place to aid in LD rate estimations.

Only 20% of the respondents differentiate staffing requirements for both agency and consultant personnel. Tennessee DOT differentiates by first examining the availability of departmental personnel. Consultant personnel are a consideration when an area or office is understaffed and cannot adequately oversee a project. Staffing considerations and the approach toward the project separate the two personnel groups. One specific example, Florida DOT (FDOT) decided a few years ago to outsource all CE inspection needs, thereby relying on consultant CE services for all projects. They have two methods to complete the construction management and inspection of their projects: (1) a full-service consultant, where a consultant provides all positions necessary for a project, or (2) inspector services, which provides inspectors to work along with FDOT engineers to perform CE inspection duties.

The top factors by respondents for determining minimum staffing requirements of personnel duties were: *'Specific Tasks'* (45%), *'Required Number of Hours'* (17%), and *'Percentage of Construction Contractor Hours'* (10%). The *'Other'* category was selected by 42% of respondents. Within these responses, most agencies did not have official requirements, stating

that they have recommendations based upon project experience, and historical data played a part in determining minimum staffing requirements.

When asked about union representation for construction oversight employees across the country, 40 responses were received. After analyzing the results (Figure 3-4), it was clear that the states that have union representation were concentrated in the northern and western portion of the U.S., while the southern half indicated they did not have union representation. The agencies who had union representation for construction oversight employees all stated that the unions do not require a certain level of staffing for construction oversight on construction projects. Union representation does not pose an impact on liquidated damages.

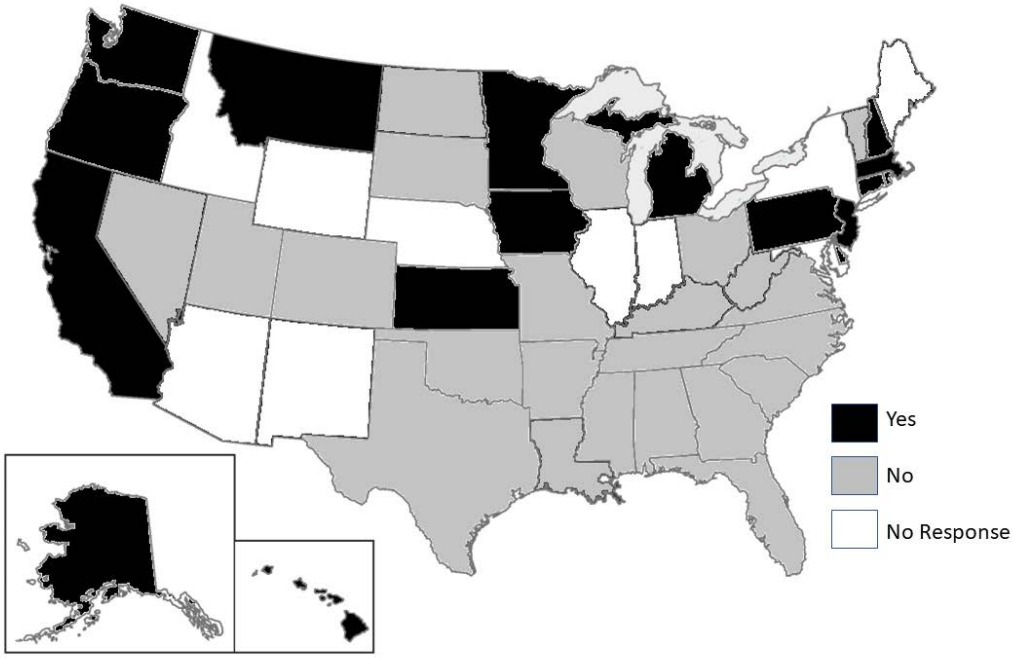


Figure 3-4: State Construction Oversight Employee Union Representation.

3.2.4 Assessment Based Upon Project Status

The assessment of LDs can occur in a few different ways based upon the status of a project, so it is important to review methods and gain an understanding of the advantages and

disadvantages associated with each assessment strategy. By reviewing how all STDs assess LDs, best practices can be found to maximize success in recovery of damages. It was determined that not all agencies have an exact definition for substantial completion, but use similar wording. Some examples of other terminology are: maintenance acceptance and final acceptance. A few agencies do not have a formal definition, but use a statement for interpretation of substantial completion on a project. After reviewing all agencies' definitions, common themes were noticed, such as: requiring all necessary signage, striping, guardrails, and other safety systems (i.e., fire safety systems, illumination, etc.) be installed prior to substantial completion. Curbs and sidewalks must be in place and up to Americans with Disabilities Act (ADA) standards. Additionally, any additional work needed to achieve final completion must not impede traffic flow. Common items listed as exceptions are landscaping, cleanup, removal of erosion and sediment control devices, and other work of a minor nature. A few agencies do not list specific items that can be excluded from substantial completion but list a percent of estimated final contract amount (e.g., 1-2%) which may be still outstanding when substantial completion is officially achieved. Eighty-four percent of respondents also declared that determination of substantial completion on a project occurs locally, either at project-level or regional/district-level.

The most common selection for when agencies officially charged the contractor was *'Upon Expiration of Contract Time'* by almost 83% of the respondents. The second most common selection was *'By Phase or Milestone'* with 45% of the respondents. The *'Other'* category represents 18% of responses. New Jersey DOT stated that LDs can be charged at *'interim*

completion dates (if specified)', *'substantial completion'*, and *'at completion'*. South Dakota DOT stated that LDs are charged at the end of each construction season for multi-year contracts.

3.2.5 Auditing Process and Review

An audit process and review is an important element to ensure LD, I/D, and RUC provisions are accurately recovering the costs associated with damages incurred by an agency or the public in the event of a contractual breach. Without an audit process and review, rates could become unreasonable, leading rates to be challenged in court; or they could be significantly low resulting in an agency not fully recouping delay-based damages. Cost-analysis or audits on projects to evaluate LD rates against actual project costs of CE efforts are not being used by 87% of the respondents. Audits could be used by STDs to better determine if LDs are recouping intended costs due to project delays. Of the 40 agencies who responded, 12% provided various comments on their auditing and review processes. Mississippi DOT commented that they rely on the help of their legal and audit divisions for rate calculation. New Jersey DOT stated that this process does not occur unless LD rates are challenged, which has not happened to the agency in recent years. Other agencies examine the actual costs for each project upon completion to form the basis for determining future LD rates. Vermont DOT plots CE costs from prior projects and overlays a best fit line to assist in the determination of contract value ranges and LD values. Wisconsin DOT stated that they update their standard schedule of LD rates every year. Fifty-percent of the respondents stated they update their standard schedule of LD rates every 2 years. Thirty-five-percent of the respondents update less frequently than every two years. According to 23CFR§635.127(b)*, "*After initial approval by the FHWA of the rates, the STD shall review the

rates at least every 2 years and provide updated rates, when necessary, for FHWA approval," (NHTSA and FHWA, USDOT, 2018).

3.2.6 Legal Issues

Another critical matter is whether agencies have had their LD, I/D, and RUC provisions challenged in the court of law and the resulting verdict, which can establish precedence for the assessment of LD, I/D, and RUC provisions. Agencies should understand where other agencies erred and correct their provisions to ensure they will be upheld in court, if challenged. Eighty-five percent of the 40 respondents stated that their provisions have never been challenged. Such a high percentage suggests that, in general, contractors in the transportation construction industry consider that LD, I/D, and RUC rates being used by STDs are reasonable and are satisfied with the current practices in relation to the use of these contract provisions. Six agencies stated that their provisions have been challenged in court with mixed outcomes, but only two of these cases have experienced legal challenges within the last five years. Five of these cases are discussed and summarized below:

3.2.6.1 Alabama-Good Hope Contracting Company, Inc. v. ALDOT

Good Hope Contracting Company, Inc. entered into three separate contracts with the ALDOT to conduct roadway construction between 2002 and 2003. Upon completion of these projects, ALDOT claimed $600,000 in LDs based upon contract terminology concerning these provisions. Good Hope challenged ALDOT in court, stating that the LDs had been wrongfully assessed and declared that they were penalties and should be void as an attempt to reclaim these lost damages. In trial court, ALDOT tried for a dismissal based upon their sovereign immunity as an agency in the state, but the trial court proceeded without making a ruling on this motion.

Upon review in the U.S. Supreme Court and a writ of mandamus (an order to an inferior court telling them to properly fulfill their duties or correct their abuse of discretion from them (Cornell Law School)), ALDOT was granted dismissal in trial court, due to the trial court's error in failing to dismiss claims on the basis of sovereign immunity (*Good Hope Contracting Company, Inc. v. Alabama DOT, 2007*).

3.2.6.2 Iowa-Rohlin Const. Co. Inc. vs. City of Hinton

In 1991, Rohlin entered into three contracts for road resurfacing in the city of Hinton, which were completed late. LD provisions of $400 per day were enforced based on consultation with an individual at the Iowa DOT for a total of $32,400. Rohlin challenged these values in court and ended up winning their case as the claim for LDs was denied at trial and at the U.S. Supreme Court. LD values within the contract were not validated and the designer was unknown therefore they could not be used as a witness. The due diligence for LD proof was not conducted, therefore the LD provision was not upheld in court *(Rohlin Const. Co. v. City of Hinton, 1991).*

3.2.6.3 Montana-Highway Specialties Inc. vs. State of Montana, DOT

Highway Specialties Inc. entered a contract with the Montana DOT for a highway restriping project. The project completion date was scheduled for August 2003 but Highway Specialties Inc. elected to not begin until October of 2003, and was halted in November due to winter conditions. At $387 per day on fixed date projects, the DOT claimed almost $70,000 in LDs due to late completion. When disputed, the district court ruled in favor of the DOT and enforced the LDs against the contractor; the U.S. Supreme Court agreed with this decision. This decision occurred because the contractor could not prove the provisions were unreasonable, and

had prior history with the DOT, paying LDs three separate times (*Highway Specialties, Inc. v. State of Montana, 2009*).

3.2.6.4 New Jersey-P.T.&L. Construction Company Inc. vs. State of New Jersey (NJ), DOT

P.T.&L. entered a contract with the NJDOT for roadwork on Interstate 78 in Union County. When the project began in November 1972, the site received heavy rainfall, which left areas underwater. This rainfall lengthened the task of stripping from 3 days, as scheduled by P.T.&L., to 171 days. NJDOT invoked their LD clause of $300 per day, but P.T.&L. argued that they were deceived about the working conditions. In trial court, it was decided that the DOT was responsible for the breach and had to pay P.T.&L. damages for delay (*P.T. & L. Construction v. State of New Jersey, 1987*).

3.2.6.5 Pennsylvania-Interstate Contractors Supply Co. vs. Commonwealth of PA, DOT

In 1986, Interstate entered a contract with the Pennsylvania DOT for bridge maintenance in Allegheny County. The contract was to be completed within 61 days, but inclement weather occurred over 27 of those days. The department enforced LDs of $200 per day for a total assessment of $8,600. Interstate challenged this value, stating it constituted a penalty and was not an estimate of probable damages. The Board of Claims ruled in favor of Interstate, but was overruled by the U.S. Supreme Court based on contract language. The burden of unforeseen events was placed upon Interstate. Also, given Interstate's experience, they should have had a good estimate of the number of working days for this project, given the unpredictability of the spring weather and the inability to work Sundays and holidays (*Commonwealth of Pennsylvania v. Interstate Contractors Supply Co., 1990*).

3.2.7 Conclusions

Contractual provisions for transportation construction projects play a significant role in infrastructure expansion and upkeep within the U.S. LD provisions ensure additional costs to the agency are recovered in the event of a time-based delayed upon project completion and should be assessed in good faith and fair dealing. I/Ds provide encouragement for contractors to complete time-sensitive projects in a timely manner. RUCs create an opportunity for STDs to encourage contractors to minimize inconveniences to the motoring public and assess contractors a monetary amount to recovery monies if such inconveniences are caused.

The SOTP associated with LDs is ever-changing, but is currently in good position to aid various agencies in their attempt to recover their own costs. Many agencies across the country have experience with high contract value projects (i.e., greater than $20 million), which will be even more crucial as the size of projects continue to escalate. The *'Construction'* and *'Engineering Design'* departments play a major role in the implementation of these provisions since they are the most commonly selected offices for the development of LD, I/D and RUC rates.

This survey has shown that all responding agencies assess LDs based upon project status and use a similar definition for substantial completion that specifies all safety measures must be in place and any additional work must be minor and not impede travel lanes. Most agencies follow guidelines set forth by the FHWA and are reviewing their LD provisions every one to two years helping to ensure a minimization of legal cases concerning the validity of LD provisions. When determining this validity, courts typically review common guidelines and questions for LDs, as well as the language within the contract. The findings of this portion of the study are expected to assist ALDOT, as well as other STDs with the effective implementation of LD, I/D, and RUC

provisions in high value contracts. The intent is to improve an agency's ability to handle large infrastructure projects and recoup contractor delay-based damages. However, further research is still needed to better understand the implications of using these provisions in terms of cost, project duration, and quality. It would allow STDs and contractors to make more effective decisions based on a better understanding of their risk exposure under different of LD, I/D, and RUC provisions.

The next phase of this research effort is to use the information gathered from the literature review and the results of the SOTP survey to efficiently and effectively mine the ALDOT CPMS database for historical data. Historical data is needed to determine E&I cost factors associated with different types of ALDOT construction projects. This data will be analyzed and used to develop a method that ALDOT can use to determine project-specific LD rates on high contract value projects.

CHAPTER 4: DATA COLLECTION AND PROCESSING

4.1 DATA COLLECTION

Due to ALDOT's limited historical data for projects beyond the $20 million contract value range, it was decided that the project database would include all projects from $10 million and larger. The original dataset of projects collected included 192 projects that were performed between 1998 to 2014 (Appendix C). In addition to project identification (ID), many other variables were included in the initial data collection: 'County', 'Original Project Time', 'Contract Type', 'Time Extensions Granted', 'Total Days Used', 'Original Contract Value', 'Final Contract Value', 'Total E&I Cost', and 'Project Completion Date'. After a review, projects with duplicate and questionable data values were highlighted and reviewed by ALDOT. Upon completion, 120 projects performed between 1998 to 2014 remained in the database to be used for the creation of a liquidated damage (LD) calculator (Appendix D).

In addition to these original variables, several other variables were added to the database to assist with the data processing. Data columns were added for 'Project Completion Status' (i.e., whether it finished early/late) and 'No. of Days Early/Late' were added to identify projects that were completed late, in which ALDOT should have applied LDs. To look for similarities between projects, 'Project Description' and 'Project Region' were added to the database. 'Project Length' in miles and 'Project Letting Date' were also added to use as additional variables for LD rate calculation. 'Project Bid Data' (e.g., Earthwork, Bases, Surfacing & Pavements, Structures,

Incidentals, Traffic Control Devices/Highway Lighting, Training/Lump Sum) was added from the ALDOT Tabulation of Bids online. For the winning project bid, bid data items charged under each of the seven bid sections listed were summed and values were placed into the database accordingly. This bid data is valuable because it is unique to each project, which will assist in the creation of a project-specific LD rate methodology by creating more possible variables within the equation.

4.2 DATABASE SUMMARY

Table 4-1 shows an initial summary of the database used for this project categorized by contract value ranges. The majority of the projects (91%) are between $10 million and $30 million. There were 35 projects completed late, which is 29.2% of the total projects, which is a similar percentage when comparing late projects categorized by contract value. When the same comparison is done for the projects above and below the contract threshold that has been identified as high value (≥$20 million), the values differ by about 7% (31.0% to 24.2%). The % E&I for almost all contract value categories hovers between 9% and 11%, except for a few unusual projects.

Table 4-1: Initial Summary of ALDOT Project Database

CATEGORIES	CONTRACT VALUE RANGES (in Millions)							
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	TOTAL
Total Projects:	87	22	6	0	1	1	3	120
Late Projects:	27	6	1	0	0	0	1	35
% of Late projects:	31.0%	27.3%	16.7%	-	0.0%	0.0%	33.3%	29.2%
% E&I of Orig. Cont. Amt.	11.3%	9.8%	9.6%	-	3.1%	11.1%	8.7%	10.8%

The 120 projects in the database covered eight groupings of project type: ‘Additional Lane’ (39 projects), ‘Grade and Drainage’ (31 projects), ‘Bridge’ (15 projects), ‘Pavement’ (12

projects), 'Planning/Resurfacing' (7 projects), 'Interchange' (6 projects), 'Base and Pavement' (5 projects), and 'Other' (5 projects). Project type was determined from the project description listed in tabulation of bids on the ALDOT website for the projects under consideration.

Project Region was also reviewed to understand how projects of $10 million or greater are dispersed across the state. From highest to lowest, percentage of projects in the database for each region are: East Central (EC) (25.8%), North (N) (24.2%), West Central (WC) (21.7%), Southwest (SW) (17.5%), and Southeast (SE) (10.8%).

4.3 ALDOT PROJECT OUTLIER ANALYSIS

The multiple regression equation created through this process was used to determine a daily LD rate for typical projects, so all atypical projects within the database need to be identified and removed. In order to identify outliers, a normal distribution is needed, which creates a bell-curve shape. To create this normalization, the logarithmic function was performed on all data tested for outliers. Four parameters were used to identify outliers: (1) % E&I of original contract value (%), (2) dollars placed per day ($/Day), (3) original contract time (days), and (4) projects with extremely late finishes. The first three parameters used the logarithmic method described above and the final parameter was based upon engineering judgement. It was determined that projects that are completed 80 or more days late are not representative of projects in the database with late completion. The large number of days late has an adverse effect on the average percent recovery, average percent error, and over/under recovery ($), thereby skewing the results of the model. This was observed when results of various models were compared and analyzed. Therefore, all projects completed 80 or more days late were removed from the database as outliers.

With the normal distribution, atypical projects were detected using a 90% confidence interval, which represents 1.645 standard deviations from the mean. With this confidence interval, it is assumed that 90% of ALDOT's projects are considered typical, while 10% of projects are atypical. Figure 4-1 illustrates the outliers detected by evaluating '%E&I'. The dashed lines represent the upper (24.8%) and lower (3.5%) limits determined by the 90% confidence interval. The gray data represents the outliers, which were not used in the creation of the LD model. Figure 4-1 shows that the majority of outlier projects had lower-than-typical %E&I values, with only a few having higher-than-typical.

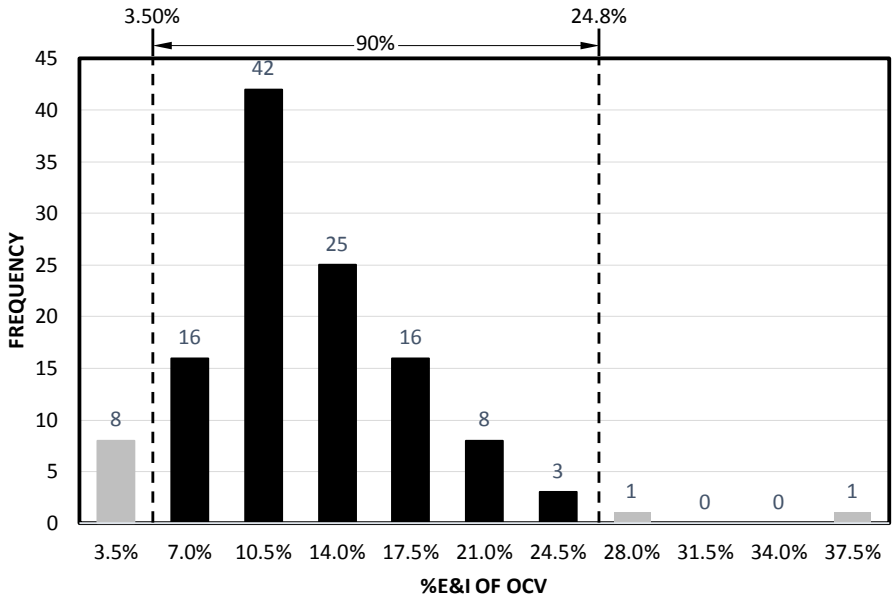


Figure 4-1: Outlier Analysis Based On %E&I of Original Contract Value (n = 120).

Figure 4-2 illustrates the same data as the previous one, but now uses 'Dollars Placed Per Day' as the parameter used to evaluate for outliers. The dashed lines again show the upper ($70,477) and lower ($19,054) limits for this parameter, set by the 90% confidence interval.

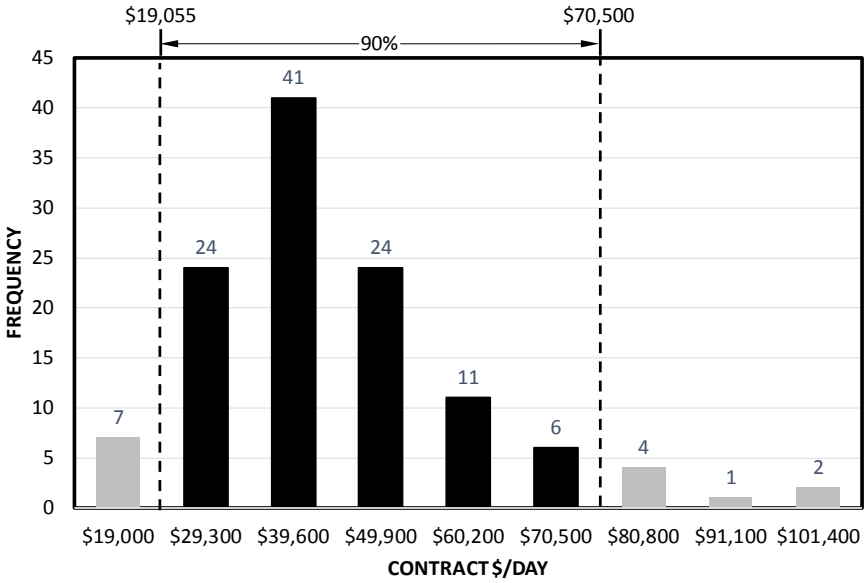


Figure 4-2: Outlier Analysis Based on Dollars Placed Per Day.

Figure 4-3 illustrates the typical 90%, showing outliers based both %E&I and $/Day. The 90% creates a box around the database, easily designating the outliers from the first two parameters.

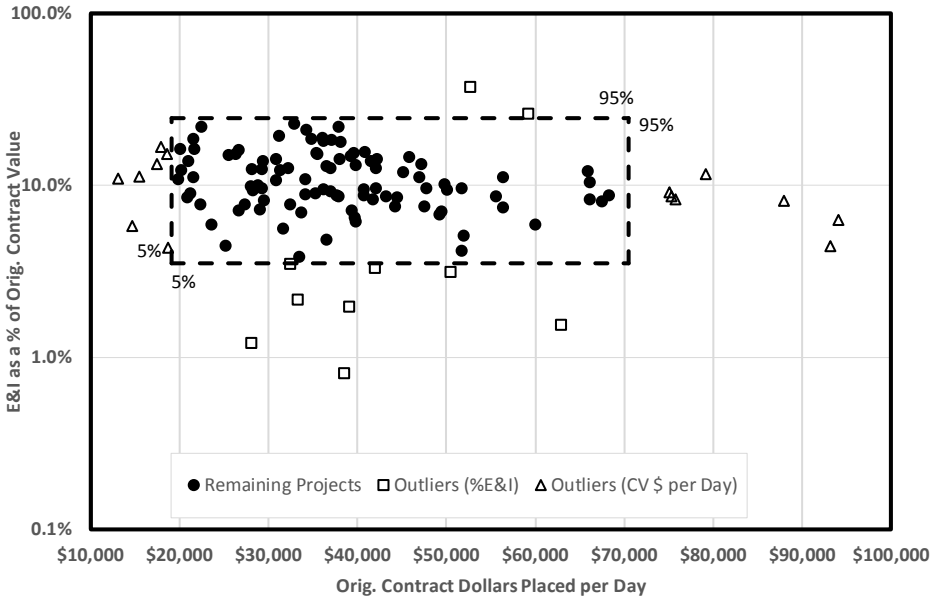


Figure 4-3: Outlier Analysis Illustration Based on %E&I and $/Day.

Figure 4-4 illustrates the outliers found using the 'Original Contract Time' parameter. The bounds for this parameter are 912 days (upper) and 243 days (lower).

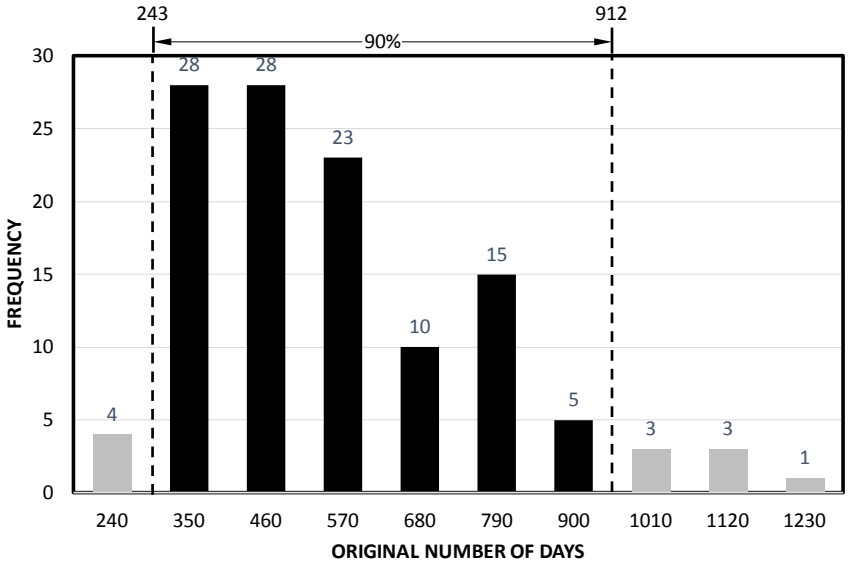


Figure 4-4: Outlier Analysis Based on Orig. Number of Contract Days.

Figure 4-5 illustrates the outliers found using the 'Projects with Extremely Late Finishes' parameter. The bound for this parameter was 80 days. Projects completed less than 80 days late were not considered outliers.

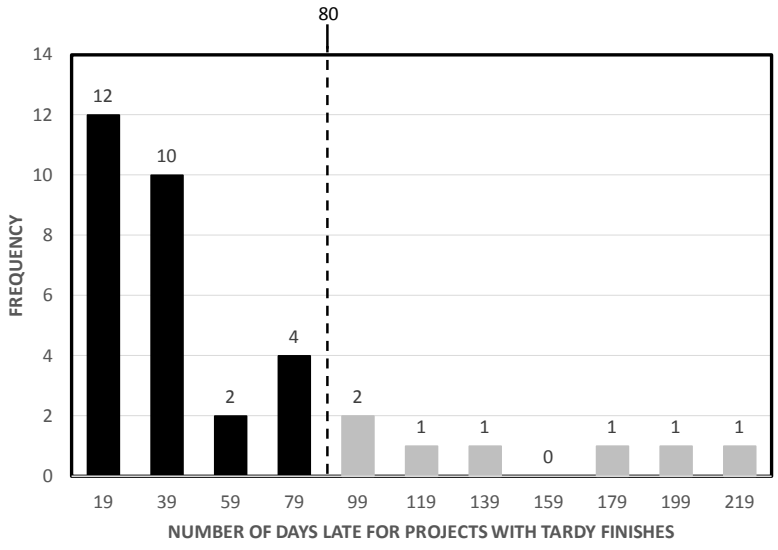


Figure 4-5: Outlier Analysis Based on Projects with Extremely Late Finishes (>80 days).

A total of 35 outlier projects were detected and removed from the database: Seven of the 35 projects were identified in more than one outlier parameter detection method. Ten projects based upon '% E&I', 14 based upon '$/Day', 11 based upon 'Original Contract Time' and 7 based upon the 'Extremely Late Finish' criteria. The seven projects which were identified in multiple outlier detection methods are: two projects were identified as outliers using both '$/Day' and 'Original Contract Time', two projects were identified as outliers using both '% E&I' and 'Original Contract Time', and three projects were identified as outliers using both '$/Day' and 'Extremely Late Finish'.

4.4 CLEAN DATASET SUMMARY

In Table 4-2, a summary of the database is shown after all the outlier analysis was conducted. This cleaned database will be used to create a project-specific LDs calculation methodology, which is discussed in Chapter 6. The values listed in parentheses are projects removed by the outlier methodology, to show which category each outlier came from.

Table 4-2: Summary of Cleaned ALDOT Project Database

CATEGORIES	CONTRACT VALUE RANGES (in Millions)							
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	TOTAL
Total Projects:	68 (19)	15 (7)	2 (4)	0	0 (1)	0 (1)	0 (3)	85
Late Projects:	18 (9)	4 (2)	0 (1)	0	0	0	0 (1)	22
% of Late projects:	25.4%	31.2%	0.0%	-	-	-	-	25.9%
% E&I of Orig. Cont. Amt.	11.7%	9.6%	8.7%	-	-	-	-	11.3%

Due to the current lack of high value projects in the ALDOT database, many high value projects were deemed outliers through our detection methods and removed. As this outlier process continues for future iterations, more high value projects should be completed, which will shift the data and allow for some of those projects to remain for future LD rate calculations.

4.5 SUMMARY AND CONCLUSIONS

Using the ALDOT project database and the outlier analysis completed, the next step is data analysis. In the next section, current ALDOT LD practices are applied to this group of projects to measure accuracy and calculate recovery percentage based on E&I costs per day. In addition, LD policies from Florida, Oregon, and Washington will be applied to the database to analyze their success and accuracy when compared to Alabama projects.

CHAPTER 5: APPLICATION OF OTHER STATES' LIQUIDATED DAMAGE METHODS

5.1 INTRODUCTION

Based on the survey results from Chapter 3, three different state DOTs were contacted to gather additional information and gain a further understanding of their project-specific liquidated damage (LD) calculation methods. Both Washington and Oregon Departments of Transportation (DOTs) use very similar methods based on percent of engineering and inspection (E&I) costs in comparison to the contract value, while the Florida DOT uses a project-specific LD calculation method for contract values above $20 million. The information gathered was used to apply these methods to ALDOT projects to measure and compare their accuracy based upon the cleaned ALDOT dataset discussed in Chapter 4.

5.2 CURRENT STATES' METHODOLOGIES

5.2.1 Alabama (ALDOT)

ALDOT currently employs a schedule of LDs in their Standard Specifications to determine LD rates for new projects, which is shown below in Figure 5-1.

"§108.10 Failure to Complete Work Within Contract Time.

Should the Contractor, or in case of default, the surety, fail to complete the work within the time stipulated in the contract or the adjusted time as granted under the provisions of Article 108.09, a deduction for each calendar day or work day that any work shall remain uncompleted, an amount indicated by the Liquidated Damages Schedule shown in Article 108.11 or provided in the contract documents shall be deducted from any monies due to the Contractor on monthly estimates. Any adjustments due to approved time extensions or overruns in the contract amount will be made on the monthly, semi-final or final estimate as may be appropriate.

Liquidated damages assessed as provided in these Specifications is not a penalty but is intended to compensate the State for increased time in administering the contract, supervision, inspection and engineering, particularly that engineering and inspection which requires maintaining normal field project engineering forces for a longer time on any construction operation or phase than originally contemplated when the contract period was agreed upon in the contract.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may be extended, will in no way operate as a wavier on the part of the Department of any of its rights under contract.

§108.11 Schedule of Liquidated Damages.

Original Contract Amount		Liquidated Damages Daily Charge	
More Than	To and including	Calendar Day or Fixed Date	Work Day
$ 0	$ 200,000	$ 550	$ 1100
200,000	500,000	750	1500
500,000	1,000,000	950	1900
1,000,000	2,000,000	1250	2500
2,000,000	5,000,000	1650	3300
5,000,000	10,000,000	1850	3700
10,000,000	----------	2500	5000

When the contract time is on the calendar day or date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used."

Figure 5-1: Schedule of Liquidated Damages per ALDOT Standard Specification (*ALDOT, 2018*).

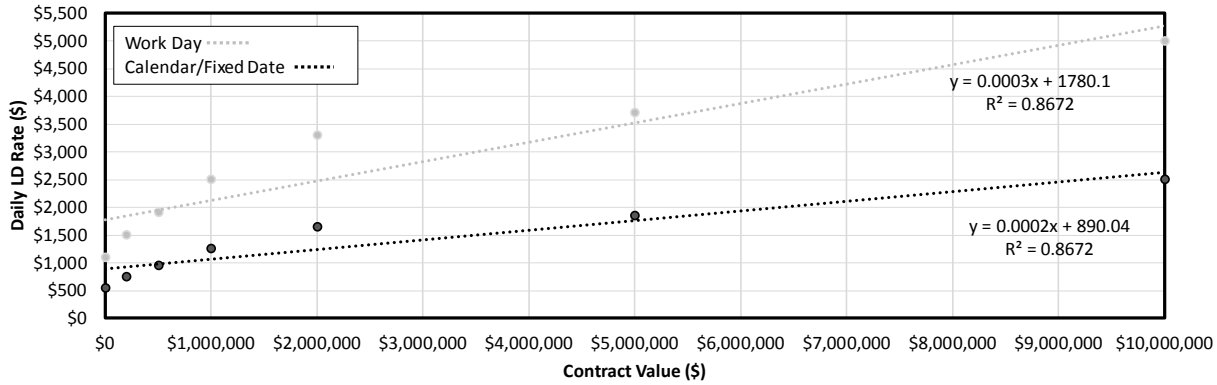
The current ALDOT LD methodology is based upon statistical analyses of historical data, where rates are calculated by contract size. To measure how successful the current ALDOT schedule of LDs method works in comparison to other DOT methodologies, each project in the cleaned database (85 projects) was matched with its original daily LD rate from the schedule in place when the project was originally let. Based on data provided from ALDOT, it was determined how early or late projects were completed based on the total days allowed and total days used. If a project used more days than allowed, it was considered late and thus would have incurred LD charges. The daily rate was multiplied by the calculated amount of days late, which produced a total amount for LDs to be charged. To measure accuracy, actual daily E&I costs were calculated, taking the total E&I cost for the project and dividing by the number of days used. This calculated value represents the monetary amount ALDOT should recover, since LDs are at a

minimum, supposed to cover the E&I costs the agency incurs. These calculated daily E&I costs were multiplied by the number of days late and added together to determine how much the agency spent in E&I costs for projects not completed on time. It was determined that $2,032,033 was the *additional E&I cost* incurred by ALDOT due to the late completion of the projects under consideration. By applying the current ALDOT LD schedule method, results showed a total E&I cost recovery of $1,067,200, which means a recovery rate of 52.5% of total E&I costs were collected by ALDOT from projects completed late within the available dataset.

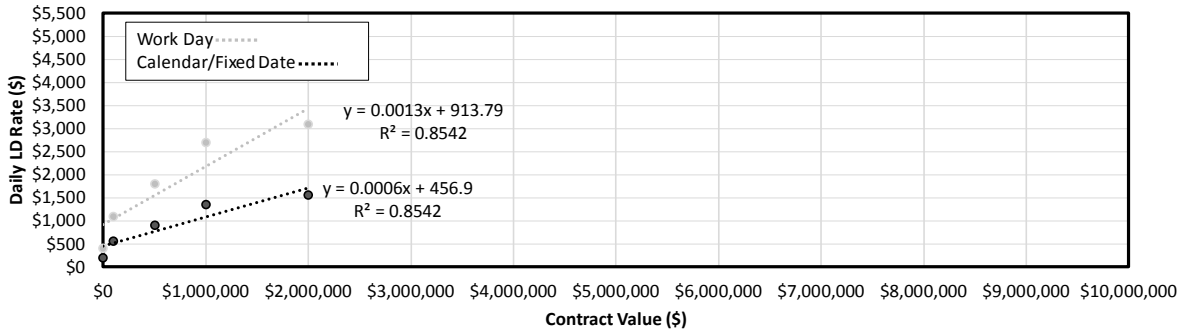
5.2.2 Florida Department of Transportation (FDOT)

Florida DOT employs a traditional LD schedule for projects up to $20 million, which was determined by taking the average E&I charges by contract size grouping as the LD amount. For projects exceeding $20 million, FDOT uses a linear regression formula that relies on a multiplier, which is determined by graphing the values in the schedule of LDs and taking the slope of the trend line created, shown in Figure 5-2. The multiplier is used to determine the additional LD amount to be charged for values exceeding $20 million, which is added to the LD amount for the $20 million range amount. When this method was applied to the database of ALDOT projects depending on the LD schedule year, a multiplier was created to use for projects greater than $2 million or $10 million, because the current ALDOT LD schedule lists $2 million as the highest value for the 2012 schedule and $10 million as highest value for coverage in 2002, 2006, 2008 and 2018. For example, using the LD values for both calendar day and work day listed on the 2018 schedule, two trend lines were generated, and a best fit line was applied to the data, as seen in Figure 5-2 for both Calendar Day/Fixed Day rates and Work Day rates. The corresponding slope (LD Rate/Contract Value) of each line was the multiplier used for LD rate calculation for contracts

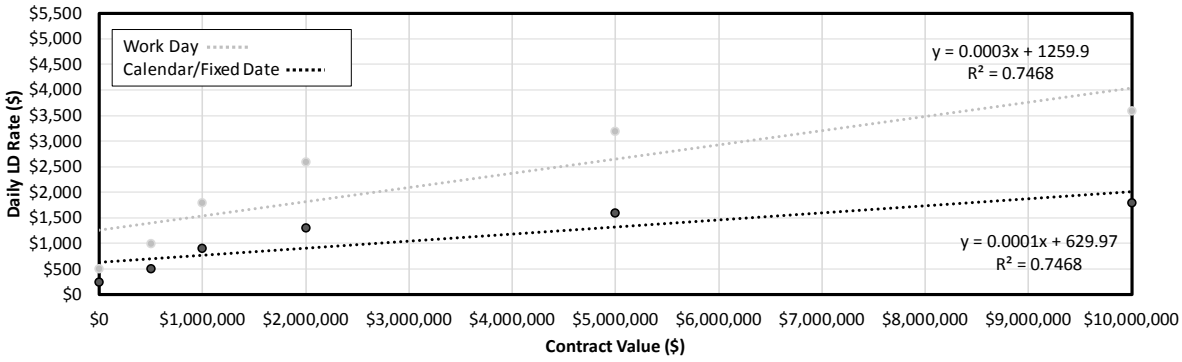
over $10 million. For calendar day/fixed date projects, the multiplier was 0.0002; for work day, the multiplier was 0.0003. This means that for every additional dollar over $10 million, either 0.0002 or 0.0003 is multiplied by the dollar amount and added to the maximum value on the LD schedule, which differs by project letting date. This process was done five times for each new ALDOT Schedule of LDs: 2002, 2006, 2008, 2012, and 2018. The LD provisions for each year are shown in Appendix E.



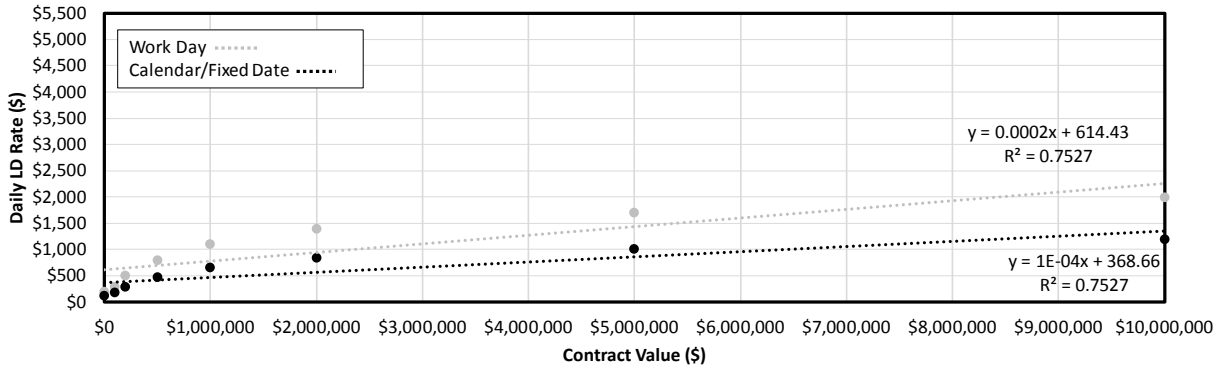
(a) FDOT LD Methodology Applied to 2018 ALDOT Schedule of LDs



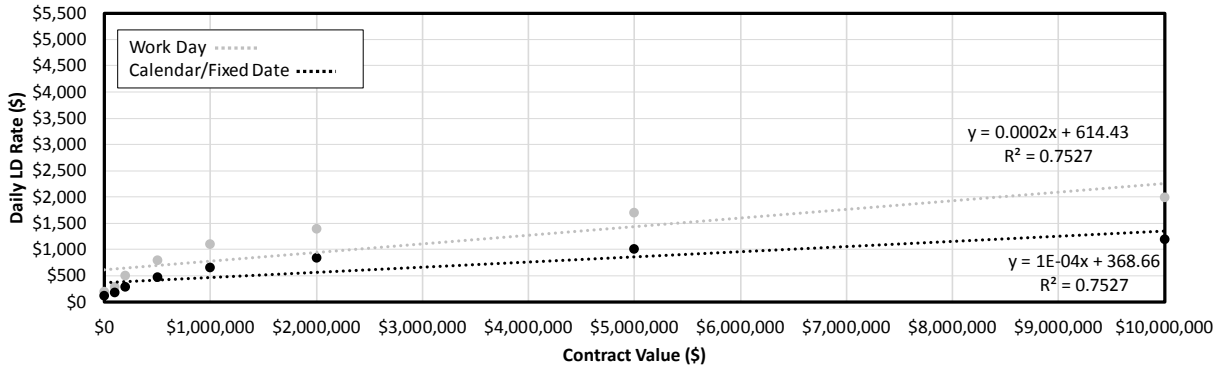
(b) FDOT LD Methodology Applied to 2012 ALDOT Schedule of LDs



(c): FDOT LD Methodology Applied to 2008 ALDOT Schedule of LDs



(d): FDOT LD Methodology Applied to 2006 ALDOT Schedule of LDs



(e) FDOT LD Methodology Applied to 2002 ALDOT Schedule of LDs

Figure 5-2: FDOT LD Methodology Applied to 2018 ALDOT Schedule of LDs.

The corresponding coefficient value for each project depending on letting date and the current schedule was applied to the entire dataset (85 total) resulted in an under-recovery of $110,129, which is a recovery rate of 94.6%. For reference, if the values in the ALDOT LD schedules are applied, it results in an under-recovery of $964,833, which is a recovery rate of 52.5% when compared to the same 85 projects. The results of the different LD schedules based on both the FDOT and ALDOT methods are summarized in Table 5-1 and allow for comparison between methods. The values for 2012 are skewed because the maximum contract value on that schedule was only $2,000,000, which caused the daily rate calculated for each project to be greatly inflated. The apparent high accuracy obtained with FDOT's approach was achieved as a

result of including in the calculation the high recovery rate calculated in 2012, which is actually an outlier. The maximum contract value on the 2012 schedule is $2 million, compared to $10 million on every other schedule included in the analysis. This results in the data being skewed for 2012 since an extra $8 million is accounted for using the multiplier. The multiplier is taking everything into account for all contract values greater than the maximum $2 million contract value listed in the schedule. The recovery rate obtained after excluding 2012 as an outlier is 83.6%.

Table 5-1: Summary of FDOT LD Methodology Applied to ALDOT Dataset

Categories	FDOT 2002	ALDOT 2002	FDOT 2006	ALDOT 2006	FDOT 2008	ALDOT 2008	FDOT 2012	ALDOT 2012
# of Projects	37		17		21		10	
Total LDs that would be charged	$1,126,467	$640,800	$193,831	$158,000	$310,889	$225,000	$290,717	$43,400
Total E&I Costs for Late Projects	$1,434,827		$253,127		$264,201		$79,878	
Over/Under Charges	($308,360)	($794,027)	($59,296)	($95,127)	$46,688	($39,201)	$210,839	($36,478)
Recovery Rate	78.5%	44.7%	76.6%	62.4%	117.7%	85.2%	364.0%[1]	54.3%

Note: 1. The recovery rate of 364.0% is due to the highest ALDOT LD contract range being $2 million, which skewed the results. This was considered an outlier. Upon outlier removal, the recovery rate was 83.6%.

5.2.3 Oregon & Washington (ODOT & WSDOT)

Both Washington and Oregon DOT employ an equation based upon *% of total E&I costs* as well as *original contract value* and *original contract time* (i.e., days). Figure 5-3 shows the LD provisions in place for both the Oregon and Washington DOTs. Oregon uses 21.2% as their estimated percentage of E&I costs based upon original contract value while Washington uses 15%.

Oregon DOT Liquidated Damages Provision, Standard Specifications (ODOT, 2018)

(1) Single Contract Time - The liquidated damages per Calendar Day* for failure to complete the Work on time as required by 00180.50(h) when a single Contract Time is listed under 00180.50(h) will be established using the following formula:

The Liquidated Damages per Calendar Day* are 21.2 percent of C divided by T as defined in this Section.

C = The Contractor's Bid amount for the Contract.
T = The total Calendar Days between the latest completion date or time listed under 00180.50(h) in the Solicitation Documents and the Bid Opening that will result in the greatest value for T.

* Calendar Day amounts are applicable when the Contract Time is expressed on the Calendar Day or fixed date basis

Washington DOT Liquidated Damages Provision, Standard Specifications (WSDOT, 2018)

Because the Contracting Agency finds it impractical to calculate the actual cost of delays, it has adopted the following formula to calculate liquidated damages for failure to complete the physical Work of a Contract on time.
Accordingly, the Contractor agrees:
To pay (according to the following formula) liquidated damages for each working day beyond the number of working days established for Physical Completion, and
To authorize the Engineer to deduct these liquidated damages from any money due ot coming due to the contractor.
Liquidated Damages Formula

$$LD = \frac{0.15C}{T}$$

Where:
LD = liquidated damages per working day (rounded to the nearest dollar)
C = original Contract amount
T = original time for Physical Completion

Figure 5-3: %E&I Liquidated Damage Equation Provisions.

When this method of calculation was applied to the database of ALDOT projects, several percentages corresponding to *% for E&I costs* were used to determine the most accurate percentage to apply. After reviewing the *% of E&I costs* for the projects in the database, it was decided to test five different percent values (i.e., 8%, 8.5%, 9%, 9.5%, and 10%) to measure the accuracy of this methodology. Table 5-1 provides a summary and comparison of the different *%E&I values* analyzed. The most accurate *%E&I value* was 9.5%, which resulted in a total E&I cost under-recovery of $41,905, which is a recovery rate of 97.9%. ALDOT's recovery rate for these same projects under consideration was 52.5%.

Table 5-2: Oregon/Washington %E&I LD Methodology Applied to ALDOT Dataset

Categories	8% E&I	8.5% E&I	9% E&I	9.5% E&I	10% E&I
Total LDs that would be charged	$1,675,898	$1,780,642	$1,885,385	$1,990,129	$2,094,872
Total E&I Costs for Late Projects	$2,032,033	$2,032,033	$2,032,033	$2,032,033	$2,032,033
Over/Under Charges	-$356,136	-$251,392	-$146,648	-$41,905	$62,839
Recovery Rate	82.5%	87.6%	92.8%	97.9%	103.1%

5.3 SUMMARY OF DATA ANALYSIS WITH OTHER STATES' METHODS

After conducting analysis on the current ALDOT method and the application of two other calculation methods developed by other state DOTs to the ALDOT database, results were compared side-by-side to determine which method was most accurate, which is displayed in Table 5-2. The ALDOT method had the lowest recovery rate at 52.5%. The best recovery rate of the applied methods came from the 9.5% E&I method with a recovery rate of 97.9%, which was modeled from the Oregon/Washington DOT approach for calculating daily E&I.

Table 5-3: Side-By-Side Comparison of LD Methodologies Applied to ALDOT Dataset

Method	Total LDs that would be charged	Total E&I for Late Projects	Over/Under Charges	Recovery Rate
Current ALDOT Method	$1,067,200	$2,032,033	-$964,833	52.5%
FDOT Method	$1,918,865	$2,032,033	-$113,169	94.4%
FDOT Method[1]	$1,631,187	$1,952,155	-$320,968	83.6%
9.5% E&I Method	$1,990,129	$2,032,033	-$41,905	97.9%

Note: 1. The FDOT Method is listed twice, once with the 2012 results included and once without because it was determined that the 2012 Schedule results are an outlier due to the low maximum contract value listed.

From these results, it can be seen that the current ALDOT method is not as accurate as methods applied from other states, which highlights the need for a provision update to help the agency recoup more of the damages they incur when projects are delivered late. As contract values continue to increase, the amount of unrecovered damages will continue to increase, affecting ALDOT's ability to maintain and update the state of Alabama roadway system.

CHAPTER 6: LIQUIDATED DAMAGE CALCULATION WITH SPSS MULTIPLE REGRESSION

6.1 INTRODUCTION TO SPSS

The main tool of the data analysis to create a project-specific liquidated damage (LD) calculator for high value contracts will be the computer program IBM® SPSS Statistics. This program is very easy to understand and navigate and can conduct many types of data analysis. Multiple regression will be the focus of the analysis in SPSS, which allows the user to choose multiple variables (also referred to as independent variables) to predict one outcome variable, the dependent variable.

During the original development of the model, multiple project-specific variables were compiled into a database, which included cost, time, and length elements, as well as project bid data. These variables included: project length, original number of project days, costs of each portion of contract (i.e., Earthwork, Bases, Surfacing/Pavements, Structures, Incidentals, Traffic Control, Training/Lump Sum etc.), original contract value, and year of project were input to determine the calculated daily engineering and inspection (E&I) cost of each project. Eleven project-specific variables were used in the original development of model, which helped determine how many years of data needs to be included in the database to create a successful model. The program will conduct an analysis and narrow down the number of variables based on those that significantly affect the output variable, which is daily E&I cost. By following an

iterative process, a final equation with only the statistically significant variables will be produced, which will be used to more accurately calculate LD amounts on a project-specific basis. This process will be repeated using different portions of the database to train and validate the equation. This will ensure the methods are accurate using past projects to predict adequate LDs for future projects within the data set.

6.2 MULTIPLE REGRESSION – DEVELOPMENT AND VALIDATION

Multiple regression is a form of data analysis used to predict a dependent variable based on two or more independent variables. Thus, in this study, a multiple regression model is an equation intended to predict the daily E&I cost for a given project using project-specific characteristics as inputs. To create a project-specific LD methodology, many different project-specific variables were tested to evaluate their effect on the output variable. The validation process followed to test the accuracy and reliability of the regression models developed in this study was divided into two phases, as shown in Figure 6-1. Phase 1: Initial Validation was intended to determine the optimal number of years of data required to predict daily E&I costs during the second validation phase. On the other hand, the purpose of Phase 2: Moving-Window Cross-Validation is to identify the set of variables that would offer the best accuracy, as well as to compare the performance of the proposed model against ALDOT's current LD provisions.

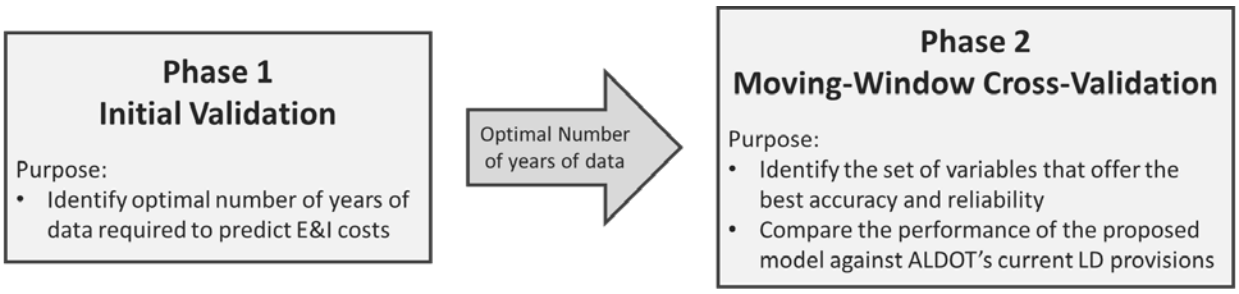


Figure 6-1: Model Validation Process

6.2.1 Phase 1 – Initial Validation

An iterative process (shown in Appendix F) was followed to determine the optimal amount of historical data required to effectively estimate LD rates. This process started with the development of a multiple regression model using of all available variables (first iteration). Eleven variables were tested in the first iteration of each analysis along with a coefficient. (Full dataset is shown in Appendix G).

Each variable corresponds to a code within the software:

- NO_DAYS – original number of contract days;
- PROJ_LENGTH – project length in miles;
- EARTH_THOU – portion of earthwork in winning bid, measured in thousands of dollars;
- BASE_THOU – portion of bases in winning bid, measured in thousands of dollars;
- SURFPAVE_THOU – portion of surfacing/pavements in winning bid, measured in thousands of dollars;
- STRUCT_THOU – portion of structures in winning bid, measured in thousands of dollars (not shown in table below because of its large insignificance);
- INCID_THOU – portion of incidentals in winning bid, measured in thousands of dollars,
- TRAFF_THOU – portion of temporary traffic control in winning bid, measured in thousands of dollars;
- TRAIN_THOU – portion of training/lump sum in winning bid, measured in thousands of dollars;
- OCV_THOU – original contract value, measured in thousands of dollars; and

- YEAR – determined by how recent each project was let (highest year values are most recent projects in model while lowest year values are furthest away from the present year).

Table 6-1 shows the regression output generated from SPSS. This table presents all the coefficients of the multiple regression equation. Listed in the left column are each of the variables that were tested to determine the daily E&I cost of construction projects. The dependent variable (output of regression equation) is DAILY_EI, which is a prediction of the daily E&I at project completion. Actual daily E&I costs at project completion are determined by dividing total E&I cost by number of project days used.

Table 6-1: Sample Coefficients SPSS Output

Variable[a]		B	Sig.
1	(Constant)	5236.214	.000
	NO_DAYS	-6.982	.000
	PROJ_LENGTH	-76.131	.243
	EARTH_THOU	-.009	.924
	BASE_THOU	.050	.762
	SURFPAVE_THOU	-.025	.758
	INCID_THOU	.396	.016
	TRAFF_THOU	-.063	.632
	TRAIN_THOU	.061	.488
	OCV_THOU	.075	.167
	YEAR	-54.609	.296

Note: a. Dependent Variable is DAILY_EI

The second column in Table 6-1, B, represents how each coefficient affect the daily E&I cost based on one additional unit. For example, for each additional original contract day a project has, the daily E&I cost should decrease by approximately $7.00. The other column of significance on this output table is the Sig. column, where the significance level for each variable is listed. Coefficients are considered statistically significant if they are at or below 0.05 (5% significance

level). In Table 6-1, only three items listed are significant to the Daily E&I cost dependent variable: Original Number of Contract Days, Incidentals bid portion in thousands of dollars, and the constant. After confirming which variables are statistically significant, the model is rerun using only those variables (second iteration). The iterations continue until all remaining variables are statistically significant, allowing for creation of a multiple regression model to determine the number of years of data required in the final model. One variable, STRUCT_THOU, is not present in the table because it was excluded by the program. If two variables appear highly colinear, the program will exclude one.

Table 6-1 is the first iteration of Phase 1. When the non-statistically significant variables are left in the model, more variables are present to describe the variability in the data. However, with more variables comes more variability.

In Table 6-2, the output of the final iteration is shown, which only includes variables that are statistically significant. Less variables in the model reduces the model variability, improving error calculations and creating a better forecast.

Table 6-2: Sample Coefficients SPSS Output

Variable[a]	B	Sig.
1 (Constant)	5047.142	.000
NO_DAYS	-6.421	.000
INCID_THOU	.509	.000

Note: a. Dependent Variable is DAILY_EI

The next step of Phase 1 was to determine the amount of years of data that yields the greatest accuracy with the regression model in Table 6-2. The ALDOT project database contains projects from 18 different years (1998 through 2015). The initial SPSS analysis testing was done by setting a data validation set, which used projects from the most recent two years, 2014-2015.

The goal was to understand how rates computed through previous years would estimate values for the most recent projects. Models were tested starting with the seven years prior to the validation years (2007-2013), adding one year at a time until all years of data had been used. Each data analysis model, from 7 through 16 years, was tested using the projects in the validation set. The validation dataset contained 7 projects, 2 of which were completed late. The cleaned database had almost 26% of projects completed late, so this validation dataset is typical for ALDOT in that case. To determine the average percent recovery of the daily LD rate, Equation 6-1 was used.

$$Avg.\%\ Recovery\ (Daily\ E\&I\ ) = Avg\left(\sum_{i=1}^{n}\frac{Calc.Daily\ E\&I_i}{Act.Daily\ E\&I_i}\right) \quad \text{(Eq. 6-1)}$$

To determine the average percent error of the 'Daily E&I', Equation 6-2 was used to determine the percent error for each project within the validation dataset and the results were averaged.

$$Avg.\%\ Error\ (Daily\ E\&I\ ) = Avg\left(\sum_{i=1}^{n}\frac{(Calc.Daily\ E\&I - Act.Daily\ E\&I)}{Act.Daily\ E\&I}\right) \quad \text{(Eq. 6-2)}$$

Equation 6-3 was used to determine the percent recovery of the 'Total E&I', which compares the total E&I calculated by the model compared with the actual total E&I recovered on the projects that were finished late.

$$\%\ Recover\ (Total\ E\&I\ ) = \frac{Calc.Total\ E\&I}{Act.Total\ E\&I} \quad \text{(Eq. 6-3)}$$

Equation 6-4 was used to determine the percent error of the 'Total E&I', which compares the total E&I calculated by the model compared with the actual total E&I recovered on the projects that were finished late.

$$\%\ Error\ (Total\ E\&I\ ) = \frac{(Calc.Total\ E\&I - Act.Total\ E\&I)}{Act.Total\ E\&I} \quad \text{(Eq. 6-4)}$$

The results of the number of years back analysis are displayed in Table 6-3.

Table 6-3: SPSS Method Validation Using Years Back Method

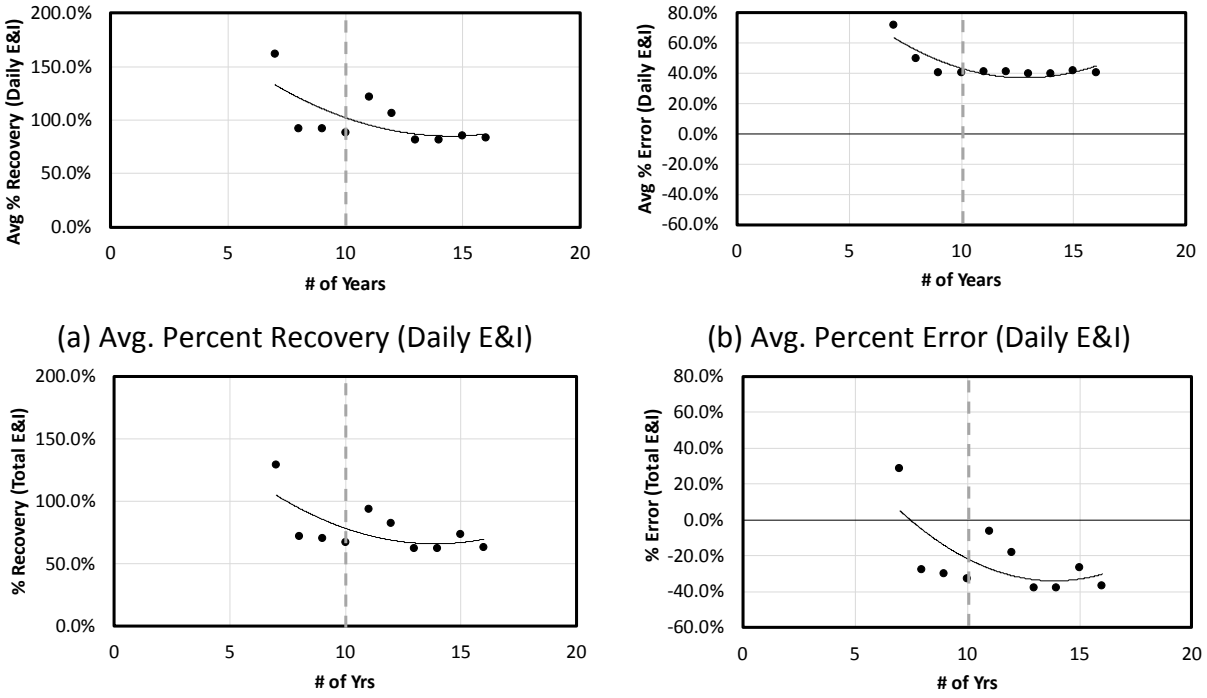
Years of Data Used	Data Years	# of Projects	DAILY E&I		TOTAL E& I			
			Avg % Recovery (Daily E&I)[1]	Avg % Error (Daily E&I)[1]	Actual Total E&I for Late Projects (2012-14)[2]	Calc. Total LDs to be Charged (Model)[3]	% Recovery (Total E&I)	% Error (Total E&I)
7	2007-2013	20	162.3%	72.1%		$422,612	1287%	28.7%
8	2006-2013	28	92.6%	50.9%		$236,893	72.2%	-27.8%
9	2005-2013	38	92.2%	40.7%		$230,038	70.1%	-29.9%
10	2004-2013	45	88.6%	40.7%		$220,924	67.3%	-32.7%
11	2003-2013	52	122.1%	41.2%		$307,773	93.7%	-6.3%
12	2002-2013	60	107.2%	41.4%	$328,332	$269,196	82.0%	-18.0%
13	2001-2013	62	82.3%	40.3%		$204,569	62.3%	-37.7%
14	2000-2013	63	82.3%	40.5%		$204,763	62.4%	-37.6%
15	1999-2013	64	85.5%	42.2%		$240,093	73.1%	-26.9%
16	1998-2013	65	83.4%	40.6%		$207,518	63.2%	-36.8%
ALDOT	**-**	**-**	**55.8%**	**50.4%**		**$136,400[4]**	**41.5%**	**-58.5%**

Note: 1. Average % Recovery (or Average % Error) is the dataset average based upon individual project percent recovery (or error).
2. Values represent the actual total E&I amounts for projects completed late within the validation years of the dataset.
3. Values represent the total liquidated damage amounts calculated by the model to be charged to late projects within the validation years of the dataset.
4. Values represent the total liquidated damage amounts recovered based upon the ALDOT Schedule of Liquidated Damages for applicable years.

The current method that ALDOT uses to determine the schedule of LDs was also tested using the validation window (2014-2015) for reference. The values listed in the last row of 6-3 represent the amount ALDOT should have recovered based upon available information from ALDOT's most updated LD schedule at the time, 2012. No project start year or number of projects are listed because this row only acts as a reference to what is currently being used by ALDOT and was not a created model.

6.2.1.1 Sensitivity Analysis Based on Years

By obtaining the results from each years' analysis, a sensitivity analysis can be done to determine how many years of data are needed to create an accurate model for LD calculation. In Figure 6-2 below, plots were created between years of data used, average percent recovery, and average percent error to understand where the analysis leveled out and still provided accurate analysis results. The dashed line represents the 10-Year model (Model 10.1) for reference. Polynomial trend lines are provided on each graph to better understand the data.



(a) Avg. Percent Recovery (Daily E&I)

(b) Avg. Percent Error (Daily E&I)

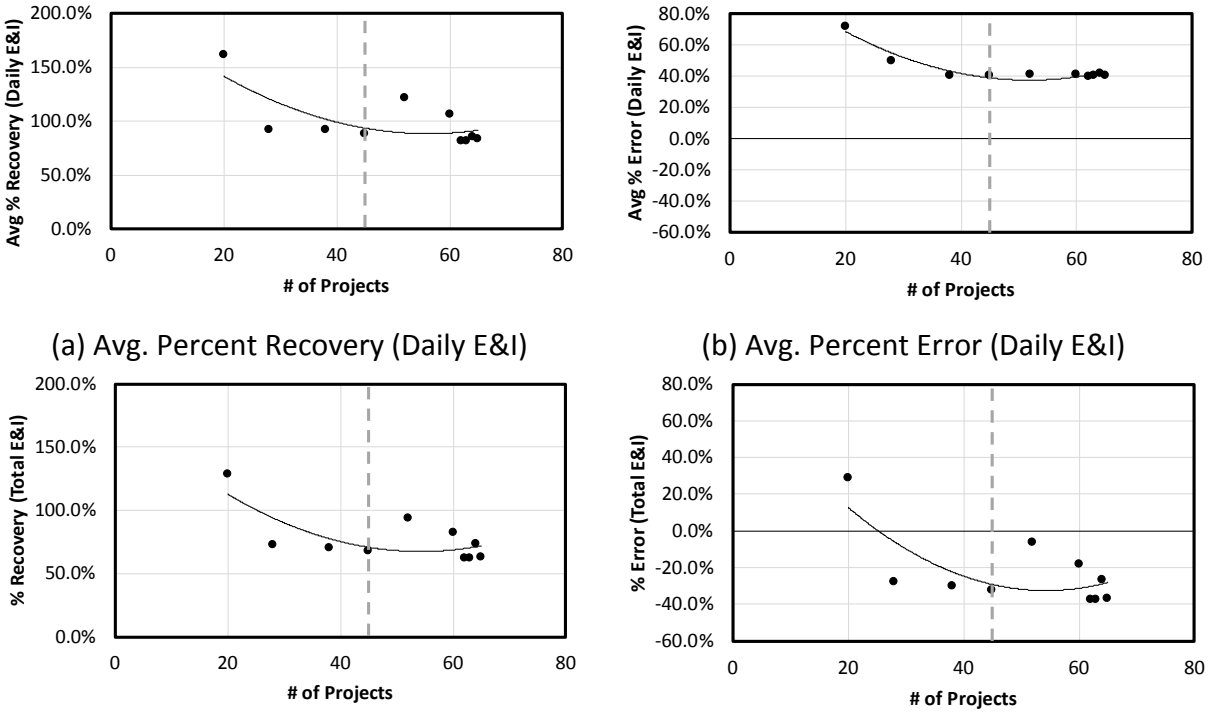
(c) Percent Recovery (Total E&I)

(d) Percent Error (Total E&I)

Figure 6-2: Sensitivity Analysis Based Upon Years of Data Used in Model.

In all plots in Figure 6-2, when the plot reaches the ten-year mark, the data points begin to level off, suggesting each subsequent model is not very different from that before it. Figure 6-3 shows four additional sensitivity plots, this time with number of projects compared to average percent recovery and average percent error. The ten-year model is also represented in

these plots by the dashed line. The ten-year mark used 45 projects for model creation, which is where the data points begin to level off.



(a) Avg. Percent Recovery (Daily E&I)

(b) Avg. Percent Error (Daily E&I)

(c) Percent Recovery (Total E&I)

(d) Percent Error (Total E&I)

Figure 6-3: Sensitivity Analysis Based Upon Number of Projects Used in Model.

After analyzing these graphs, from a practical standpoint, it was decided that ten years of data was required to effectively create a model for calculation of project-specific LD rates. Thus, Phase 2 Moving Window Cross-Validation was conducted using ten years of historical data.

6.2.2 Phase 2 – Moving Window Cross-Validation

The second validation phase is also an iterative process, but it is intended to evaluate the performance of various regression models, as well as to compare their performance against ALDOT's current LDs rate determination practices. The Moving Window Cross-Validation approach was previously used by Pakalapati (2018), as a method to simulate the actual implementation of a data-driven cost estimating system during a given period of time. This

validation approach was applied to estimate daily E&I costs for 40 high value projects awarded by ALDOT between 2008 and 2015. Assuming that the proposed multiple regression model is to be updated every two years (same updating frequency currently used for ALDOT's LD schedule) with the most recent ten years of data (optimal look-back period determined in Phase 1). Thus, the model was updated four times, as illustrated in Figure 6-4, where the model creation years are colored gray and the year during each model was applied are colored black.

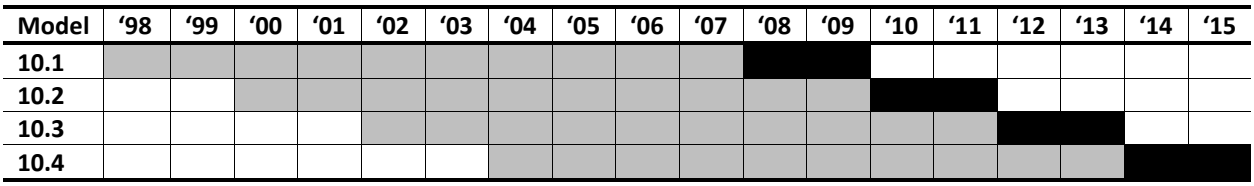


Figure 6-4: 10-Year Moving Window Illustration.

The years of data used for each of the four models (10.1 – 10.4), as well as the number of project involved on each iteration, are summarized in Table 6-4. All four validation subsets had between 7 to 14 projects with 18% to 37% of those projects being completed late.

Table 6-4: Summary of Data Used for 10-Yr Validation Models

Model	Data Years Used	No. of Projects used for		Percent of Projects
	Calibration (Validation) Years	Model Calibration	Model Validation[1]	Completed Late
10.1	1998-2007 (2008-2009)	28	14 (3)	21.4%
10.2	2000-2009 (2010-2011)	43	11 (2)	18.2%
10.3	2002-2011 (2012-2013)	52	8 (3)	37.5%
10.4	2004-2013 (2014-2015)	45	7 (2)	28.6%

Note: 1. Numbers in parenthesis represent number of projects completed late.

The first iteration of the ten-year model was created using data from 1998-2007 to estimated daily E&I costs for projects awarded from 2008-2009 (referred to in Table 6-4 as validation years). In an effort to mimic the use of this methodology by ALDOT, the model was updated at the end of 2009 to estimate daily E&I costs from 2010-2011. The model was

updated two additional times, so the final ten-year model used 2004-2013 for model creation and 2014-2015 for validation.

Since the purpose of the Moving Window Cross-Validation Approach is to simulate the actual implementation of the proposed methodology, the developed multiple regression models cannot use variables whose values are not available at the moment of establishing the LD rates before advertising construction projects. For example, it would make no sense if one of the model inputs is the bid price submitted by the selected contractor (or portions of it) since that information would only become available after awarding the contract and not when the regression equation is to be used. Therefore, unlike Phase 1 where all available variables were used to find the optimal amount of data for model development, only three of the original 11 variables discussed earlier in the chapter were analyzed (NO_DAYS (Time); PROJ_LENGTH (Length); OCV_THOU (Cost)). Models were created using these three variables in all possible combinations (1-Time, Length, Cost; 2-Time, Length; 3-Length, Cost; 4-Time, Cost; 5-Time; 6-Length; 7-Cost) to determine which offers the best estimating accuracy. Table 6-5 shows the regression coefficients output table generated from SPSS for the 'Time, Length, Cost' model for Model 10.4

Table 6-5: Sample Coefficients SPSS Output Generated from Model 10.4

Model[a]		B	Sig.
1	(Constant)	5360.948	.000
	NO_DAYS	-7.852	.000
	PROJ_LENGTH	-155.951	.017
	OCV_1000	0.175	.000

Note: a. Dependent Variable is DAILY_EI

Table 6-6 displays the results of the daily E&I analysis for all seven variations of the model in comparison to the current ALDOT methodology applied to the same dataset. Of the seven model variations, the 'Time, Cost' model had the average percent error closest to zero but had a standard deviation of 55%. The average percent error (second column of Table 6-6), by itself, could be a measure to determine what model would offer the best performance. Even though a low average percent error could indicate a good estimating performance, it could also be obtained with a combination of highly overestimated and highly underestimated projects. For example, if estimating errors for projects A and B are -4% and 6%, respectively, the average percent error between these two projects would be 1%, which seems attractive in terms of accuracy. However, the same average percent error would be obtained with estimating errors of -10% and 12%, or -50% and -52%. The mean absolute percentage error (MAPE) in the last column of Table 6-6 is a measure of accuracy commonly used to compare the estimating effectiveness of two or more cost estimating models, avoiding the accuracy measurement limitations of the absolute percent error.

Table 6-6: Summary of Project-Level Performance (Daily E&I)

Model	Average % Error	Standard Deviation	Mean Absolute Percentage Error (MAPE)
Time, Length, Cost	-7%	48%	37%
Time, Length	-11%	40%	35%
Length, Cost	-10%	52%	42%
Time, Cost	2%	55%	43%
Time	-6%	46%	39%
Length	-13%	41%	35%
Cost	-4%	59%	48%
ALDOT	-29%	29%	36%

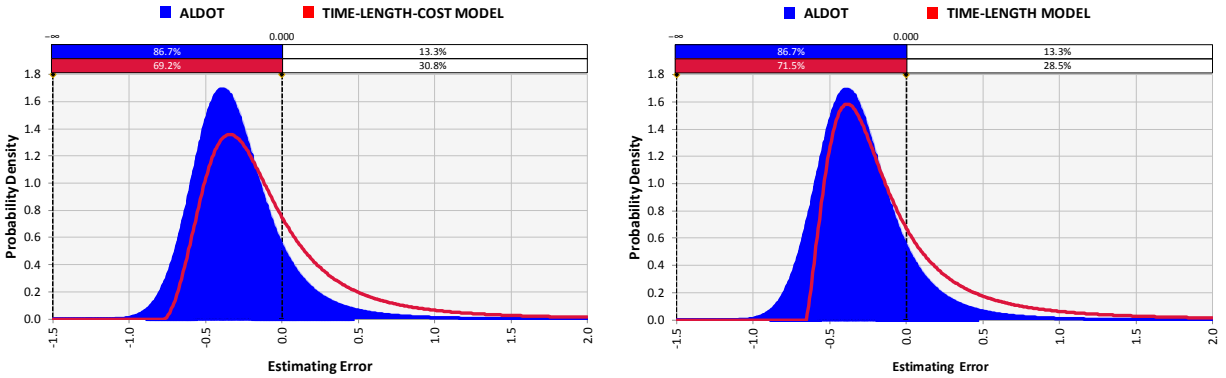
The 'Time, Length' and 'Length' models had the lowest mean absolute percent error (MAPE) value with 35%. However, the 'Time, Length, Cost' model seems to show a similar

estimating performance with a MAPE value of 37%. Moreover, the performance of these three models is also similar to the current level of estimating accuracy achieved by ALDOT with its current practices regardless of the greater magnitude of its average percent error (-29% in last row of Table 6-6). In order to better understand the differences in the performance among the models under consideration, it was necessary to conduct further testing.

First, a Levene's test was conducted to determine if there were significant differences among the variances of the seven models listed in Table 6-6. Yielding a p-value of 0.2, the Levene's test failed to find significant differences in the standard deviations across the models, allowing for the assumption that variances are homogeneous, so that, in all seven models the errors are similarly distributed around their mean. The results of the Levene's test allowed for the application of a second statistical test to determine if there are significance differences amount the average percent errors, the ANOVA test. The ANOVA test is performed under the assumption of homogeneity of variance and this assumption is usually tested with a Levene's test, as done in this study. The results of the ANOVA test produced a p-value of 0.9 which means it can be strongly assumed that there is no statistical difference in the mean errors across the seven models. Therefore, it can be said that all seven models perform similarly.

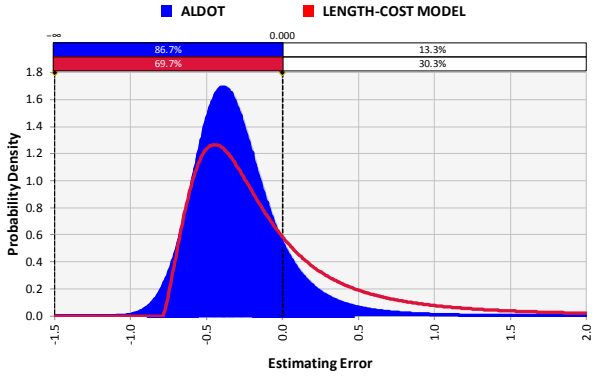
To gain a better understanding of the implication of implementing one of the seven models, Figure 6-5 overlaps the distribution of errors of each model (red curve) with the distribution of errors of the current ALDOT model (blue curve). Estimating errors in all seven models tend to be closer to a 0% estimating error than the current ALDOT model. Likewise, each of the seven models has an overall under-recovery probability close to 70% (red bar at the top of each plot), passing to the contractor 30% of the risk. The current risk share between ALDOT and

the contractor is 87% and 13% (blue bar at the top of each plot), respectively. It means that in 87% percent of the cases ALDOT is not fully recovering the additional E&I costs due to late project completion, while the risk of a contractor is considerably lower with 13% probability. This analysis suggests that any of the proposed seven models would represent a fairer risk distribution between ALDOT and the selected contractors.

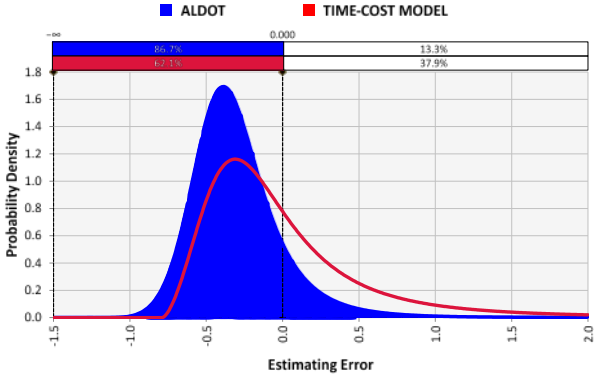


(a) time-length-cost model

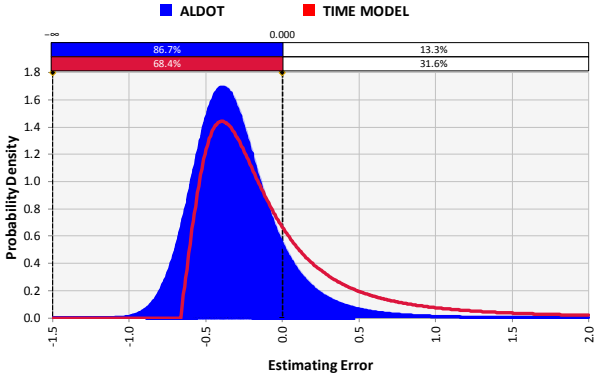
(b) time-length model



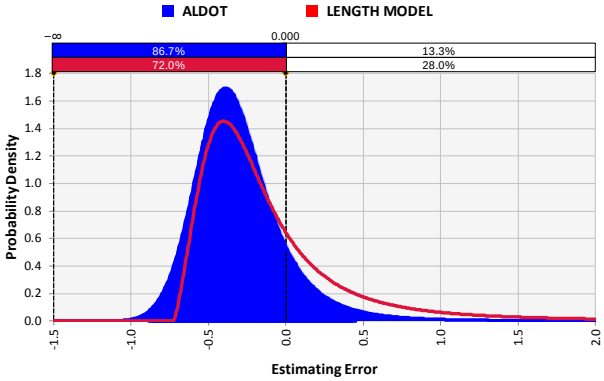
(c) length-cost model



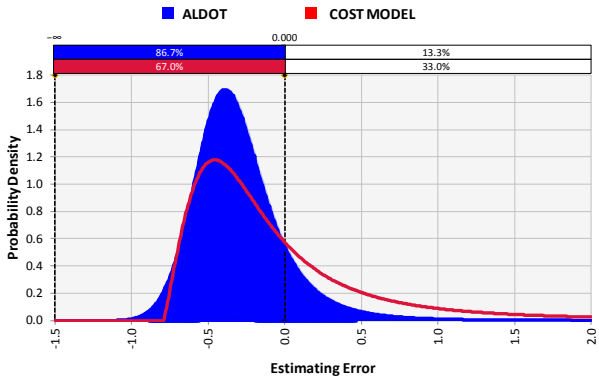
(d) time-cost model



(e) time model



(f) length model



(g) cost model

Figure 6-5: Percentage Error Distribution for Various Linear Regression Models.

So far, the analysis of the performance of ALDOT's current practices and the seven model under consideration has been conducted at the project-level. The percent errors in Table 6-6 and illustrated in Figure 6-5 are measures of central tendency of the errors calculated for each project. It means that these numbers and plots are intended to represent the expected performance of the LD rates on any single project. Thus, before selecting one of the seven models to replace ALDOT current practices, it is important to first assess the agency-level implications to be expected from the implementation of these models. In this study, the agency-level implications refer to difference between cumulative amount of E&I costs that ALDOT should have recovered through LDs across all its projects and the actual amount of LDs paid by contractors due to late project completion. A good performance of a given model at the project-level does not necessarily imply a good performance at the agency-level. For example, a good performance at the agency-level could be achieved through a bad performance at the project-level, were a group of heavily undercharged contractors could be compensated with a group of heavily overcharged contractors, yielding an error closer to zero percent. Therefore, it is important to assess the performance of all models at both the project- and agency-level to select one with a satisfactory or balanced performance in both areas.

Table 6-7 shows the results of the agency-level performance for late projects analysis for these seven models and the current ALDOT methodology for comparison. All seven models recovered closer to 100% than the current ALDOT methodology. The 'Length' model was the most accurate in terms of % recovery, under-recovering by only 7%.

Table 6-7: Summary of Agency-Level Performance (Total E&I)

Model	Actual Total Damages ($)	Total Damages Recovered ($)	% of Damages Recovered
Time, Length, Cost	$2,252,576	2,548,757	113%
Time, Length		2,072,412	92%
Length, Cost		2,432,995	108%
Time, Cost		2,580,660	115%
Time		1,979,717	88%
Length		2,091,658	93%
Cost		2,443,280	108%
ALDOT		1,652,600	73%

After conducting analysis on the seven created models using the Time, Length and Cost variables, it can be inferred that the models perform similarly and there is not much difference between them. In the project-level performance analysis, the estimating error was charted, and it was seen that the risk is fairly distributed between ALDOT and the contractors. Through the Levene's and ANOVA tests, it was determined that the models are very similar based on their variances and their mean error values. In the analysis based upon agency-level performance, the % recovery values of actual damages ranged from 88% to 115% for the seven created models, while the current ALDOT method in place only recovered 73% of actual damages incurred. Thus, it can be concluded that ALDOT could benefit at both the project- and the agency-level from the implementation of any of the seven models developed in this study. However, an additional quantitative analysis is required to compare the performance of the multiple regression models against the methodology used by the Washington and Oregon DOTs. Full results for this section are shown in Appendix H.

6.2.3 Percent E&I Method Cross Validation

Analysis conducted in Chapter 5 using LD calculation methods currently in place from other states on the ALDOT database of projects showed that the %E&I method from Oregon and

Washington was highly accurate in terms of percent recovery. To determine the best possible method for ALDOT to employ, additional validation methods were used on this calculation method, identical to what was done with the linear regression method in 6.2.2. Five models were used in the verification process (i.e., 8.0%, 8.5%, 9.0%, 9.5%, 10.0% E&I). In other words, the additional calculations presented in this section are intended to provide an apples-to-apples comparison between the Washington/Oregon methods and the multiple regression models by applying both approaches to the same validation projects.

Table 6-8 displays the results of the daily E&I analysis for all five variations of the %E&I model in comparison to the current ALDOT methodology applied to the same dataset. Of the five models, the '9.0% E&I' model had the average percent error closest to zero but had a standard deviation of 44%.

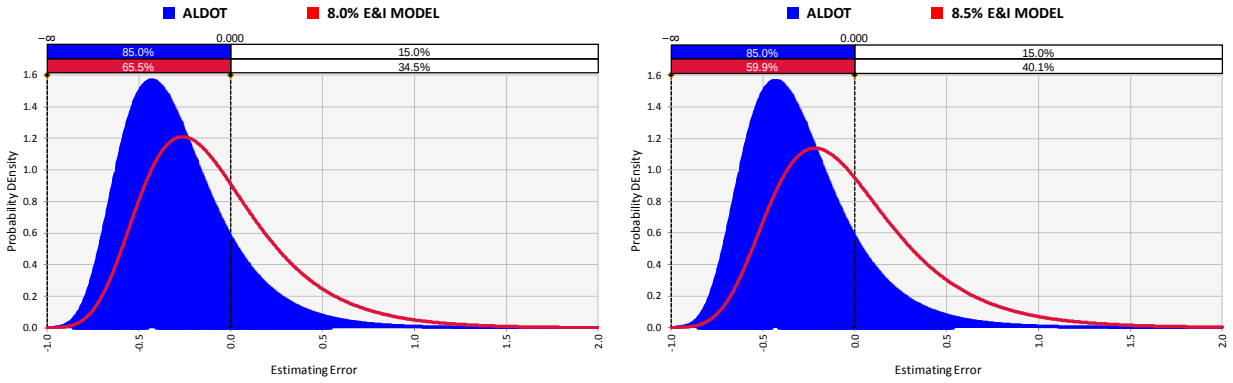
Table 6-8: Summary of Project-Level Performance (Daily E&I)

Model	Average % Error	Standard Deviation	Mean Absolute Percentage Error (MAPE)
8.0% E&I	-12%	39%	34%
8.5% E&I	-6%	42%	34%
9.0% E&I	-1%	44%	35%
9.5% E&I	5%	47%	37%
10.0% E&I	10%	49%	38%
ALDOT	-29%	29%	36%

The '8.0% E&I' and '8.5% E&I' models had the lowest mean absolute percent error (MAPE) value with 34%. The performance of all five models is better than the current practices of ALDOT in terms of average % error. In order to better understand the differences in the performance among the models under consideration, it was necessary to conduct further testing.

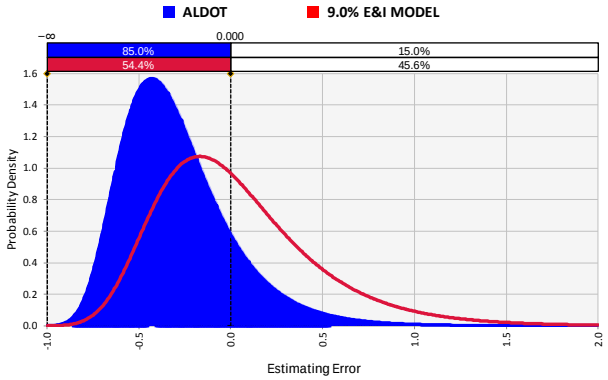
As occurred before in Section 6.2.2 with the multiple regression models, the Levene's and ANOVA tests, with p-values of 0.7 and 0.2, respectively, allowed to assume that all five models listed in Table 6-8 offer a similar LD estimating performance in terms of their expected average error and variability Therefore, it can be said that all five models perform similarly.

To gain a better understanding of the implication of implementing one of the five models, Figure 6-6 overlaps the distribution of errors of each model (red curve) with the distribution of errors of the current ALDOT model (blue curve). Average estimating errors in all five models tend to be closer to 0% than the current ALDOT model. Likewise, each of the five models has an overall under-recovery probability between 42%-65% (red bar at the top of each plot), passing to the contractor 35%-68% of the risk. This analysis suggests that any of the proposed five models built through the methodology used in Washington and Oregon would represent a fairer distribution of risk between ALDOT and the selected contractors, even more equitable than the risk distribution obtained with the multiple regression models.

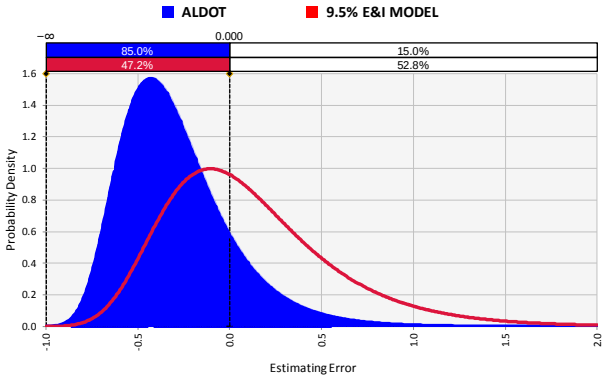


(a) 8.0% E&I model

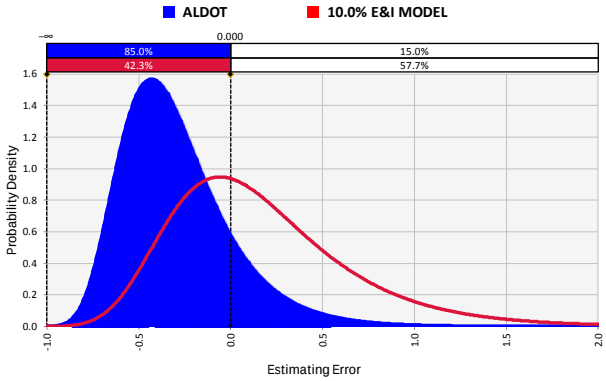
(b) 8.5% E&I model



(c) 9.0% E&I model



(d) 9.5% E&I model



(e) 10.0% E&I model

Figure 6-6: Percentage Error Distribution for Various %E&I Models.

Table 6-9 shows the results of the agency-level performance for late projects analysis for these five models and the current ALDOT methodology for comparison. Four of the five models recovered closer to 100% than the current ALDOT methodology. The '8.0% E&I' model was the

most accurate in terms of % recovery, over-recovering by only 6%. Full results are shown in Appendix I.

Table 6-9: Summary of Agency-Level Performance (Total E&I)

Model	Actual Total Damages ($)	Total Damages Recovered ($)	% of Damages Recovered
8.0% E&I	$2,252,576	$2,393,239	106%
8.5% E&I		$2,542,801	113%
9.0% E&I		$2,692,378	120%
9.5% E&I		$2,841,916	126%
10.0% E&I		$2,991,490	133%
ALDOT		$1,652,600	73%

This study has proven that both the Oregon/Washington methods and the multiple regression approach outperform ALDOT's current LD estimating methodology. Likewise, results presented in this sections and section 6.3.3 show no considerable differences between these two alternatives, meaning that ALDOT could similarly benefit from any of the models presented. However, based on the simplicity of its implementation, this study recommendation to ALDOT is to adopt the methodology used in Oregon and Washington. More specifically, this study recommends the use of this method with a 8.5% E&I, which showed an improved distribution of risk between ALDOT and the contractors as shown in Figure 6-6, in comparison to ALDOT's current method. Additionally the 8.5% E&I method showed a higher percent recovery of damages (113%, see Table 6-9), compared to ALDOT's current recovery percentage of 73%. It should be noted that the agency-level assessment was conducted only on projects completed late, which is a smaller dataset than the used in the project-level assessment. The probability distributions in Figure 6-6 suggest that, in the long run, with the overall percent recovery with a 8.5% E&I would be closer to zero, with a more balanced distribution of overestimated and underestimated LD rates, compared to ALDOT's current method.

6.3 ADDITIONAL LD COST COMPONENTS

The model created using multiple regression in SPSS only calculates the LD amount that should be applied to a project based upon original project time, the length of the project, and the original contract value, which would be used to recover E&I costs if a project did not finish on time. Transportation and other miscellaneous damages can be incorporated into these rates as long as they are reasonable, meant to recover damages in the event of late completion, and are only charged as liquidated damages. Additional rates to possibly incorporate on a per day basis are: vehicle transportation cost, additional office space/project trailer rental/lease/expenses, laboratory/inspection retainer fees, public relations/notification cost, public safety costs (i.e. police/trooper presence), railroad safety costs (i.e. flaggers, right-of-way rental), and loss of revenue (i.e. toll roads, toll bridges, parking meters).

For the transportation costs, mileage from the office to the project site must be known to determine a daily vehicle cost. These values give the inspection roundtrip miles per day, which can be multiplied by $0.545, the federal standard mileage rate for cars and trucks as determined by the IRS for business travel (IRS, 2017). The final daily cost can be added to the calculated LD rate to account for transportation. For other rates, total cost must be known and divided by original number of contract days for a per day cost. These values could be added on top of the calculated daily E&I rate as means to recover transportation and miscellaneous damages when projects are not completed on time.

6.4 SUMMARY

Using SPSS software to conduct multiple regression analysis on project-specific data to create a project-specific LD calculation method tested seven combinations of three different

variables to monitor their accuracy when computing the daily E&I costs. An initial validation process of the cleaned database showed that a 10-year model was suitable when creating equations for LD rates. The values began to level out at 10 years of data.

This was reinforced using the Moving Window Cross-Validation method, where other 10-year sets of data were used to create seven LD equations based on three variables. In the project level performance analysis, each of the seven models had a more accurate average percent error (-13% to 2%) than the current ALDOT method (-29%). The mean absolute percent error values (MAPE) of the models ranged from 35% to 48%, while the current ALDOT method had a MAPE of 36%. The agency-level performance for late projects analysis showed that each of the seven models recovered damages at a more accurate rate than the current ALDOT model. The percent recovery range of the seven models was 88% to 115% while ALDOT recovered only 73%. Estimating error was plotted for each of the seven models against the ALDOT method, which showed a more equitable distribution of risk between ALDOT and the contractor. From the Levene's test, used to determine if variances across different models are equal, it was determined that the seven new models had similar variances and could be considered homogenous. The ANOVA test further reinforced the similarity in models by showing a lack of statistical difference between the mean errors of each model. All seven models perform similarly. After conducting a sensitivity analysis based on number of data years, a moving window analysis with differing variable combinations and running final model analysis (Error plots, Levene's test, ANOVA test), it was determined that ALDOT would gain similar benefits from any of the seven models.

In-depth data analysis was also conducted on the most successful state method from the Chapter 5 analysis, which was the %E&I method used by Oregon and Washington. In the project

level performance analysis, all five models had a more accurate average percent error (-12% to 10%) than the current ALDOT method (-29%). The mean absolute percent error values (MAPE) of the models ranged from 34% to 38%, while the current ALDOT method had a MAPE of 36%. The agency-level performance for late projects analysis showed that four of the five models recovered damages at a more accurate rate than the current ALDOT model. The percent recovery range of the seven models was 106% to 133%, in comparison to the 73% recovery currently achieved by ALDOT. In a similar way, as done with the multiple regression models estimating errors were plotted for each of the five models against the ALDOT method, also showing a more equitable distribution of risk between ALDOT and the contractor. The distribution of risk was even more equitable than the distribution offered by the multiple regression models The Levene's and ANOVA tests also allowed to strongly assume that all five of the %E&I models perform similarly in terms of their average errors and variability.

As a final recommendation from this study, ALDOT should consider implementing the '8.5% E&I' method given the following two reasons:

1. The use of a %E&I is simpler than the implementation of multiple regression models, which would offer a similar estimating performance; and
2. All % E&I show a similar performance, but 8.5% it produced more accurate results than the current ALDOT method at both the project-level and agency-level and it created a more balanced risk share between the agency and contractor (60%-40%) than is currently in place (85%-15%).

CHAPTER 7: SUMMARY AND CONCLUSIONS

7.1 INTRODUCTION

This research project focused on three main objectives: (1) gain a comprehensive understanding of the current body of knowledge of LD, incentive/disincentive (I/D), road user cost (RUC) provisions, and legal challenges associated with implementation; (2) determine the state-of-the-practice in the U.S. regarding DOTs and SHAs development and implementation of LD, I/D, and RUC provisions on high contract value construction projects, and (3) develop a repeatable, project-specific methodology for determining and calculating LD rates on projects with contract values exceeding $20 million. The successes, shortcomings, and recommendations for future work regarding these goals are discussed next.

7.2 LITERATURE REVIEW

The first objective of this project was to obtain a better understanding of LD, I/D, and RUC provisions in construction contracts. This was accomplished through an extensive literature review. In order to use all three provisions, each must cover a different type of cost with no overlap. LDs are used very commonly while I/Ds and RUCs are reserved for projects that have large impacts on the public. RUCs typically are not charged under separate contract provisions but used as a basis for calculation of I/D provisions and sometimes LD provisions. In general, LD provisions must meet three criteria to stand up in court: (1) damages must be difficult to

accurately estimate pre-project; (2) the provision must be designated for losses incurred by the department; and (3) the rates must be reasonable prebreach estimates of the possible damage.

7.3 SURVEY

The second objective of this research project was to understand the state-of-the-practice regarding LD, I/D, and RUC provisions among other State transportation departments (STDs). This was accomplished by creating a survey through Qualtrics and distributing it to 51 STDs across the country. The survey response rate was 88% (45/51). The survey showed that many agencies across the country do have experience with high value contracts (>$20 million) and that many agencies are keeping their LD rates up to date every two years. Not many instances of court cases challenging LD provisions were found, suggesting that STDs have effective rate calculation methods, agreeable to all parties. It was found that some states use project-specific LD methods, which were applied to the data from ALDOT. Applying a %E&I equation was the most successful of the methods from other states.

7.4 ALDOT DATA ACQUISITION

The third objective of this research was to develop a repeatable, project-specific methodology for determining and calculating LD rates on projects with contract values exceeding $20 million. In order to accomplish this task, a reliable and accurate database needed to be acquired. Upon completion of data collection, data cleaning and outlier analysis were conducted. Data for 120 projects was collected originally. Outlier analysis regarding four parameters (%E&I of Original Contract Value, $/Day, Original Number of Project Days, and Projects with Extremely Late Finishes) eliminated 35 projects, which brought the database total to 85 projects.

7.5 LIQUIDATED DAMAGE CALCULATION METHODOLOGY

The final objective of this research was to develop a repeatable, project-specific methodology for determining and calculating LD rates on projects with contract values exceeding $20 million. This was accomplished using SPSS software. Multiple regression analysis was used, which allows multiple variables to affect an output variable, if they are deemed statistically significant. Initially, a sensitivity analysis was performed, ranging from 7 to 16 years of data input for calculation. Two years were used as validation between the different analyses. After observing the results, it became apparent that 10 years of data was a reasonable window for calculation. A Moving Window Cross-Validation method was then applied to validate the selection of 10 years. In the project-level performance analysis, it was determined that the average % error range for the seven different models was -13% to 2% while the current ALDOT model posted a value of -29%. In the agency-level performance for late projects analysis, the percent recovery range of the seven different models was 88% to 115%. The 'Time, Length, Cost' model recovered 113% of the total damages, which was an over-recovery of $326,181. All seven of the models helped to shift the risk back toward the contractor and proved to be very similar in both the Levene's and ANOVA tests.

The %E&I method, currently used by Oregon and Washington, was also analyzed in-depth because it proved to be the most accurate of the state methods in terms of percent recovery in Chapter 5. Five different percentage values were tested in total: 8.0%, 8.5%, 9.0%, 9.5%, and 10.0%. At a project-level, the average % error range for the five models ranged from-12% to 10%. At an agency level, the percent recovery for all five models ranged from 106%-133%. Four of the

five models had a recovery closer to 100% than the current ALDOT method. All five %E&I models helped to shift risk toward the contractor and create a better balance than is currently in place.

It is recommended for ALDOT to consider the use of the '8.5% E&I' method because: 1) the use of a % E&I is simpler than the implementation of multiple regression models, which would offer a similar estimating performance; and 2) all % E&I show a similar performance, but 8.5% it produced more accurate results than the current ALDOT method at both the project-level and agency-level and it created a more balanced risk share between the agency and contractor.

From this, it is recommended that ALDOT use a minimum of ten years of data to conduct this analysis in the future. For example, to calculate the LD equation for 2019, the project database should begin with data from 2018. We advise ALDOT to update the model every two years as stated by the FHWA, which will allow for more recent projects to finish and keep the database current. As time continues, projects will continue to grow in value, meaning ALDOT will spend more money for engineering and inspection (E&I) activities, which could affect ALDOT's ability to maximize their funds to maintain and improve the State's facilities. It is important to implement the new model for calculating LDs, in lieu of the current method to ensure the maximum amount of damages is recovered in the event projects are not completed on-time. We also recommend that ALDOT include transportation and miscellaneous damage costs when allowable to recover damages in addition to the extra E&I costs.

7.6 RECOMMENDED FURTHER RESEARCH

As projects continue to grow in size, it is important to continue to research additional parameters to assist in the creation of the project-specific LD calculator. It is possible that many parameters not identified through this project could have an effect on the calculation of LD rates.

One specific parameter is the cost and time of engineers and inspectors on the job site. This is referred to as project staffing, which would help increase the accuracy of a daily LD calculation methodology.

7.6.1 Project Staffing Research

Project staffing is area of research which should be expanded in the future. Currently, many agencies do not have a set staffing plan used for projects to determine how many engineers and inspectors are needed. It is typically based upon judgement or prior knowledge. Data could be collected concerning project type, project size, and total hours on project per engineer and inspector position. Plots between total hours per position and project size/type would help show correlations between these values and give reliable hourly values to forecast projects in the future. These forecasts would allow managers to better assign their resources to projects early and ensure additional help is brought in if the department is lacking personnel. It would also help with ALDOT's budgetary assignments for projects that are in the early planning and fund allocation stages. This research was performed for the SCDOT by Stefanie Brandenburg and Lansford Bell in 2000 and was discussed in depth in Chapter 2 of this document. Updated data could be collected for ALDOT so these forecasts can be recreated, which can provide a major benefit to agencies.

7.6.2 I/D and RUC Further Research

I/D and RUC provisions can be very beneficial to the motoring public, but more research should be done to quantify and bring to light the possible hazards these provisions can bring. Incentives provide extra capital for a contractor's early finish. Sometimes this involves working in non-ideal conditions, such as night time. If extra precautions are not taken, workers and the

motoring public can have a higher risk of injury due to night work. In addition, finding the balance point between agencies and contractors should be a high priority. I/D provisions do not always divide the risk between both parties equally, which can adversely affect their usage.

RUC provisions should be researched in greater detail regarding the increased effect road users have on the environment while in or near construction zones. Quantifying these values to properly assess damages to a contractor should be of high priority due to the increasing amount of construction work and the increasing world population. More work zones and more road users are going to increase the effect on the environment. By correctly quantifying these values as a portion of RUC provisions, more effort to minimize delays should be put forth by contractors.

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APPENDICES

APPENDIX A

SURVEY OF LIQUIDATED DAMAGE RATES FOR HIGH CONTRACT VALUE PROJECTS

Survey of Liquidated Damage Rates for High Contract Value Projects

We are kindly requesting for you to participate in a survey of the state-of-the-practice for liquidated damage (LD) provisions on projects with contract values exceeding $20 million.

We estimate that this survey should take about 10 to 15 minutes to complete. We request that all inputs be submitted by May 31, 2017. A brief overview of the background, motivation, and purpose of the survey is provided below. If you have any survey related questions, please contact Wesley C. Zech at (334) 844-6272 or via email at zechwes@auburn.edu.

BACKGROUND: The Alabama Department of Transportation (ALDOT) uses a statistically based method for determining a schedule of liquidated damage (LD) rates to be included as a provision in construction contracts. However, when this method is applied on projects with contract values exceeding $20 million, there is the potential to not fully characterize the estimated average daily construction engineering and inspection costs or other anticipated costs of project related delays to ALDOT due to the lack of historical data on contracts exceeding this amount.

PURPOSE: The purpose of this survey is to gather information from other state highway agencies regarding the methods used to calculate LD rates for projects with contract values exceeding $20 million. Responses to this survey will be used to: (1) describe the state-of-the-practice for determining LD rates in contract provisions related to projects with contract values exceeding $20 million and (2) assist with the development of a project-specific LD calculation methodology. ALDOT will share a summary of the responses with all participating agencies.

Thank you in advance for your participation.

Skip Powe, P.E.
State Construction Engineer
Alabama Department of Transportation
Construction Bureau

AGENCY CONTACT INFORMATION

Please provide contact information below for potential follow-up questions:

Responding Agency _____
Responding Individual _____
Title _____
Department/Bureau _____
Street Address _____
Unit/Suite _____
City _____
State _____
Zip Code _____
Telephone Number _____
Email Address _____

CONTRACTUAL PROVISIONS

1. Does your agency stipulate liquidated damages (LDs), in lieu of recovering actual damages, as a contract provision on state and/or federally funded construction projects?
   - ❍ Yes
   - ❍ No

If "No" Is Selected, Then Skip To End of Survey.

2. Does your agency have experience with oversight of single construction contracts with values exceeding $20 million?
   - ❍ Yes
   - ❍ No

If "No" Is Selected, Then Skip To End of Survey.

3. Does your agency have any declarative statements as to the purpose, scope, range, and intent of the LD provision in contractual documents or other agency manuals (e.g., technical specifications)?
If yes, please give a brief explanation.
   - ❍ Yes _____
   - ❍ No

If "Yes" is selected, display this question.

If your agency has a declarative statement as to the purpose, scope, range, and intent of the LD provision in contractual documents or other agency manuals (e.g., technical specifications), please attach a copy of the statement.

If you have an additional file pertaining to the previous question, please upload it below.

4. For contracts subject to LDs, how is the duration specified? (check all that apply)
   - ❑ Calendar Days
   - ❑ Work Days
   - ❑ Fixed Calendar Date
   - ❑ Other (please specify) _____

5. Does the contractual rate stipulated for LDs by your agency vary based on: (provide a brief explanation of your response)
   - ❍ Contract Value (i.e. 0-$100,000; $100,000-$500,000; $500,000-$1,000,000; $1,000,000-$2,000,000; $2,000,000+) _____
   - ❍ Project Type (i.e. bridge, highway, maintenance, widening, etc.)
     _____
   - ❍ Both contract value and project type
     _____
   - ❍ Other (please explain)
     _____

If 'Contract Value" is selected, display this question.

If the contractual rate stipulated for LDs by your agency vary based on contract value, please attach a current schedule for liquidated damages.

If you have an additional file pertaining to the previous question, please upload it below.

6. Does your agency have a standard procedure for determining appropriate incentive/disincentive (I/D) provisions for construction projects? If yes, please provide a brief explanation.

- ❍ Yes _____
- ❍ No

If "Yes" is selected, display this question.

If your agency has a standard procedure for determining appropriate incentive/disincentive (I/D) provisions for construction projects, please attach a copy of the procedure.

If you have an additional file pertaining to the previous question, please upload it below.

7. Does your agency have a standard method for calculating road user costs (RUCs)? If yes, please provide a brief explanation.

- ❍ Yes _____
- ❍ No

If "Yes" is selected, display this question.

If your agency has a standard method for quantifying and calculating road user costs (RUCs), please attach a copy of the procedure.

If you have an additional file pertaining to the previous question, please upload it below.

8. What project-specific factors are considered when deciding to include I/D and RUC provisions in the contract? (check all that apply)

- ❑ Urban versus rural project
- ❑ Traffic volumes
- ❑ Potential for congestion
- ❑ Detour considerations
- ❑ Follow-on projects
- ❑ Other (please specify) _____

9. Does your agency assess LDs, I/Ds, or RUCs simultaneously on construction contracts?

- ❍ Yes
- ❍ No

If "Yes" is selected, display this question.

10. Identify how your agency assesses LDs, I/Ds, or RUCs simultaneously on construction contracts? (check all that apply)
    - ❑ Yes, as a single, combined value
    - ❑ Yes, as separate stipulations
    - ❑ Yes, other: _____

If "Yes, as a single, combined value" is selected, display this question.

If your agency assesses LDs, I/Ds, or RUCs simultaneously on construction contracts as a single, combined value, please provide a short explanation of how the combined figure is generated.

_____
_____

If "Yes, as separate stipulations" is selected, display this question.

If your agency assesses LDs, I/Ds, or RUCs simultaneously on construction contracts as separate stipulations, please provide a short explanation of how the differentiation between the costs is made.

_____
_____

If "Yes, other" is selected, display this question.

If your agency assesses LDs, I/Ds, or RUCs simultaneously on construction contracts in another way, please provide a short explanation of how the assessment works.

_____
_____

11. Prior to letting the contract, do project related circumstances arise that would allow your agency to discount or not include or require a separate LD provision in a contract due to I/Ds or RUCs being drastically higher? (provide a brief explanation of your response)

- ❍ Yes

_____
_____

- ❍ No

_____
_____

12. Within performance bond contracts, does your agency require provisions to ensure the coverage of liquidated damages, disincentives or road user costs in the event of contractor default?

- ❍ Yes
- ❍ No

If "Yes" is selected, display this question.

12A. If your agency requires provisions to cover LDs, disincentives, or RUCs in the event of a contractor default within the performance bond, please specify which of the following damages are included. (check all that apply)

- ❑ LDs
- ❑ Disincentives
- ❑ RUCs
- ❑ Other (please specify) _____

LD, I/D, AND RUC ESTIMATING METHODOLOGIES

13. Which department within your agency develops the LD rates that are included in construction contracts? (check all that apply)

	LDs	I/Ds	RUCs
Accounting	❑	❑	❑
Engineering Design	❑	❑	❑
Construction	❑	❑	❑
Administrative Staff	❑	❑	❑
Other (please specify) _____	❑	❑	❑
Other (please specify) _____	❑	❑	❑
Other (please specify) _____	❑	❑	❑

14. Does your agency develop project-specific LD rates for projects with contract values exceeding $20 million?

- ❍ Yes
- ❍ No

If "No" is selected, skip to next section.

15. Does your agency follow an established cost estimating technique/methodology/worksheet in preparing project-specific LD rates?

- ❍ Yes
- ❍ No

If "Yes" is selected, display this question.

If your agency follows an established cost estimating technique/methodology/worksheet in preparing project-specific LD rates, please attach a copy of the technique/methodology/worksheet.

If you have an additional file pertaining to the previous question, please upload it below.

16. What factors are used to estimate or determine LD rates for contracts exceeding $20 million? (check all that apply)

- ❑ Agency construction engineering effort
- ❑ Agency oversight of consultant contract, if consultant contract is used
- ❑ Consultant construction engineering effort
- ❑ Materials testing effort
- ❑ Vehicle usage costs
- ❑ Office space/project trailer/etc. costs
- ❑ Additional costs to ensure public safety (i.e. state trooper) presence
- ❑ Additional public affairs notification/information costs
- ❑ Road User Costs (RUCs)
- ❑ Other (please specify) _____

17. For contracts with values exceeding $20 million, is construction oversight (i.e., construction administration, engineering and inspection services) performed by agency personnel or via a consultant contract?

- ❍ All construction oversight conducted by agency personnel
- ❍ All construction oversight conducted by consultant contract
- ❍ Mixture of agency personnel and consultant personnel perform construction oversight
- ❍ Sometimes a mixture and sometimes just one

PROJECT STAFFING REQUIREMENTS

18. Does your agency have a standard project staffing plan or a methodology for estimating staff requirements used for calculating LD rates based on project type (e.g., bridge, highway paving, resurfacing, widening, maintenance, etc.)? A project staffing plan sets forth the required number of personnel (i.e., engineers, inspectors, managers, etc.) and the total man hours for a specific project.

- ❍ Yes
- ❍ No

If "Yes" is selected, display this question.

If your agency has a standard project staffing plan or a methodology for estimating staff requirements used for calculating LD rates based on project type (e.g., bridge, highway paving, resurfacing, widening, maintenance, etc.), please provide a brief description of the methodology.

_____
_____

If "Yes" is selected, display this question.

If your agency has a standard project staffing plan or a methodology for estimating staff requirements used for calculating LD rates based on project type (e.g., bridge, highway paving, resurfacing, widening, maintenance, etc.), please provide a copy of the documentation.

If you have an additional file pertaining to the previous question, please upload it below.

19. Are construction oversight employees in your agency represented by a union?

- ❍ Yes
- ❍ No

If "Yes" is selected, display this question.

20. Does a union require a certain level of staffing on your construction projects for construction oversight?

- ❍ Yes
- ❍ No

21. Does the agency differentiate between staffing plan requirements of agency and consultant personnel?

- ❍ Yes
- ❍ No

22. Does your agency have minimum staffing requirements or metrics for personnel duties during project execution?

	Yes	No
Contract Administration	❑	❑
Construction Engineering	❑	❑
Construction Inspection	❑	❑

23. Does the agency determine minimum staffing requirements or metrics for personnel duties based on: (check all that apply)

- ❑ Specific tasks
- ❑ A required number of hours
- ❑ A percentage of construction contractor hours
- ❑ A certain percent of work in place
- ❑ A certain number of samplings
- ❑ Other (please specify) _____

LD ASSESSMENT BASED UPON PROJECT STATUS

24. Does the agency have a standard definition of "substantial completion"?

- ❍ Yes
- ❍ No

If "Yes" is selected, display this question. If your agency has a standard definition of "substantial completion", please provide the definition in the space below.

_____
_____

25. At what level is the determination of substantial completion on a project made?

- ❍ Consultant-level
- ❍ Project-level
- ❍ Regional/District-level
- ❍ State/Agency-level
- ❍ Other (please specify) _____

26. Typically, when are LDs charged to a contractor on a high value contract project? (check all that apply)

- ❑ By phase or milestone (or when phase or milestone date not achieved)
- ❑ Upon expiration of contract time
- ❑ Substantial Completion
- ❑ Other (please specify) _____

27. Does your agency stop charging LDs once substantial completion is achieved?
Substantial Completion (from AIA): the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

- ❍ Yes
- ❍ No

AUDITING PROCESS AND REVIEW

28. Does your agency conduct a cost analysis or an audit on projects to compare LDs with actual costs incurred after the project is complete?

- ❍ Yes
- ❍ No

If "Yes" is selected, display this question.

If your agency conducts a cost analysis/audit on projects, provide a brief explanation of actions taken following the audit results. If possible, provide general findings from recent audits.

_____
_____

29. If your agency uses a standard schedule of LD rates, how often is it updated?
- ❍ More frequently than annually
- ❍ Every year
- ❍ Every 2 years
- ❍ Less frequently than 2 years
- ❍ We use only project-specific LD rates

LEGAL ISSUES

30. Have your LD provisions or rates been challenged in court?
- ❍ Yes, within the last 5 years
- ❍ Yes, more than 5 years ago
- ❍ No

If "No" is selected, skip to end of survey.

31. If your LD provisions have been challenged in court, have any of these challenges been against projects with a contract value over $20 million?
- ❍ Yes
- ❍ No

If "Yes" is selected, display this question.

If your LD provisions have been challenged in court on contracts valued over $20 million, please provide Case Numbers, Case Titles, Dates, and Court Jurisdictions.

_____
_____

32. If your LD provisions have been challenged in court, in general, have the rulings: (check all that apply)
- ❑ Upheld LD provisions or rates
- ❑ Overturned LD provisions or rates
- ❑ Mandated revision of LD provisions or rates
- ❑ Other (please clarify) _____

APPENDIX B

SURVEY RESULTS

A. CONTRACTUAL PROVISIONS

Question 1: Does your agency stipulate liquidated damages (LDs) in lieu of recovering actual damages, as a contract provision on state and/or federally funded construction projects?

Total Responses	Yes	No
46	45	1
100%	97.83%	2.17%

Please use comment box to provide clarifying remarks.

Responding State[1,2]	Response	Comments
Alabama	Yes	None
Alaska	Yes	None
Arkansas	Yes	None
California	Yes	None
Colorado	Yes	None
Connecticut	Yes	None
Delaware	Yes	None
Florida	Yes	None
Georgia	Yes	None
Hawaii	Yes	None
Idaho	Yes	None
Illinois	Yes	None
Indiana	Yes	None
Iowa	Yes	None
Kansas	Yes	None
Kentucky	Yes	None
Louisiana	Yes	None
Maine	Yes	None
Massachusetts	Yes	None
Michigan	Yes	None
Minnesota	Yes	None
Mississippi	Yes	None
Missouri	Yes	None
Montana	Yes	None
Nevada	Yes	None
New Hampshire	Yes	None
New Jersey	Yes	None
New Mexico	Yes	None
North Carolina	Yes	None
North Dakota	Yes	None
Ohio	Yes	None
Oklahoma	Yes	None
Oregon	Yes	None
Pennsylvania	Yes	None
Rhode Island	Yes	None
South Carolina	Yes	None
South Dakota	Yes	None
Tennessee	Yes	None
Texas	Yes	None
Utah	Yes	None
Vermont	Yes	None
Virginia	Yes	None
Washington	Yes	None
West Virginia	Yes	None
Wisconsin	Yes	None
Wyoming	No	None

Note:

1. Partial responses were received from the following states: British Columbia, Idaho, Indiana, Illinois, and New Mexico.

2. No response was received from the following states: Arizona, Maryland, Nebraska, New York, and Washington D.C.

A. CONTRACTUAL PROVISIONS

Question 2: Does your agency have experience with oversight of single construction contracts with values exceeding $20 million?

Total Responses	Yes	No
45	44	1
100%	97.78%	2.22%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Yes	None
Alaska	Yes	None
Arkansas	Yes	None
California	Yes	None
Colorado	Yes	None
Connecticut	Yes	None
Delaware	Yes	None
Florida	Yes	None
Georgia	Yes	None
Hawaii	Yes	None
Idaho	Yes	None
Illinois	Yes	None
Indiana	Yes	None
Iowa	Yes	None
Kansas	Yes	None
Kentucky	Yes	None
Louisiana	Yes	None
Maine	No	None
Massachusetts	Yes	None
Michigan	Yes	None
Minnesota	Yes	None
Mississippi	Yes	None
Missouri	Yes	None
Montana	Yes	None
Nevada	Yes	None
New Hampshire	Yes	None
New Jersey	Yes	None
New Mexico	Yes	None
North Carolina	Yes	None

Responding State	Response	Comments
North Dakota	Yes	None
Ohio	Yes	None
Oklahoma	Yes	None
Oregon	Yes	None
Pennsylvania	Yes	None
Rhode Island	Yes	None
South Carolina	Yes	None
South Dakota	Yes	None
Tennessee	Yes	None
Texas	Yes	None
Utah	Yes	None
Vermont	Yes	None
Virginia	Yes	None
Washington	Yes	None
West Virginia	Yes	None
Wisconsin	Yes	None

A. CONTRACTUAL PROVISIONS

Question 3: Does your agency have any declarative statements as to the purpose, scope, range, and intent of the LD provision in contractual documents or other agency manuals (e.g., technical specifications)? If yes, please give a brief explanation.

Total Responses	Yes	No
44	36	8
100%	81.82%	18.18%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Yes	The purpose of LDs is described in Article 108.11 (copy attached). The current range of LD rates is shown in Special Provision 12-0426(3) (copy attached).
Alaska	Yes	LDs are applied for 4-5 different things. See highway specifications. For purposes of exceeding contract time, see section 108-1.07
Arkansas	Yes	In the Department's contract signing page, liquidated damages are described as the costs that the Commission/Department will sustain in delay produced by the Contractor exceeding the contract time.
California	Yes	The Standard Specification states terms of when LDs apply and when they may be withheld for possible LD application, and identifies the ranges of bid amounts that are applicable.
Colorado	Yes	SS 108.09 .The schedule of liquidated damages set forth below is an amount, agreed to by the Contractor and the Department, as reasonably representing additional construction engineering costs incurred by the Department if the Contractor fails to complete performance within the contract time.... Also in CDOT Construction Manual 108.9 Failure to complete work on time.
Connecticut	Yes	Description of LD's is in Standard Specifications Article 1.08.09, "Failure to Complete Work on Time." There are Special Provisions in every contract titled "Contract Time and Liquidated Damages" which contain the project specific LD rates (Completion date and Lane Use LD's). We also have an Engineering and Construction Directive, "Minimum Daily Liquidated Damage Rates" which is updated every two years for the contract completion LD rates.

Delaware	No	None
Florida	Yes	8-10 Liquidated Damages for Failure to Complete the Work. 8-10.1 Highway Code Requirements Pertaining to Liquidated Damages: Section 337.18, paragraph (2) of the Florida Statutes, requires that the Department adopt regulations for the determination of default and provides that the Contractor pay liquidated damages to the Department for any failure of the Contractor to complete the Contract work within the Contract Time. These Code requirements govern, and are herewith made a part of the Contract. 8-10.2 Amount of Liquidated Damages: Applicable liquidated damages are the amounts established in the following schedule: Original Contract Amount Daily Charge Per Calendar Day $50,000 and under ---$763 Over $50,000 but less than $250,000 ---$958 $250,000 but less than $500,000 ---$1,099 $500,000 but less than $2,500,000 ---$1,584 $2,500,000 but less than $5,000,000 ---$2,811 $5,000,000 but less than $10,000,000 ---$3,645 $10,000,000 but less than $15,000,000 ---$4,217 $15,000,000 but less than $20,000,000 ---$4,698 $20,000,000 and over ---$6,323 plus 0.00005 of any amount over $20 million (Round to nearest whole dollar) 8-10.4 Conditions under which Liquidated Damages are Imposed: If the Contractor or, in case of his default, the surety fails to complete the work within the time stipulated in the Contract, or within such extra time that the Department may have granted then the Contractor or, in case of his default, the surety shall pay to the Department, not as a penalty, but as liquidated damages, the amount so due as determined by the Code requirements, as provided in 8-10.2.
Georgia	Yes	Explanation of LD is covered by standard specifications Section 18.08.
Hawaii	Yes	It is located in our technical specifications section 108.08. Amount of LDs are indicated in the special provisions.
Idaho	No	None
Illinois	Yes	LD's are explained in Article 108.09 of our Standard Specifications. Here is a link to our current version: http://www.idot.illinois.gov/Assets/uploads/files/Doing-Business/Manuals-Guides-&-Handbooks/Highways/Construction/Standard-Specifications/Standard%20Specifications%20for%20Road%20and%20Bridge%20Construction%202016.pdf
Indiana	No	None

Iowa	Yes	Liquidated Damages may be adjusted based on user costs such as delay or out of distance travel or other justifiable damages pertaining to a contract. Refer to the Liquidated Damages Worksheet to calculate additional damages for an individual contract.
Kansas	Yes	$3,000 for Working Day LD, $1,500 for Cleanup Day LD.
Kentucky	Yes	Standard Specification 108.09 (FAILURE TO COMPLETE ON TIME)- For each calendar day that the Contractor fails to complete the work after the final Contract time allowed according to Subsection 108.07 for the completion of the Contract, the Department will deduct the applicable daily charge specified in this subsection from any money due the Contractor; not as a penalty, but as agreed liquidated damages. The Department will deduct daily charges as agreed liquidated damages for each calendar day without regard to inclement weather or the temperature limitations in the Contract, except that the Department will not deduct liquidated damages when the specified seasonal or temperature limitations prohibit the Contractor from performing work on the controlling item or operation. The Department will charge the agreed liquidated damages on a calendar day basis regardless of whether the Contract time is measured in calendar days, working days, or is established as a specified completion date contract. Because the prosecution of work in connection with the construction of road and bridge projects will inconvenience the public, obstruct traffic, and interfere with business, complete the work as quickly as practical. Also, the Department's costs for the administration of the Contract, including inspection, engineering, supervision, and maintaining detours, increases with the time that the Contractor takes to execute the work. When the Department allows the Contractor to continue and to finish the project beyond the Contract time, such permission does not operate as a waiver by the Department of any of its rights under the Contract.
Louisiana	Yes	LADOTD has a Chart setting damages for different valued projects.
Massachusetts	Yes	See attached LDs spec excerpts from our 1995 Metric Std. Specs. for Highways & Bridges and our 07-15-2015 Supplemental Specs.
Michigan	Yes	Located in our spec book. Subsection 108.10. (http://mdotcf.state.mi.us/public/specbook/2012/)
Minnesota	Yes	(See attached document).
Mississippi	No	None
Missouri	Yes	The specifications state that amount of liquidated damages is not a penalty but a liquidated damage for loss to the Commission and public.
Montana	Yes	The specification includes this statement: This deduction is for liquidated damages for added Department contract administration costs, etc. for failure to complete the work on time.
Nevada	No	None

New Hampshire	Yes	This sum shall not be considered and treated as a penalty but as liquidated damages due the Department by reason of inconvenience to the public, added cost of Engineering and supervision, and other extra expenditures of public funds due to the Contractor's failure to complete the Work on time....
New Jersey	Yes	Specification reads- 108.20 LIQUIDATED DAMAGES: The Contractor and the Department recognize that delays to Contract Time result in damages to the Department including the effect of the delay on the use of the Project, public convenience and economic development of the State, and additional costs to the Department for engineering, inspection, and administration of the Contract. Because it is difficult or impossible to accurately estimate the damages incurred, the parties agree that if the Contractor fails to complete the Contract or portion of the Contract within the Contract Time, the Contractor shall pay the Department the liquidated damages specified in the Special Provisions. The Department will assess liquidated damages for each and every day that the Contractor has failed to complete the Work or portion of the Work within the Contract Time requirements as specified in 108.10. If the Department discovers that the work required to meet an Interim Completion requirement is unacceptable after the RE notified the Contractor that the work appeared to be complete, the Department has the right to assess liquidated damages for the time period required to correct the unacceptable work. When the Contractor may be subjected to more than one rate of liquidated damages established in this Section, the Department will assess liquidated damages at the higher rate.
New Mexico	Yes	It is to represent the value of inconvenience to the public and the Department.
North Carolina	Yes	Article 108-11 of the 2012 Standard Specifications for Roads and Structures discusses purpose and intent of the LD provision.
North Dakota	Yes	See section 108.07 of our standard specifications
Ohio	No	None
Oklahoma	Yes	It is covered in our specifications. (http://www.odot.org/c_manuals/specbook/oe_ss_2009.pdf)
Oregon	Yes	Special Provision 00180.85(b)
Pennsylvania	Yes	LD language is found in the Departments Publication 408 - Specifications.
Rhode Island	No	None
South Carolina	Yes	SCDOT Standard Specifications address most project LD rates. The Contract Special Provisions address LD's outside of those provisions on projects with high public impact, significance or cost.
South Dakota	Yes	The amount deducted will be considered not as a penalty but as liquidated damages due the Department from the Contractor by reason of added cost to the Department for contract administration resulting from the work not being completed within the required time.
Tennessee	Yes	LD's are the administrative cost for TDOT to staff the job. Occasionally, on projects that have significant impacts on traffic, we will apply a user cost delay. See our 104.04 and 108.09 here: (http://tn.gov/assets/entities/tdot/attachments/TDOT_2015_Spec_Book_FINAL_pdf.pdf)

Texas	Yes	To recover administrative costs for managing contracts past projected completion.
Utah	No	None
Vermont	Yes	As outlined in our Specification Book; See section 108.12- (http://vtrans.vermont.gov/sites/aot/files/contractadmin/documents/2011specbook/2011Division100.pdf)
Virginia	Yes	108.06- Failure to Complete on Time (a) General: For each calendar day that any work remains incomplete after the Contract time limit specified for the completion of the work, the Department will assess liquidated damages against the Contractor. Liquidated damages will be assessed at the rate applicable to the Contract in accordance with the Schedule of Liquidated Damages, Table I-1, or as otherwise specified in the Contract provisions. Liquidated damages will be deducted from any monies due the Contractor for each calendar day of additional time consumed until final completion and acceptance of the Work, subject to such adjustments as provided in accordance with the requirements of Section 108.04, not as a penalty, but as liquidated damages. The Contractor waives any defense as to the validity of any liquidated damages stated in the Contract or these Specifications and assessed by the Department against the Contractor on the grounds that such liquidated damages are void as penalties or are not reasonably related to actual damages. (b) Liquidated Damages- The following Schedule of Liquidated Damages, representing the cost of administration, engineering, supervision, inspection and other expenses, will be charged against the Contractor for each calendar day beyond the Contract time limit that the Contract remains in an incomplete state: Schedule of Liquidated Damages- Original Contract Amount in Dollars Daily Charge in Dollars $0-$500,000.00 ---$350 $500,000-$2,000,000 ---$600 $2,000,000-$8,000,000 ---$1,350 $8,000,000-$15,000,000 ---$2,500 $15,000,000 or more ---$3,100 SECTION 108.06(b) LIQUIDATED DAMAGES of the Specifications is replaced by the following: All work for this Contract shall be completed and accepted on or before the time limit established in the Contract. In the event the Contractor fails to complete the work by the time limit, liquidated damages, representing the estimated additional cost of administration, engineering, supervision, inspection and other expenses will be charged against the Contractor in the amount of $fill-in amount for each calendar day beyond the time limit, including Sundays and Holidays, in which the Contract remains in an incomplete state.
Washington	Yes	I have attached our specification for LDs. We use a formula based on Contract total price and working days. The explanation of what LDs are is also in the spec.
West Virginia	Yes	Standard Specifications, Section 108.7; Link to Specifications webpage: (http://www.transportation.wv.gov/highways/contractadmin/specifications/2017StandSpec/Pages/default.aspx)

Wisconsin	Yes	Normal LD's are assessed from Standard Spec book and are based on the project value. We also enhance LD's based on road user costs, for project that have high road user impacts. STSP for the enhanced is attached below. This is placed the Prosecution and Progress section.

A. CONTRACTUAL PROVISIONS

Question 4: For contracts subject to LDs, how is the duration specified? (check all that apply)

Total Responses	Calendar Days	Fixed Calendar Date	Work Days	Other
44	32	19	16	4
	73%	43%	36%	9%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Calendar Days, Work Days, Fixed Calendar Date	None
Alaska	Calendar Days	None
Arkansas	Calendar Days, Work Days, Fixed Calendar Date	None
California	Work Days	None
Colorado	Calendar Days, Work Days, Fixed Calendar Date	None
Connecticut	Calendar Days, Fixed Calendar Date, Other	Hourly
Delaware	Calendar Days	None
Florida	Calendar Days	None
Georgia	Calendar Days	None
Hawaii	Work Days	None
Idaho	Work Days	None
Illinois	Calendar Days, Work Days, Fixed Calendar Date	None
Indiana	Calendar Days, Work Days, Fixed Calendar Date	None
Iowa	Calendar Days, Work Days, Fixed Calendar Date	None
Kansas	Calendar Days, Work Days, Fixed Calendar Date, Other	Also Cleanup Days
Kentucky	Calendar Days, Work Days, Fixed Calendar Date	None
Louisiana	Calendar Days	None

Massachusetts	Calendar Days, Fixed Calendar Date	None
Michigan	Calendar Days, Work Days, Fixed Calendar Date	None
Minnesota	Calendar Days	None
Mississippi	Calendar Days	None
Missouri	Calendar Days	None
Montana	Calendar Days	None
Nevada	Work Days, Fixed Calendar Date	None
New Hampshire	Calendar Days, Work Days	None
New Jersey	Calendar Days	None
New Mexico	Calendar Days	None
North Carolina	Calendar Days, Other	Intermediate Contract times may also be in hours
North Dakota	Calendar Days, Work Days, Fixed Calendar Date	None
Ohio	Calendar Days	None
Oklahoma	Calendar Days, Fixed Calendar Date	None
Oregon	Calendar Days, Fixed Calendar Date	None
Pennsylvania	Calendar Days	None
Rhode Island	Fixed Calendar Date	None
South Carolina	Calendar Days, Fixed Calendar Date	None
South Dakota	Calendar Days, Work Days, Fixed Calendar Date	None
Tennessee	Calendar Days	None
Texas	Calendar Days, Work Days, Fixed Calendar Date	None
Utah	Other	contract value dependent
Vermont	Calendar Days, Work Days, Fixed Calendar Date	None
Virginia	Fixed Calendar Date	None
Washington	Work Days	None
West Virginia	Calendar Days	None
Wisconsin	Calendar Days, Work Days, Fixed Calendar Date	None

A. CONTRACTUAL PROVISIONS

Question 5: Does the contractual rate stipulated for LDs by your agency vary based on: (provide a brief explanation of your response)

Total Responses	Contract Value	Project Type	Both contract value and project type	Other
44	37	0	3	4
100%	84.09%	0.00%	6.82%	9.09%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Contract Value	Our current specifications list LD rates across seven ranges of contract amount. See Special Provision 12-0426(3) attached under previous question.
Alaska	Contract Value	See 108-1.07
Arkansas	Contract Value	Two scales are used; one for working day projects and the other for fixed date projects. The individual ranges are the same for both scales, but the individual rates differ according to the project type.
California	Contract Value	We have 11 ranges of "total bid" amount specified in the Standard Specs with each range consisting of an attributed average LD value for each specific range.
Colorado	Contract Value	Our new Schedule to go in effect July 1, 2017. With FHWA we calculate every two years.Proposed Liquidated Schedule Revision Table:Original Contract Amount ($) Liquidated Damages per Calendar Day ($)(From More Than To And Including) $0-$500,000 $900$500,000- $1,000,000 $1,500$1,000,000- $2,000,000 $2,200$2,000,000- $5,000,000 $4,100$5,000,000- $15,000,000 $5,500$15,000,000+ $9,900 ***We give each project an opportunity to calculate their own, this would allow for mega or highly complex projects to establish a project specific approved rate.The weighted average daily cost per million dollars was calculated for all the projects above $15 million by calculating the average cost for the group, and dividing by the average project cost for the group in millions of dollars. This amount was relatively high, based on only a few projects. CDOT did an evaluation/estimate of staffing a major project and it was determined that the rate presented below would typically cover CDOT's construction oversite costs. CDOT has previously issued a notice to designers that liquidated damages for large dollar projects the designers may adjust this amount in the contract after consultation with and approval of the contract and Market Analysis Branch Manager. This would allow for mega or highly complex projects to establish a project specific approved rate.

Connecticut	Contract Value	For contract completion date LD's, the recommended values vary by Contract value. However, the Directive states that for projects over $10 million, the designer should compute project-specific LD's. It also states that the LD's should be adjusted to reflect user costs associated with delays and interruptions to the traveling public.
Delaware	Contract Value	DelDOT has a chart for determining LD's based on the award value of the contract. DelDOT charges road user costs separately for interim milestones on a case by case basis.
Florida	Contract Value	Varies by contract value and table established in the contract.
Georgia	Contract Value	LD varies based on Original Contract Amount for the following ranges: ($0 to $500,000; 500,000 to $1,000,000; 1,000,000 to $2,000,000; 2,000,000 to $5,000,000; 5,000,000 to $10,000,000; 10,000,000 to $20,000,000; 20,000,000 to $40,000,000; greater than 40,000,000)
Hawaii	Other	It is based on the construction management cost to the state.
Idaho	Contract Value	LDs increase as the contract value increases. LD for contracts greater than $10 million is $7700 per working day.
Illinois	Contract Value	Article 108.09 specifies the rate of LD's for a given range of contract value. The assumption is the more expensive a contract is the more administration costs will be incurred.
Indiana	Contract Value	It is based on the original contract amount and whether is it a calendar day fixed date or work day contract.
Iowa	Contract Value	Iowa uses a table based on contract value that increases the standard LD rate.
Kansas	Contract Value	Original Contract Price: Working Day/Cleanup Day $0.00 -$500,000.00 - $900.00/$450.00 $500,000.01-$1,000,000.00 - $1,200.00/ $600.00 $1,000,000.01-$2,500,000.00 - $1,400.00/ $700.00 $2,500,000.01-$5,000,000.00 - $1,600.00/ $800.00 $5,000,000.01-$10,000,000.00 - $2,000.0/ $1,000.00 $10,000,000.01-$25,000,000.00 - $3,000.00/$1,500.00 Over $25,000,000.01 - $3,000.00/ $1,500.00
Kentucky	Contract Value	Original Contract Amount Daily Charge (From) (To and including) $0.00- $100,000.00 $250.00 $100,000.01 - $500,000.00 $750.00 $500,000.01 - $1,000,000.00 $1,650.00 $1,000,000.01 - $5,000,000.00 $2,400.00 $5,000,000.01 - $10,000,000.00 $3,250.00 $10,000,000.01 - $20,000,000.00 $4,000.00 $20,000,000.01 or more $4,750.00
Louisiana	Contract Value	Yes

Massachusetts	Contract Value	See attached LDs spec excerpts from our 1995 Metric Std. Specs. for Highways & Bridges and our 07-15-2015 Supplemental Specs.
Michigan	Contract Value	We recently updated our LD rates per CFR and we followed your report and process outlined in your AASHTO presentation using the same logic and statistical analyses. We manually updated the project value thresholds & ranges rather than doing Kruskal-Wallis tests to better fit our data and needs. A copy of our new LD rates table can be found here: http://mdotcf.state.mi.us/public/dessssp/spss_source/12SP-108D-01.pdf
Minnesota	Contract Value	Contract value as stated in MnDOT Specification Table 1807-1. (See attached document)
Mississippi	Contract Value	0-100K, is $150 100K-500K is $360 500K-1M is $540 1M-5M is $830 5M-10M is $1200 10M-20M is $1800 20M+ is $3500
Missouri	Contract Value	The cost to administer the project is a direct correlation to the project cost. Road User Costs are determined by the length of detours and speed reductions associated with the project. There are not separate tiers for the cost of the project.
Montana	Contract Value	Table is based on ranges of contract award amounts.
Nevada	Other	We base our liquidated damages for exceeding contractual time on the cost of the construction engineering, what it costs the Department to administer the project including any consultant costs as well.
New Hampshire	Contract Value	Strictly done on the original contract amount.
New Jersey	Other	The LDs vary based CE costs and road user costs. CE costs take into account estimated contract cost, project type, lane miles & bridge span length. Road user costs take into account traffic demand, facility capacity and timing, duration and frequency of work zone induced capacity restrictions.LDs for Substantial Completion = CE + RU costs and LDs for Completion =1/2 CE cost. There are also LDs for interim completion dates if specified based on RU cost.
New Mexico	Contract Value	Schedule of Liquidated Damages Total Original Contract Amount ($) Charge ($) per Day $0 to $100,000 $500 $100,000 to $500,000 $1,000 $500,000 to $1,000,000 $1,500 $1,000,000 to $2,000,000 $2,000 $2,000,000 to $4,000,000 $2,500 $4,000,000 to $7,000,000 $3,000 $7,000,000 to $10,000,000 $4,000 $10,000,000+ $5,000

North Carolina	Contract Value	Liquidated damages are typically based on a contract value range 0 -500K; 500K -1M; 1M-2M; 2M-5M; 5M-10M; 10M-30M; 30M-50M; 50M-100M; >100M. In some cases, the LD rate is based on a calculate road user cost.
North Dakota	Contract Value	LD rate is based on original contract amount.
Ohio	Contract Value	We break our LD's table into amounts depending on original contract value.
Oklahoma	Contract Value	Contract Amount, $ Daily Assessment Rate, $ $0 to $100,000 300 $100,000 to $1,000,000 500 $1,000,000 to $3,000,000 750 $3,000,000 to $7,000,000 1,000 $7,000,000+ 2,000
Oregon	Both contract value and project type	Liquidated damages are calculated by the following formula: [(Contractor's Total Bid $) x (%CE)] / (Contract Time) %CE represents our average historical construction contract administration costs and is currently 15.0% for pavement preservation projects and 21.2% for all other projects. Contract Time is the number of calendar days from Bid Opening to Specified Completion.
Pennsylvania	Contract Value	Construction Engineering Liquidated Damages are based on the original contract amount. The Road Users Liquidated damages are calculated using the Department's RULD Calculator. Please see Section 108.07 for the schedule of daily charges for CELDs.
Rhode Island	Contract Value	For most projects RIDOT uses the AASHTO guide specifications to set the LD rates. They are based on a range of contract value. The rate does not vary per project type. The more complex projects have an LD rate based on projected actual DOT costs to maintain resources on a project, plus motorists costs.
South Carolina	Both contract value and project type	SCDOT Standard Specifications apply to every project. Projects with high public impact, significance or cost are assessed for the need for higher LD's. User costs are calculated to determine LD rates for those projects.
South Dakota	Contract Value	SDDOT breaks out projects in ranges up to $10M. All projects exceeding $10M follow same schedule. Small sample size of projects exceeding $10M.
Tennessee	Contract Value	See specs in link above
Texas	Both contract value and project type	both contract value and project type

Utah	Contract Value	0-100k = $560 per day 100k-500k = $930 per day 500k-1m = $1200 per day 1m-5m = $1570 per day 5m-10m = $2130 per day 10m-30m = $2430 per day 30m+ = $4870 per day
Vermont	Contract Value	Yes, Section 108.12 (c) provides the breakdown of contract values and LD rate.
Virginia	Contract Value	Schedule of Liquidated Damages Contract Value — Daily LD Amount $0.00 - $500,000.00 — $350 $500,000.01 - $2,000,000.00 — $600 $2,000,000.01 - $8,000,000.00 — $1,350 $8,000,000.01 - $15,000,000.00 — $2,500 $15,000,000.01 or more — $3,100
Washington	Other	We have had some push back on projects that have a high cost due to a special component like an expensive manufactured item coupled with a low number of working days. The contention is that formula calculates too high of a number for that situation. We are considering making some modifications but haven't as of yet.
West Virginia	Contract Value	ORIGINAL CONTRACT AMOUNT - DAILY CHARGE From More Than To And Including Per Calendar Day $ 0 -$25,000…….$40 $ 25,000 - $100,000…….. $70 $ 100,000 - $500,00…….. $150 $ 500,000 - $1,000,000…… $310 $ 1,000,000 - $2,000,000…….. $570 $ 2,000,000 - $5,000,000…… $910 $ 5,000,000 - $10,000,000…… $1410 $ 10,000,000+ ……$3280
Wisconsin	Contract Value	Section 108.11 of the standard spec book covers the typical project value bracket and the LD associated with that up to the greater than $2M project.

A. CONTRACTUAL PROVISIONS

Question 6: Does your agency have a standard procedure for determining appropriate incentive/disincentive (I/D) provisions for construction projects? If yes, please provide a brief explanation.

Total Responses	Yes	No
43	26	17
100%	60.47%	39.53%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Yes	We follow GFO 4-7 (attached).
Alaska	No	None
Arkansas	Yes	The AHTD has utilized methods from the Alabama DOT and the Michigan DOT in the development of their upcoming, updated LD schedule.
California	Yes	We have a policy document that explains we use I/Ds to meet internal milestones when needed. I/Ds consist of liquidated damages and road user costs, etc. Use of the provision and the amounts must be approved by region/district director (7 regions/districts in State). May use only incentive or only disincentive and they do not have to be equal in absolute value.
Colorado	No	None
Connecticut	No	None
Delaware	No	None
Florida	Yes	http://www.fdot.gov/construction/manuals/cpam/New%20Clean%20Chapters/Chapter1s2.pdf
Georgia	No	None
Hawaii	No	None
Idaho	No	None
Illinois	Yes	Procedures are written in Chapter 66 of the Design and Environment Manual.
Iowa	Yes	We calculate the I/D rate based on user costs such as out of distance travel, delay, or other costs to the traveling public.
Kansas	Yes	User Costs
Kentucky	Yes	User costs.
Louisiana	No	None

Massachusetts	Yes	We use a two-part feasibility checklist, the first one at 25% Design and the second one at 75% Design, to select viable projects as candidates for the inclusion of an I/D provision and then select the appropriate provision, i.e. a standard I/D clause or a No Excuse I/D Clause, for that project.
Michigan	Yes	I am not fully familiar with that process as it takes place in design & development, but I know they factor in the generated user-delay cost when they make that determination.
Minnesota	Yes	Time incentives/disincentives are typically used on projects with a high road-user cost or business impacts. Typical projects include urban reconstruction, interstate and high traffic impacts, A + B, lengthy detours, and bridge replacement or rehabilitation. Material incentives/disincentives are determined by material specifications.
Mississippi	No	None
Missouri	No	None
Montana	Yes	Incentive/disincentive for time may be used on large projects with significant impacts to traffic or critical time elements. These are project specific and identified by the design team. The road user costs are calculated and then used in the contract time special provision.
Nevada	Yes	NDOT calculates the user costs to determine I/D.
New Hampshire	No	None
New Jersey	No	None
New Mexico	No	None
North Carolina	Yes	Yes, the procedures factor in projects with Road user costs greater than $2000 per day, off-site detours, Urban widening with multiple business impacts, and projects that complete a gap in the highway system or open a new facility.
North Dakota	Yes	We review Construction Engineering costs for projects of different contract values.
Ohio	No	None
Oklahoma	Yes	Based on the daily value of labor during construction.
Oregon	Yes	I/D provisions are based on road user costs.
Pennsylvania	Yes	We utilize the Departments RULD Calculator to determine approprite values for the I/D provisions. I/D provisions have been used sparingly by the Department. We are currently utilizing A+Bx.
Rhode Island	No	None
South Carolina	No	None
South Dakota	Yes	Currently in draft form and not available at this time.
Tennessee	Yes	We are going to make A+B bidding more common practice. To do that, user cost delay has to be calculated for each project. We are working on improving this process, but attached is our current practice.
Texas	No	None
Utah	Yes	Generally it is 10% of user cost but this is the starting point and the team has the option to change.

Vermont	Yes	Yes, but it is not well documented.
Virginia	Yes	Generally the Road User costs determine the I/D values. But this is not a mandate either.
Washington	Yes	Our main incentive/disincentive use is in some bid items such as hot mix asphalt. We have I/D for compaction and for job mix compliance. The attached specification explains our method for statistical evaluation.
West Virginia	Yes	When there are special timely needs and/or date requirements for the project/site.
Wisconsin	Yes	Once again we base off of the impact to the road user. Presently we are using the New Jersey Road User Cost workbook though may be moving to another process for calculating the RUC.

A. CONTRACTUAL PROVISIONS

Question 7: Does your agency have a standard method for calculating road user costs (RUCs)? If yes, please provide a brief explanation.

Total Responses	Yes	No
43	33	10
100%	76.74%	23.26%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Yes	We consider our I/D calculation to be essentially the same as RUC, so the procedure is the same.
Alaska	Yes	I don't remember how we calculate it, but there is a lane adjustment LD in specification Table 643-3. We have not recalculated the rates in awhile, and some people complain they are too low.
Arkansas	Yes	RUCs are calculated in accordance with the Highway Safety Manual and a spreadsheet provided by the FHWA.
California	Yes	Traffic section in each district or region calculates RUC. It is used in Cost plus Time Bidding and in I/D provisions. Spreadsheet of the RUC calculation is attached below.
Colorado	Yes	The project team works with the Traffic and Safety Unit to determine this value. More info contact San Lee at san.lee@state.co.us for the specific information.
Connecticut	Yes	The Department's Traffic Division determines road user costs utilizing the QUEWZ program developed by the Texas Transportation Institute.
Delaware	Yes	Based on traffic counts and then adjusted downward to make the actual road user costs charge be less than the calculated value in order for them to be considered "reasonable".
Florida	Yes	FDOT has a program developed for Florida roadways by one of our State Universities that is used for the RUC calculations.
Georgia	No	None
Hawaii	Yes	It is based on traffic volumes.
Idaho	No	None
Illinois	Yes	Procedures are written in Chapter 66 of the Design and Environment Manual.
Iowa	Yes	Users costs are calculated based on out of distance travel, delay or other factors.
Kansas	Yes	Based on Formula
Kentucky	Yes	I believe these are provided by our Division of Planning.
Louisiana	No	None
Massachusetts	Yes	We use a four-part formula consisting of the dollar value of the drivers' time, traffic counts, delay time and the duration of the delay to calculate RUCs.
Michigan	Yes	The attached document should help with how these are determined.
Minnesota	Yes	Road-user costs are determined by MnDOT's Office of Investment Management.

Mississippi	No	None
Missouri	Yes	Road user costs have standard rates for speed reductions and detour lengths that affect traffic.
Montana	Yes	Time delays are based on ADT, speeds and distances.
Nevada	Yes	We calculate the number and type of vehicle, miles travelled within the work zone and the associated delay due to construction activities.
New Hampshire	No	None
New Jersey	Yes	Road User Costs are directly related to the traffic demand, facility capacity, and the timing, duration and frequency of work zone induced capacity restrictions. The reliability of Road User Cost calculations is greatly dependent on good 24-hour traffic counts for weekday and weekend traffic and the percent of passenger cars and trucks in the traffic stream.
New Mexico	No	None
North Carolina	Yes	It looks at traffic volumes on the route and time impacts due to the project, including any detours.
North Dakota	No	None
Ohio	No	None
Oklahoma	Yes	We call this Lane Rental. It is based on information provided by our Traffic Engineering Division.
Oregon	No	None
Pennsylvania	Yes	The Department utilizes a RULD spreadsheet to determine its' LDs. Based upon the output, engineering judgement is utilized to keep or lessen the calculated value based on the contract.
Rhode Island	Yes	NCHRP report for establishing road user costs for Federal Aid projects. I do not recall the document number at this time.
South Carolina	Yes	SCDOT utilizes traffic data to determine user costs as a starting pint for LD determination.
South Dakota	Yes	Conducted research to develop a RUC tool (program). Tool is updated annually.
Tennessee	Yes	See attached file.
Texas	Yes	Based on traffic volumes
Utah	Yes	I know we do but to be honest I do not know what it is and I cannot save this survey and return to it. Please email me and I will find out.
Vermont	Yes	Yes but it is not well documented.
Virginia	Yes	We have various methods none of which are mandated statewide. We have a program created called HUBCAP that is used in the majority of the state.
Washington	Yes	These are calculated in-house by our travel data group. The following is a link to their web page: http://wwwi.wsdot.wa.gov/planning/data/travel/default.htm
West Virginia	No	None
Wisconsin	Yes	As above New Jersey RUC workbook.

A. CONTRACTUAL PROVISIONS

Question 8: What project-specific factors are considered when deciding to include I/D and RUC provisions in the contract? (check all that apply)

Total Responses	Traffic Volumes	Potential For Congestion	Detour Considerations	Urban vs. Rural Project	Follow-On Projects	Other
43	40	33	30	27	12	11
	93%	77%	70%	63%	28%	26%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Traffic volumes, Potential for congestion	None
Alaska	Traffic volumes	None
Arkansas	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations	None
California	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects	None
Colorado	Urban versus rural project, Traffic volumes, Other	Please check with contact from question above
Connecticut	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects, Other	Major milestones (Stage completions) within a longer duration project, major local events, utility relocations, winter, environmental restrictions,
Delaware	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations	None
Florida	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Other	Look to see if there are specific commitments or community needs that would lead to use of an I/D clause.
Georgia	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations	None

Hawaii	Traffic volumes, Potential for congestion	None
Idaho	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations	None
Illinois	Traffic volumes, Detour considerations, Other	Travel delay through project limits.
Iowa	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects	None
Kansas	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects	None
Kentucky	Traffic volumes, Potential for congestion	None
Louisiana	Traffic volumes	None
Massachusetts	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects	None
Michigan	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects	None
Minnesota	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects	None
Mississippi	Urban versus rural project, Traffic volumes	None
Missouri	Traffic volumes, Potential for congestion, Detour considerations	None
Montana	Urban versus rural project, Traffic volumes, Detour considerations	None
Nevada	Traffic volumes, Potential for congestion, Detour considerations, Other	Environmental or stakeholder impacts and the need to complete the work as fast as possible
New Hampshire	Potential for congestion	None

New Jersey	Other	RUC are applied to all contracts unles traffic is not affected. CE costs are applied to all contracts and we almost never apply I/D.
New Mexico	Urban versus rural project, Traffic volumes, Potential for congestion	None
North Carolina	Urban versus rural project, Traffic volumes, Detour considerations, Other	RUC greater than $2000 per day
North Dakota	Traffic volumes, Potential for congestion, Detour considerations	None
Ohio	Urban versus rural project, Traffic volumes, Detour considerations	None
Oklahoma	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects	None
Oregon	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects	None
Pennsylvania	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations	None
Rhode Island	Traffic volumes, Potential for congestion, Detour considerations	None
South Carolina	Traffic volumes, Potential for congestion, Detour considerations	None
South Dakota	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects	None
Tennessee	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations	None
Texas	Urban versus rural project, Traffic volumes, Potential for congestion	None

Utah	Other	Please contact in follow up as I do not know.
Vermont	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations	None
Virginia	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations	None
Washington	Traffic volumes, Potential for congestion, Other	Contact TD office for more info.
West Virginia	Urban versus rural project, Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects, Other	school schedule, emergency response, community event
Wisconsin	Traffic volumes, Potential for congestion, Detour considerations, Follow-on projects, Other	municiple functions/festivals, possible impacts to business

A. CONTRACTUAL PROVISIONS

Question 9: Does your agency assess LDs, I/Ds, or RUCs simultaneously on construction contracts?

Total Responses	Yes	No
43	33	10
100%	76.74%	23.26%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Yes	None
Alaska	Yes	None
Arkansas	Yes	None
California	Yes	None
Colorado	No	None
Connecticut	Yes	None
Delaware	No	None
Florida	Yes	None
Georgia	Yes	None
Hawaii	Yes	None
Idaho	Yes	None
Illinois	Yes	None
Iowa	No	None
Kansas	Yes	None
Kentucky	Yes	None
Louisiana	Yes	None
Massachusetts	Yes	None
Michigan	Yes	None
Minnesota	Yes	None
Mississippi	No	None
Missouri	Yes	None
Montana	Yes	None
Nevada	Yes	None
New Hampshire	No	None
New Jersey	Yes	None
New Mexico	Yes	None
North Carolina	Yes	None
North Dakota	No	None
Ohio	No	None
Oklahoma	Yes	None
Oregon	Yes	None
Pennsylvania	Yes	None

Responding State	Response	Comments
Rhode Island	Yes	None
South Carolina	No	None
South Dakota	Yes	None
Tennessee	No	None
Texas	Yes	None
Utah	No	None
Vermont	Yes	None
Virginia	Yes	None
Washington	Yes	None
West Virginia	Yes	None
Wisconsin	Yes	None

A. CONTRACTUAL PROVISIONS

Question 10: Identify how your agency assesses LDs, I/Ds, or RUCs simultaneously on construction contracts? (check all that apply)

Total Responses	Single	Separate	Other
33	2	31	2
	6.06%	93.94%	6.06%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	separate stipulations	LDs are assessed to reimburse the Department for additional admin, management, and E&I costs due to the Contractor's failure to complete the project within the allowable contract time. I/D (RUCs) are assessed to offset the cost to the public due to the Contractor exceeding the allowable time frame for completion of a particular phase of the project or for failure to complete the entire project within the allowable contract time.
Alaska	separate stipulations	They are differentiated by whatever triggers them and the appropriate contract language.
Arkansas	separate stipulations	SiteManager handles the liquidated damage costs automatically within the system, and are assessed at the end of each two week estimate period. RUCs are handled by the Resident Engineer via change order at the end of each two week estimate period.
California	separate stipulations	LDs pertain to entire contract time, I/Ds pertain to internal milestones, and RUC pertains to whether lanes are opened when time expires.
Connecticut	other	separate and combined; The separate assessments are defined by the Special Provisions: "Contract Time and Liquidated Damages" defines the Contract completion LD daily rate and separately within it, the hourly lane use (user cost) LD rate, and if applicable, the special provision "Milestone Incentives and Milestone Liquidated Damages" would define incentives and/or LD's for milestones.
Florida	separate stipulations	LD rates are established in the standard specification language as provided earlier. I/D rates are provided in Special Provisions and the disincentives are tied to end of allowable contract time whereas the incentive is tied to completing prior to original contract time. RUC costs are used when we include a Lane Rental or Damage Recovery specification. RUC also used in determination of I/D values.

Georgia	separate stipulations	They are cumulative.
Hawaii	separate stipulations	RUCs are assessed for failure to open lanes on a timely (daily) basis. LDs are for overall project delays.
Idaho	separate stipulations	RUCs assessed during the contract time. LDs assessed after the contract time.
Illinois	single stipulation	The RUC is combined with the correlating LD value and is written into the contract via a special provision.
Kansas	separate stipulations	In our Work Schedule Special Provisions, they are given separate sections that explain how they are charged.
Kentucky	as single and separate	The LD's are per the specifications and the I/D's are stipulated in the contract. There is a note that says both will apply.; There are additional RUC's above the standard LD rate in the specifications.
Louisiana	separate stipulations	None
Massachusetts	separate stipulations	RUCs are included in our I/Ds amounts. Incentives are paid for on-time attainment of the designated milestone(s), disincentives are assessed for failing to attain the designated milestone(s) and LDs are assessed for failure to attain the completion milestone on time.
Michigan	separate stipulations	Different pay items are set up for each stipulation. For example: Liquidated Damages, Oversight; Liquidated Damages, Other; Incentive, Approved for Traffic; Incentive, Completion of Work; Lane Rental Incentive; User Delay Cost Penalty
Minnesota	separate stipulations	LDs are assessed based on MnDOT's average daily construction engineering, inspection and testing costs. An evaluation is done on these values every few years to make sure the costs stay current. This is totally separate from other incentive/disincentive costs or road user costs.
Missouri	separate stipulations	We have two LD's: Administration Cost and Road User Cost.
Montana	separate stipulations	This is not common. I/Ds are typically applied to a contract milestone, defined in a special provision. It indicates that an incentive/disincentive will be applied to the time specified for the milestone and that liquidated damages will be assessed for exceeding the contract time. There have been a couple of projects where the incentive/disincentive applied to the overall contract time. In that case, the two would be applied at the same time, but are still distinct.

Nevada	separate stipulations	The LD's are assessed if the contractor does not complete the work on time, exceeds working hours and/or I/D for not meeting interim milestones as defined in the contract
New Jersey	other	LDs include RUC and CE const combined for substantial completion and only 1/2 CE for completion.; As previously stated, LDs= CE + RU for substantial completion and LDs= 1/2 CE for completion
New Mexico	separate stipulations	The LDs are associated with the extra costs for administration of the contract and inconvenience to the public. The RUC are viewed more as a disincentive.
North Carolina	separate and other	All contracts have LDs. When incentives are applied, the LD rate is the disincentive.; Typically the incentive rate and the liquidated damage (disincentive) rate are the same amount (rate)
Oklahoma	separate stipulations	The daily LD rate is defined in the specifications. The I/D and RUC rates are defined in project specific special provisions.
Oregon	separate stipulations	LDs are assessed to account for increased costs to the Agency. I/Ds are specific to road user costs.
Pennsylvania	separate stipulations	The CELDs are based on completion dates. They are a set amount based on the original contract cost. The RULDs could be assessed if linked to a completion date.
Rhode Island	separate stipulations	LDs were considered for when the project failed to meet a milestone or project substantially completed date. I/Ds were used to incentivize a contractor to meet or accelerate a milestone date within a project.
South Dakota	separate stipulations	LD's are used for added cost of contract administration. The term "Liquidated Damages" is used for this case. I/D or straight disincentive are used for RUC considerations. The terms "Incentive" and "Disincentive" are used for these cases. This has helped some confusion surrounding what each value represents. Mostly internal confusion.
Texas	separate stipulations	LD is administrative, I/D is determined during project development as is RUC.
Vermont	separate stipulations	LD's are associated with overall contract completion dates. RUC are associated with I/D periods. The function and values are kept independent.

Virginia	separate stipulations	LD's are considered unrelated to the others. VDOT has no mandatory procedure for ID's and RUC's but generally these two are combined or considered the same. The difference is identified as LD's are direct costs to the Department and the IDs and RUC's are assessed as costs to the public for economy and inconvenience.
Washington	separate stipulations	They are all separate issues. I/Ds are for quality of work and L/Ds are for contract time. We use RUCs mainly for individual items of work. We may allow a freeway ramp to be closed from 8 pm to 5 am with a penalty of X dollars for every 10 minutes you are late in opening the ramp to traffic. So you could get a penalty for that without affecting your working days and L/Ds. On top of this, you could have produced excellent materials and gained an incentive for the quality of your work.
West Virginia	separate stipulations	Both LD & I/D may apply on project. LDs would apply per specification. I/Ds would apply per project specific special provision within proposal.
Wisconsin	separate stipulations	Road user costs are assessed under Lane Rental (LR), and used for developing the $amount of an I/D or LD. We state that if a contractor is being assessed LR and they do not meet the final completion the LD's would be assessed as well as the LR. LR would be assessed whether they are in the Incentive portion or Disincentive portion. If the I/D is for project completion we can assess the 108.11 LD amounts with the D portion.

A. CONTRACTUAL PROVISIONS

Question 11: Prior to letting the contract, do project related circumstances arise that would allow your agency to discount or not include or require a separate LD provision in a contract due to I/Ds or RUCs being drastically higher? (provide a brief explanation of your response)

Total Responses	Yes	No
43	9	34
100%	20.93%	79.07%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	No	We would rarely NOT include an LD provision.
Alaska	No	We generally use LDs in the standard specifications. If the regions want to use a different rate or not use the LDs they would have to say that in regional special provisions.
Arkansas	No	This has not been considered.
California	No	LDs are set relative to bid amount and are set regardless of project related circumstances.
Colorado	Yes	RUC and I/D are typically tied to milestones within the project. LD's can only be accessed at the end of the project. i.e. getting lanes open, water ways cleared, but additional construction still needs to be finished.
Connecticut	No	Each are calculated separately and their purposes are for different reasons. Therefore, they do not conflict with each other or "double assess" the same things. Contract completion date LD's are for the end of the project. Incentive/LD provisions are during the project at major milestones, and hourly lane use (RUC) LD's are for when the contractor does not reopen a lane(s) by rush hour typically.
Delaware	No	DelDOT does not.
Florida	No	If a circumstance arose like described, FDOT would likely remove the I/D or RUC part of the contract specs.
Georgia	No	LD and I/Ds are cumulative.
Hawaii	No	RUCs are assessed for daily delays. LDs are assessed for overall project delays.
Idaho	No	LDs and RUCs are separate provisions.
Illinois	No	I'm not sure what this question is asking. The decision to include an I/D clause based on RUC is a project by project decision.
Iowa	No	Always have LD provisions.
Kansas	Yes	Some time a community need would drive this. Impact to traffic is the biggest reason that drives costs up especially in our metropolitan areas where traffic impact on workday going to work and leaving work has a significant impact.
Kentucky	No	The reasons for liquidated damages, as described in the specifications, would always apply if the contract time is exceeded.
Louisiana	No	No

Massachusetts	No	RUCs are contained within our I/Ds. I/Ds and LDs are always handled separately.
Michigan	Yes	Our LD rates table is strictly for Department Oversight costs and is applicable to all projects. Usually certain high impact projects will carry their own special provisions that will stipulate the incentive amounts and/or user delay costs are on an individual basis.
Minnesota	No	Liquidated damages are included in all MnDOT contracts.
Mississippi	Yes	On some projects that are in high traffic volume areas and are high profile, we may revise our LD provision and to account for increased RUC.
Missouri	No	Administration Costs and Road User Costs are not adjusted due to high I/D; they are independent.
Montana	No	Liquidated damages are to recoup agency construction engineering costs. This applies to every contract. I/Ds are for road user costs.
Nevada	Yes	RUC calculations can be so high they are not reasonable to assess and therefore the Department will reduce the LD and/or I/D.
New Hampshire	No	We typically only specify LD's. We use I/Ds rarely and are careful to not double charge a contractor for delays.
New Jersey	Yes	In some instances, if we feel there is an unusually higher risk we will increase the RU for interim dates and substantial completion dates
New Mexico	No	LDs are part of the Division 100s that go through rulemaking and they cannot be changed for a specific contract. RUC are usually included through a Notice to Contractors.
North Carolina	No	Liquidated damages are included in every contract regardless of I/D.
North Dakota	No	Do not understand question.
Ohio	No	LD provisions are separate from I/D or RUC. If I/D or RUC are much higher than the LD, then we would likely asses the higher amount, but not a combination of the two (or three).
Oklahoma	No	I am not aware of this ever occurring.
Oregon	No	LDs and I/Ds represent different costs. LDs are Agency only, I/Ds do not include Agency costs.
Pennsylvania	No	CELDs are applicable to all contracts.
Rhode Island	No	Not sure I understand the question, but not aware of any projects where L/Ds were not included in contract.
South Carolina	No	Only LD's are charged on projects
South Dakota	No	I know of no cases where we have not also wanted to recover the added cost of contract administration.
Tennessee	Yes	Still new for us....I think that we would pick the LD rate or the user cost rate. Not both.
Texas	No	No
Utah	Yes	We can replace the LD table in the stnadard provisions with a special provision.
Vermont	No	Our traffic volumes are so low that the RUCs don't dwarf the LD costs for larger contracts.
Virginia	No	As explained previously VDOT looks at LD's and ID/RUC's as unrelated to one another so I our thinking one should not affect the other.

Washington	No	We have LDs in every project. We do not use RUCs very often in projects. The I/Ds are a standard calculation based on the specification I attached earlier. We may write a special provision for other I/D for special cases or for early completion if there is a benefit to the public to do so.
West Virginia	Yes	This could be done if circumstances required it. The I/Ds provision could be edit/updated to remove the LD requirements.
Wisconsin	No	To date we have not had an instance that I know of. Typically, the assessments have been well vetted and we try to be sensitive to the delivery cost, and possible contractor profit in order to have the assessment robust enough to cause contractor not to want to be there, though not so robust as to blow the unit prices out the roof. we try to balance the risks for contractor and owner.

A. CONTRACTUAL PROVISIONS

Question 12: Within performance bond contracts, does your agency require provisions to ensure the coverage of liquidated damages, disincentives or road user costs in the event of contractor default?

Total Responses	Yes	No
43	20	23
100%	46.51%	53.49%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	No	None
Alaska	No	None
Arkansas	Yes	None
California	Yes	None
Colorado	Yes	None
Connecticut	No	None
Delaware	Yes	None
Florida	Yes	None
Georgia	Yes	None
Hawaii	No	None
Idaho	Yes	None
Illinois	Yes	None
Iowa	No	None
Kansas	Yes	None
Kentucky	Yes	None
Louisiana	No	None
Massachusetts	No	None
Michigan	Yes	None
Minnesota	No	None
Mississippi	No	None
Missouri	No	None
Montana	No	None
Nevada	Yes	None
New Hampshire	No	None
New Jersey	Yes	None
New Mexico	Yes	None
North Carolina	Yes	None
North Dakota	Yes	None
Ohio	No	None
Oklahoma	No	None
Oregon	Yes	None
Pennsylvania	No	None
Rhode Island	No	None
South Carolina	No	None
South Dakota	No	None
Tennessee	Yes	None
Texas	No	None
Utah	No	None
Vermont	No	None
Virginia	No	None
Washington	Yes	None
West Virginia	No	None
Wisconsin	Yes	None

A. CONTRACTUAL PROVISIONS

Question 12A: If your agency requires provisions to cover LDs, disincentives, or RUCs in the event of a contractor default within the performance bond, please specify which of the following damages are included. (check all that apply)

Total Responses	LDs	Disincentives	RUCs	Other
20	19	13	10	3
	95.00%	65.00%	50.00%	15.00%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Arkansas	LDs, Disincentives, RUCs	None
California	LDs, Disincentives, RUCs	None
Colorado	LDs, Disincentives, RUCs	None
Delaware	LDs	None
Florida	LDs, Disincentives, RUCs	None
Georgia	LDs	None
Idaho	LDs	None
Illinois	LDs & Disincentives	None
Kansas	LDs & Disincentives	None
Kentucky	LDs, Disincentives, RUCs	None
Michigan	Other	I don't know for sure. I think LDs would be covered, but I'm not sure on the other two.
Nevada	LDs, Disincentives	None
New Jersey	LDs, RUCs	None
New Mexico	LDs, Disincentives	None
North Carolina	LDs, Disincentives	None
North Dakota	LDs, Disincentives, RUCs	None
Oregon	LDs	None
Tennessee	LDs, RUCs	None
Washington	LDs, Disincentives, RUCs, Other	Any direct or indirect loss
Wisconsin	LDs, Disincentives, RUCs, Other	For a $1M project bond covers $1M in value of contract and $1M for performance

B. LD, I/D, AND RUC ESTIMATING METHODOLOGIES

Question 13: Which department within your agency develops the LD rates that are included in construction contracts? (check all that apply)

Dept.	LDs	I/Ds	RUCs
Traffic	0	3	7
Engineering Design	7	16	17
Construction	33	16	10
Administrative Staff	2	1	0
Other	7	9	7

% of 43 Responses	LDs	I/Ds	RUCs
Traffic	0%	7%	16%
Engineering Design	16%	37%	40%
Construction	77%	37%	23%
Administrative Staff	5%	2%	0%
Other	16%	21%	16%

Responding State	LDs	I/Ds	RUCs
Alabama	Construction	Engineering Design	Engineering Design
Alaska	HQ, Design and Construction Standards		HQ, Design and Construction Standards
Arkansas	Construction	Traffic	Traffic
California	Construction	Traffic	Traffic
Colorado	Project Support	Engineering Design	Engineering Design
Connecticut	Construction & Engineering Design	Construction & Engineering Design	Engineering Design
Delaware	Performance Management	Performance Management	Traffic
Florida	Construction	Construction	Construction

Other
Accounting
Alternative Contracting Engineer
Capital Program Support
Contract Office
Design Bureau
Division of Planning
Highway Division, Contracts
HQ, Design and Construction Standards
Innovative Delivery (DB-P3)
Office Engineer
Office of Investment Management
Performance Management
Program Delivery (PM)
Project Support
Technical Services/Office of Project Letting

Georgia	Construction & Engineering Design	Construction, Program Delivery (PM), Innovative Delivery (DB-P3)	
Hawaii	Construction & Engineering Design		Engineering Design
Idaho	Engineering Design		
Illinois	Construction	Engineering Design	Engineering Design
Iowa	Highway Division, Contracts	Highway Division, Contracts	Highway Division, Contracts
Kansas	Construction	Construction	Construction
Kentucky	Construction	Construction	Division of Planning
Louisiana	Construction & Administrative Staff		
Massachusetts	Construction	Construction & Engineering Design	Construction & Engineering Design
Michigan	Administrative Staff	Engineering Design	Engineering Design
Minnesota	Construction	Construction, Engineering Design & Office of Investment Management	Construction, Engineering Design & Office of Investment Management
Mississippi	Construction	Construction	Construction
Missouri	Engineering Design		Engineering Design
Montana	Construction	Construction	Construction
Nevada	Construction	Construction	Construction
New Hampshire	Construction		
New Jersey	Construction		Capital Program Support
New Mexico	Construction	Engineering Design	Engineering Design
North Carolina	Construction & Contract Office	Construction & Contract Office	Traffic

North Dakota	Construction	Construction	Engineering Design
Ohio	Accounting	Engineering Design	Engineering Design
Oklahoma	Construction	Office Engineer	Traffic
Oregon	Construction	Technical Services/Office of Project Letting	Technical Services/Office of Project Letting
Pennsylvania	Construction	Engineering Design	Engineering Design
Rhode Island	Engineering Design	Engineering Design	Engineering Design
South Carolina	Construction		
South Dakota	Construction	Construction	Construction
Tennessee	Construction		Construction
Texas	Construction	Engineering Design	Engineering Design
Utah	Construction	Construction, Engineering Design & Traffic	Construction & Traffic
Vermont	Construction	Engineering Design	Engineering Design
Virginia	Construction	Engineering Design	Engineering Design
Washington	Construction	Construction	Traffic
West Virginia	Construction & Engineering Design	Construction & Engineering Design	
Wisconsin	Alternative Contracting Engineer	Alternative Contracting Engineer	Alternative Contracting Engineer

B. LD, I/D, AND RUC ESTIMATING METHODOLOGIES

Question 14: Does your agency develop project-specific LD rates for projects with contract values exceeding $20 million?

Total Responses	Yes	No
43	14	29
100%	32.56%	67.44%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	No	None
Alaska	No	None
Arkansas	No	None
California	Yes	None
Colorado	No	None
Connecticut	Yes	None
Delaware	No	None
Florida	Yes	None
Georgia	No	None
Hawaii	Yes	None
Idaho	No	None
Illinois	No	None
Iowa	Yes	None
Kansas	No	None
Kentucky	No	None
Louisiana	No	None
Massachusetts	No	None
Michigan	Yes	None
Minnesota	No	None
Mississippi	No	None
Missouri	No	None
Montana	No	None
Nevada	No	None
New Hampshire	Yes	None
New Jersey	Yes	None
New Mexico	No	None
North Carolina	Yes	None
North Dakota	Yes	None
Ohio	No	None
Oklahoma	No	None

Responding State	Response	Comments
Oregon	No	None
Pennsylvania	No	None
Rhode Island	Yes	None
South Carolina	No	None
South Dakota	No	None
Tennessee	No	None
Texas	Yes	None
Utah	No	None
Vermont	No	None
Virginia	Yes	None
Washington	No	None
West Virginia	No	None
Wisconsin	Yes	None

B. LD, I/D, AND RUC ESTIMATING METHODOLOGIES

Question 15: Does your agency follow an established cost estimating technique/methodology/worksheet in preparing project-specific LD rates?

Total Responses	Yes	No
14	12	2
100%	85.71%	14.29%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
California	Yes	None
Connecticut	Yes	None
Florida	Yes	None
Hawaii	Yes	None
Iowa	Yes	None
Michigan	Yes	None
New Hampshire	Yes	None
New Jersey	Yes	None
North Carolina	Yes	None
North Dakota	Yes	None
Rhode Island	No	None
Virginia	Yes	None
Texas	No	None
Wisconsin	Yes	None

B. LD, I/D, AND RUC ESTIMATING METHODOLOGIES

Question 16: What factors are used to estimate or determine LD rates for contracts exceeding $20 million? (check all that apply)

Factors	Total Responses	14
Agency Const. Engr. Effort	13	93%
Consultant Const. Engr. Effort	12	86%
Agency Oversight Of Consultant Contract, If Used	9	64%
Road User Costs (RUCs)	8	57%
Veh. Usage Costs	8	57%
Materials Testing Effort	6	43%
Office Space/ Project Trailer/Etc. Costs	6	43%
Add. Costs To Ensure Public Safety	3	21%
Other	2	14%
Add. Public Affairs Notification/Information Costs	1	7%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
California	Agency construction engineering effort, Office space/project trailer/etc. costs	None
Connecticut	Agency construction engineering effort, Agency oversight of consultant contract, if consultant contract is used, Consultant construction engineering effort, Materials testing effort, Vehicle usage costs, Road User Costs (RUCs)	None
Florida	Agency construction engineering effort, Agency oversight of consultant contract, if consultant contract is used, Consultant construction engineering effort, vehicle usage costs, office space/project trailer/etc. costs, Materials testing effort, Road User Costs (RUCs)	NOTE: the vehicle and office space charges would be included in the consultant CEI effort for FDOT contracts.

Hawaii	Agency construction engineering effort, Agency oversight of consultant contract, if consultant contract is used, Consultant construction engineering effort, Vehicle usage costs, Office space/project trailer/etc. costs	None
Iowa	Vehicle usage costs,Additional costs to ensure public safety (i.e. state trooper) presence,Road User Costs (RUCs)	None
Michigan	Agency construction engineering effort,Agency oversight of consultant contract, if consultant contract is used,Consultant construction engineering effort,Materials testing effort,Vehicle usage costs,Office space/project trailer/etc. costs,Road User Costs (RUCs),Other	Any CE cost is factored into the statistical model which determines the LD rates table for Department Oversight. RUC are used to calculate other LDs. Refer back to 108.10.C in Spec Book
New Hampshire	Agency construction engineering effort,Agency oversight of consultant contract, if consultant contract is used,Consultant construction engineering effort,Vehicle usage costs,Office space/project trailer/etc. costs,Other	Administration Overhead and Debt Service
New Jersey	Agency construction engineering effort,Agency oversight of consultant contract, if consultant contract is used,Consultant construction engineering effort,Materials testing effort,Road User Costs (RUCs)	None
North Carolina	Agency construction engineering effort,Agency oversight of consultant contract, if consultant contract is used,Consultant construction engineering effort,Materials testing effort,Vehicle usage costs, Road User Costs (RUCs)	None

North Dakota	Agency construction engineering effort, Agency oversight of consultant contract, if consultant contract is used, Consultant construction engineering effort	None
Rhode Island	Agency construction engineering effort, Consultant construction engineering effort, Office space/project trailer/etc. costs, Additional costs to ensure public safety (i.e. state trooper) presence, Road User Costs (RUCs)	None
Texas	Agency construction engineering effort, Consultant construction engineering effort	None
Virginia	Agency construction engineering effort, Agency oversight of consultant contract, if consultant contract is used, Consultant construction engineering effort, Materials testing effort, Vehicle usage costs, Additional costs to ensure public safety (i.e. state trooper) presence, Additional public affairs notification/information costs	None
Wisconsin	Agency construction engineering effort, Consultant construction engineering effort, Road User Costs (RUCs)	None

B. LD, I/D, AND RUC ESTIMATING METHODOLOGIES

Question 17: For contracts with values exceeding $20 million, is construction oversight (i.e., construction administration, engineering and inspection services) performed by agency personnel or via a consultant contract?

Total Responses	Agency Personnel	Consultant Contract	Mixture of Both	Sometimes a mixture and sometimes one
14	1	0	5	8
100%	7.14%	0.00%	35.71%	57.14%

Please use comment box to provide clarifying remarks.

Responding State	**Response**	**Comments**
California	Sometimes a mixture and sometimes just one	None
Connecticut	Mixture of both	None
Florida	Mixture of both	None
Hawaii	Sometimes a mixture and sometimes just one	None
Iowa	Sometimes a mixture and sometimes just one	None
Michigan	Sometimes a mixture and sometimes just one	None
New Hampshire	Mixture of both	None
New Jersey	Sometimes a mixture and sometimes just one	None
North Carolina	Sometimes a mixture and sometimes just one	None
North Dakota	Mixture of both	None
Rhode Island	Agency Personnel	None
Texas	Sometimes a mixture and sometimes just one	None
Virginia	Sometimes a mixture and sometimes just one	None
Wisconsin	Mixture of both	None

C. PROJECT STAFFING REQUIREMENTS

Question 18: Does your agency have a standard project staffing plan or a methodology for estimating staff requirements used for calculating LD rates based on project type (e.g., bridge, highway paving, resurfacing, widening, maintenance, etc.)? A project staffing plan sets forth the required number of personnel (i.e., engineers, inspectors, managers, etc.) and the total man hours for a specific project.

Total Responses	Yes	No
40	4	36
100%	10.00%	90.00%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	No	None
Alaska	No	None
Arkansas	No	None
California	No	None
Colorado	No	None
Connecticut	No	None
Delaware	No	None
Florida	No	None
Georgia	No	None
Hawaii	No	None
Iowa	No	None
Kansas	No	None
Kentucky	No	None
Louisiana	No	None
Massachusetts	No	None
Michigan	No	None
Minnesota	No	None
Mississippi	No	None
Missouri	No	None
Montana	No	None
Nevada	Yes	NDOT utilizes the construction crew project staffing to calculate LD's.
New Hampshire	No	None
New Jersey	Yes	The file uploaded in previous question for calculation of CE costs also provides staffing requirements/ needs.
North Carolina	No	None

North Dakota	No	None
Ohio	No	None
Oklahoma	No	None
Oregon	No	None
Pennsylvania	Yes	Develop cost of hourly rates based on projected staffing needs.
Rhode Island	No	None
South Carolina	No	None
South Dakota	No	None
Tennessee	No	None
Texas	No	None
Utah	No	None
Vermont	No	None
Virginia	Yes	None
Washington	No	None
West Virginia	No	None
Wisconsin	No	None

C. PROJECT STAFFING REQUIREMENTS

Question 19: Are construction oversight employees in your agency represented by a union?

Total Responses	Yes	No
40	17	23
100%	42.50%	57.50%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	No	None
Alaska	Yes	None
Arkansas	No	None
California	Yes	None
Colorado	No	None
Connecticut	Yes	None
Delaware	Yes	None
Florida	No	None
Georgia	No	None
Hawaii	Yes	None
Iowa	Yes	None
Kansas	Yes	None
Kentucky	No	None
Louisiana	No	None
Massachusetts	Yes	None
Michigan	Yes	None
Minnesota	Yes	None
Mississippi	No	None
Missouri	No	None
Montana	Yes	None
Nevada	No	None
New Hampshire	Yes	None
New Jersey	Yes	None
North Carolina	No	None
North Dakota	No	None
Ohio	No	None
Oklahoma	No	None
Oregon	Yes	None
Pennsylvania	Yes	None
Rhode Island	Yes	None
South Carolina	No	None
South Dakota	No	None
Tennessee	No	None
Texas	No	None
Utah	No	None
Vermont	No	None
Virginia	No	None
Washington	Yes	None
West Virginia	No	None
Wisconsin	No	None

C. PROJECT STAFFING REQUIREMENTS

Question 20: Does a union require a certain level of staffing on your construction projects for construction oversight?

Total Responses	Yes	No
17	0	17
100%	0.00%	100.00%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alaska	No	None
California	No	None
Connecticut	No	None
Delaware	No	None
Hawaii	No	None
Iowa	No	None
Kansas	No	None
Massachusetts	No	None
Michigan	No	None
Minnesota	No	None
Montana	No	None
New Hampshire	No	None
New Jersey	No	None
Oregon	No	None
Pennsylvania	No	None
Rhode Island	No	None
Washington	No	None

C. PROJECT STAFFING REQUIREMENTS

Question 21: Does the agency differentiate between staffing plan requirements of agency and consultant personnel?

Total Responses	Yes	No
40	8	32
100%	20.00%	80.00%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	No	None
Alaska	No	None
Arkansas	Yes	None
California	Yes	None
Colorado	No	None
Connecticut	No	None
Delaware	No	None
Florida	Yes	None
Georgia	No	None
Hawaii	No	None
Iowa	No	None
Kansas	No	None
Kentucky	No	None
Louisiana	No	None
Massachusetts	No	None
Michigan	Yes	None
Minnesota	No	None
Mississippi	Yes	None
Missouri	No	None
Montana	No	None
Nevada	Yes	None
New Hampshire	No	None
New Jersey	No	None
North Carolina	No	None
North Dakota	No	None
Ohio	No	None
Oklahoma	No	None
Oregon	No	None
Pennsylvania	No	None
Rhode Island	No	None

Responding State	Response	Comments
South Carolina	No	None
South Dakota	No	None
Tennessee	Yes	None
Texas	No	None
Utah	No	None
Vermont	No	None
Virginia	Yes	None
Washington	No	None
West Virginia	No	None
Wisconsin	No	None

C. PROJECT STAFFING REQUIREMENTS

Question 22: Does your agency have minimum staffing requirements or metrics for personnel duties during project execution?

Total Responses (40)	Contract Administration	Construction Engineering	Construction Inspection
Yes	14	11	13
Yes %	35.00%	27.50%	32.50%
No	26	29	27
No %	65.00%	72.50%	67.50%

Responding State	Contract Administration	Construction Engineering	Construction Inspection
Alabama	No	No	No
Alaska	No	No	No
Arkansas	Yes	Yes	Yes
California	Yes	Yes	Yes
Colorado	No	Yes	Yes
Connecticut	Yes	Yes	Yes
Delaware	Yes	No	No
Florida	Yes	Yes	Yes
Georgia	Yes	Yes	Yes
Hawaii	No	No	No
Iowa	No	No	No
Kansas	No	No	No
Kentucky	No	No	No
Louisiana	Yes	No	Yes
Massachusetts	No	No	No
Michigan	No	No	No
Minnesota	No	No	No

Responding State	Contract Administration	Construction Engineering	Construction Inspection
Mississippi	Yes	Yes	Yes
Missouri	No	No	No
Montana	No	No	No
Nevada	No	No	No
New Hampshire	Yes	No	No
New Jersey	Yes	Yes	Yes
North Carolina	Yes	Yes	Yes
North Dakota	No	No	No
Ohio	No	No	No
Oklahoma	No	No	No
Oregon	No	No	No
Pennsylvania	No	No	No
Rhode Island	No	No	No
South Carolina	No	No	No
South Dakota	No	No	No
Tennessee	Yes	Yes	Yes
Texas	No	No	No
Utah	No	No	No
Vermont	No	No	No
Virginia	Yes	Yes	Yes
Washington	No	No	No
West Virginia	No	No	Yes
Wisconsin	Yes	No	No

C. PROJECT STAFFING REQUIREMENTS

Question 23: Does the agency determine minimum staffing requirements or metrics for personnel duties based on: (check all that apply)

Total Responses	Specific Tasks	A required number of hours	A percentage of construction contractor hours	A certain percent of work in place	A certain number of samplings	Other
40	18	7	4	2	3	17
	45.00%	17.50%	10.00%	5.00%	7.50%	42.50%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Other	We do not have a minimum staffing requirement
Alaska	Specific tasks	None
Arkansas	Other	Original contract dollar amount
California	Specific tasks, A required number of hours, A percentage of construction contractor hours	None
Colorado	Other	Metrics is developed by our Regions based on experience and construction type
Connecticut	Specific tasks	None
Delaware	Specific tasks	None
Florida	Specific tasks	None
Georgia	Other	Cost of inspection based on cost of contract
Hawaii	Specific tasks	None
Iowa	Other	None
Kansas	Specific tasks	None
Kentucky	Other	There aren't requirements, only recommendations.
Louisiana	A certain number of samplings	None
Massachusetts	A required number of hours	None
Michigan	Other	Don't think there are official requirements. Offices and consultants simply appropriate resources as determined or as needed to get the job done properly.
Minnesota	Specific tasks	None
Mississippi	Specific tasks, A required number of hours	None
Missouri	Specific tasks	None

Montana	Other	Minimum staffing requirements are based on the size and scope of the project. There are no metrics.
Nevada	Other	NDOT does not have minimum staffing requirements, it is determined on project by project basis
New Hampshire	Specific tasks, A required number of hours, A percentage of construction contractor hours	None
New Jersey	Specific tasks	None
North Carolina	Specific tasks	None
North Dakota	Other	None
Ohio	Specific tasks, A certain number of samplings	None
Oklahoma	Other	None
Oregon	Other	There are certain minimum activities that must be performed but project staffing decisions are at the discretion of the Project Managers
Pennsylvania	A required number of hours	None
Rhode Island	Specific tasks	None
South Carolina	Specific tasks	None
South Dakota	Other	None
Tennessee	A required number of hours, A certain percent of work in place	None
Texas	Other	historical
Utah	Other	none
Vermont	Other	N/A
Virginia	Specific tasks, A required number of hours, A percentage of construction contractor hours, A certain percent of work in place	None
Washington	A percentage of construction contractor hours	None
West Virginia	Specific tasks, A certain number of samplings	None
Wisconsin	Other	size of contract/visibility/criticalness

D. LD ASSESSMENT BASED UPON PROJECT STATUS

Question 24: Does the agency have a standard definition of "substantial completion"?

Total Responses	Yes	No
40	24	16
100%	60.00%	40.00%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Yes	Our specifications do not define "substantial completion", but this is generally considered the point of "maintenance acceptance" as written in Article 105.15 of the specifications.
Alaska	Yes	See Definitions in 101-1.03
Arkansas	Yes	A "standard" definition is not available. However, it is generally accepted to declare a project substantially complete when all of the contract line items have been paid.
California	No	None
Colorado	No	None
Connecticut	Yes	SUBSTANTIAL COMPLETION: The date at which the performance of all work on the Project has been completed except minor or incidental items, final cleanup, work required under a warranty, and repair of unacceptable work, provided the Engineer has determined: A. The Project is safe and convenient for use by the public; B. All traffic lanes including all safety appurtenances are in their final configuration.; C. Failure to complete the work (including repairs) excepted above has not and will not result in the deterioration of other completed Project work, and provided further, that the Contract value of the work remaining to be performed, including cleanup, is less than one percent (1%) of the estimated final Contract amount; D. If applicable, a Certificate of Compliance has been issued.
Delaware	Yes	Substantial Completion - Substantial Completion is the point at which all Contract Items are complete as deemed by the Department excluding any warranties or vegetation growth.
Florida	No	None
Georgia	Yes	All major safety features are installed and functional, such major safety features to include shoulders, guard rails, permanent striping and delineations, concrete traffic barriers, bridge railings, fire safety systems, cable safety systems, metal beam guard fences, safety end treatments, terminal anchor sections and crash attenuators, illumination, signals and other major safety features and any sidewalks and all devices needed in accordance with the ADA;

Hawaii	Yes	This is what we have currently, but the specifications are being revised. Substantial Completion - The status of the project when the Contractor has completed the work, except for plant establishment, and each of the following requirements are met: (1) All utilities and services are connected and working,(2) All equipment is in acceptable working condition,(3) Additional activity by the Contractor to correct punchlist items will not prevent or disrupt use of the work or the facility in which the work is located, and (4) The building, structure, improvement or facility can be used for its intended purpose. For bridge and highway work, in addition to the above requirements, substantial completion is the point at which all bridge deck, parapet, pavement structure, shoulder, drainage, traffic signal, guardrail, safety appurtenance, traffic barrier, lighting, and required signs and markings work are complete.
Iowa	No	None
Kansas	No	None
Kentucky	No	None
Louisiana	No	None
Massachusetts	Yes	Substantial Completion- A walkthrough of the entire contract Work has been performed by the Resident Engineer, a Punch List has been generated and the Work required by the contract, including paper work, has been completed, except for work having a contract price of less than one percent of the adjusted total contract price, including overruns, underruns and all contract amendments. All material submittals have been received by the District Materials Lab.
Michigan	No	None
Minnesota	No	None
Mississippi	No	None
Missouri	Yes	Substantial completion is all work is completed other than excepted items such as seed growth and signal test periods.
Montana	Yes	We used to use the term "substantial work complete" in our specifications but changed that to "final acceptance" because of the different uses of the term. Final Acceptance is when the Final Walk-through Process is complete, all project-specific warranties have expired, and all warranty issues have been resolved.
Nevada	No	None
New Hampshire	Yes	The Work will be considered "substantially complete" when all necessary signing, striping, guardrail, and other safety appurtenances have been installed, and when applicable opened to the traveling public. For projects that will not be opened to the traveling public, the Contract will be considered substantially complete when it is ready for the subsequent project. This shall not be construed as a Contractual right and its application will be contingent upon the Contractor's diligence in completing the remaining items of work.

New Jersey	Yes	Substantial Completion. When all work is complete, with the exception of landscaping Items listed in 811.04, removal of SESC measures, FINAL CLEANUP, and repair of unacceptable work; provided the RE has determined that: 1. The Project is safe and convenient for use by the public. 2. Failure to complete work and repairs excepted above will not result in the deterioration of other completed work. 3. The value of the remaining landscaping work, removal of SESC measures, repairs, and FINAL CLEANUP is less than 2 percent of the Total Adjusted Contract Price.
North Carolina	No	None
North Dakota	Yes	When a project is open for safe and convenient use by the traveling public and all necessary safety features are in in place.
Ohio	Yes	When the project has completed final inspection with no punchlist items or when the project has completed final inspection and punchlist items are complete.
Oklahoma	Yes	A. Substantial Completion Substantial completion is defined as follows: All pavement markings and safety appurtenances have been installed; Traffic has been placed in its final lane configuration, and; No further lane closures will be necessary to perform remaining Contract work. For projects not opened to traffic, substantial completion occurs if the project is available for a subsequent project or the designated use. The Department may identify project specific features or requirements in the Contract requirements.
Oregon	No	None
Pennsylvania	Yes	When physical work is complete.
Rhode Island	Yes	101.71 SUBSTANTIAL COMPLETION. Substantial completion of a unit, or portion of the work such as a structure, an interchange, or section of road or pavement occurs at the point at which the portion of the work is complete such that it can be safely and effectively used by the public and when the following criteria are realized: 1) All courses of pavement are complete; 2) curbing and sidewalks are placed; 3) all project drainage is complete; 4) guardrail and terminal sections are properly installed; 5) pavement markings are in place; 6) traffic signal systems meet the following requirements: (a) isolated traffic signals - the signal control equipment is fully programmed, detectors are installed and functioning, and the signal is in actuated operation, (b) coordinated traffic signal systems - the requirements of condition (a) are met, the interconnect is installed and functioning, and the signals are operating as a coordinated system, (c) closed loop signal systems - the conditions of (a) and (b) are met, the communications link is operating, and the monitoring functions, including system and intersection graphics, are installed and operating at the Department's monitoring stations; 7) regulatory and warning signs are installed; 8) highway lighting is operational; and 9) only corrective or repair work remains for the physical completion of the Contract.

South Carolina	Yes	SECTION 108: FAILURE TO COMPLETE THE WORK ON TIME- Paragraph 1 of Section 108.9 is hereby replaced with the following: If the Contractor fails to substantially complete the work by the contract completion date, the Contractor is liable for liquidated damages. Liquidated damages will be assessed for each day beyond the contract completion date that work items are not completed. This includes the application of thermoplastic, raised pavement markers and grassing. Days to be charged for liquidated damages will not stop due to seasonal restrictions. The daily liquidated damages rate is determined from the following schedule. The date of substantial completion is determined by the RCE.
South Dakota	Yes	Unless otherwise specified, the Department will consider the work substantially complete when all lanes are open to unimpeded traffic and the Contractor's work will not impede traffic again.
Tennessee	No	None
Texas	No	None
Utah	Yes	Substantial Completion- Substantially complete. The day as determined by the Engineer when all of the following have occurred: a. The public, (including vehicles and pedestrians), have full and unrestricted use and benefit of the facilities both from the operational and safety standpoint. b. Successful completion of the LFOT, successful integration of devices to the Traffic Operations Center and active central communications to all devices. c. All safety features are installed and fully functional, including, but not limited to, illumination, signing, pavement markings, all coats of striping paint, barrier, guardrail, impact attenuators, delineators, and all other safety appurtenances. d. All remaining pay items in the contract are complete in addition to safety features. Only minor corrective work and replacement of temporary substitute facilities remains for physical completion. e. The Contractor and Engineer mutually agree that all work remaining will be performed without lane closures, trail or sidewalk closures, and further delays, disruption, or impediment to the public.
Vermont	Yes	LIQUIDATED DAMAGES - The charge assessed to the Contractor pursuant to the Contract because the Contractor did not complete the Contract within the Contract time or by the Contract Completion Date, not as a penalty but as an assessment of damages impossible or difficult to determine with accuracy.
Virginia	Yes	Completion Date, Substantial. The date on or before which the project is complete such that it can be safely and effectively used by the public without delays, disruption, or other impediments and only clean up and Work of a minor nature, as agreed to by the Engineer, remains to be finished.

Washington	Yes	Completion Dates- “Substantial Completion Date is the day the Engineer determines the Contracting Agency has full and unrestricted use and benefit of the facilities, both from the operational and safety standpoint, all the initial plantings are completed and only minor incidental work, replacement of temporary substitute facilities, plant establishment periods, or correction or repair remains for the Physical Completion of the total Contract. Physical Completion Date is the day all of the Work is physically completed on the project. All documentation required by the Contract and required by law does not necessarily need to be furnished by the Contractor by this date. Completion Date is the day all the Work specified in the Contract is completed and all the obligations of the Contractor under the Contract are fulfilled by the Contractor. All documentation required by the Contract and required by law must be furnished by the Contractor before establishment of this date.
West Virginia	Yes	Substantial Completion or Substantially Complete-The work on the Contract will be considered substantially complete when the Project could be opened continuously for the safe, convenient, and unimpeded use of the traveling public, or the Project has met the intention of the plans, as reasonably determined by the Engineer.
Wisconsin	No	None

D. LD ASSESSMENT BASED UPON PROJECT STATUS

Question 25: At what level is the determination of substantial completion on a project made?

Total Responses	Consultant-level	Project-level	Regional/ District-level	State/ Agency-level	Other
40	1	22	11	2	4
100%	2.50%	55.00%	27.50%	5.00%	10.00%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Regional/ District-level	None
Alaska	Project-level	None
Arkansas	Regional/ District-level	None
California	Regional/ District-level	None
Colorado	Other	Substantial completion is not in our Standards.
Connecticut	Project-level	None
Delaware	Regional/ District-level	None
Florida	Other	FDOT uses Final Acceptance of the work rather than substantial completion. Decisions on Final Acceptance are the Project level.
Georgia	Regional/ District-level	None
Hawaii	Project-level	None
Iowa	Regional/ District-level	None
Kansas	Other	We don't us substantial completion. We use roadway open to traffic and project complete.
Kentucky	Project-level	None
Louisiana	Consultant-level	None
Massachusetts	Regional/ District-level	None
Michigan	Project-level	None
Minnesota	Project-level	None
Mississippi	Regional/ District-level	None
Missouri	Project-level	None
Montana	Project-level	None
Nevada	Regional/ District-level	None
New Hampshire	Project-level	None

New Jersey	State/ Agency-level	None
North Carolina	State/ Agency-level	None
North Dakota	Project-level	None
Ohio	Project-level	None
Oklahoma	Project-level	None
Oregon	Project-level	None
Pennsylvania	Project-level	None
Rhode Island	Project-level	None
South Carolina	Project-level	None
South Dakota	Project-level	None
Tennessee	Other	Complete is complete.
Texas	Project-level	None
Utah	Project-level	None
Vermont	Project-level	None
Virginia	Project-level	None
Washington	Project-level	None
West Virginia	Regional/ District-level	None
Wisconsin	Regional/ District-level	None

D. LD ASSESSMENT BASED UPON PROJECT STATUS

Question 26: Typically, when are LDs charged to a contractor on a high value contract project? (check all that apply)

Total Responses	40	
By phase of milestone (or when phase or milestone not achieved)	18	45.00%
Upon expiration of contract time	33	82.50%
Substantial Completion	15	37.50%
Other	7	17.50%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Upon expiration of contract time	None
Alaska	Upon expiration of contract time, Substantial Completion	None
Arkansas	By phase or milestone, Upon expiration of contract time	None
California	Upon expiration of contract time	None
Colorado	Upon expiration of contract time	None
Connecticut	By phase or milestone, Upon expiration of contract time, Substantial Completion, Other	Hourly lane use LD's, milestone LD's.
Delaware	By phase or milestone, Upon expiration of contract time	None
Florida	Upon expiration of contract time	None
Georgia	By phase or milestone, Upon expiration of contract time	None

Hawaii	Upon expiration of contract time	None
Iowa	Substantial Completion	None
Kansas	By phase or milestone, Upon expiration of contract time	None
Kentucky	By phase or milestone, Upon expiration of contract time	None
Louisiana	By phase or milestone	None
Massachusetts	Upon expiration of contract time	None
Michigan	By phase or milestone, Upon expiration of contract time, Substantial Completion, Other	All may have LDs associated with them.
Minnesota	Upon expiration of contract time	None
Mississippi	By phase or milestone, Upon expiration of contract time, Substantial Completion	None
Missouri	By phase or milestone, Upon expiration of contract time	None
Montana	Upon expiration of contract time	None
Nevada	By phase or milestone, Upon expiration of contract time, Substantial Completion	None
New Hampshire	By phase or milestone, Upon expiration of contract time, Substantial Completion	None
New Jersey	Other	At interim completion if specified, at substantial completion and at completion.

North Carolina	By phase or milestone, Upon expiration of contract time, Substantial Completion, Other	We withhold apparent damages when it is clear the dates will not be met.
North Dakota	By phase or milestone, Upon expiration of contract time, Substantial Completion	None
Ohio	Upon expiration of contract time	None
Oklahoma	Upon expiration of contract time	None
Oregon	By phase or milestone, Upon expiration of contract time	None
Pennsylvania	Other	CELDs can occur after you've exceeded project completion.
Rhode Island	By phase or milestone, Substantial Completion	None
South Carolina	Substantial Completion	None
South Dakota	Upon expiration of contract time, Substantial Completion, Other	SDDOT may charge LD's at the end of the construction season for multi-year contracts. SDDOT has different rates for Substantial completion and Field work completion based on expected staffing levels and historical data.
Tennessee	Upon expiration of contract time, Other	We occasionally have milestone completion dates for phased work. This is rare.
Texas	Upon expiration of contract time	None
Utah	By phase or milestone, Substantial Completion	None
Vermont	Upon expiration of contract time	None
Virginia	Upon expiration of contract time, Substantial Completion	None

Washington	By phase or milestone, Upon expiration of contract time, Substantial Completion	None
West Virginia	Upon expiration of contract time	None
Wisconsin	Upon expiration of contract time	None

D. LD ASSESSMENT BASED UPON PROJECT STATUS

Question 27: Does your agency stop charging LDs once substantial completion is achieved? Substantial Completion (from AIA): the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

Total Responses	Yes	No
40	23	17
100%	57.50%	42.50%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Yes	None
Alaska	No	None
Arkansas	Yes	None
California	Yes	None
Colorado	No	None
Connecticut	Yes	None
Delaware	No	None
Florida	No	None
Georgia	No	None
Hawaii	Yes	None
Iowa	No	None
Kansas	No	None
Kentucky	Yes	None
Louisiana	No	None
Massachusetts	No	None
Michigan	Yes	None
Minnesota	Yes	None
Mississippi	No	None
Missouri	Yes	None
Montana	No	None
Nevada	Yes	None
New Hampshire	Yes	None
New Jersey	No	None
North Carolina	No	None
North Dakota	Yes	None
Ohio	Yes	None
Oklahoma	Yes	None
Oregon	Yes	None
Pennsylvania	Yes	None
Rhode Island	Yes	None
South Carolina	Yes	None
South Dakota	No	None
Tennessee	No	None
Texas	Yes	None
Utah	Yes	None
Vermont	Yes	None
Virginia	No	None
Washington	No	None
West Virginia	Yes	None
Wisconsin	Yes	None

E. AUDITING PROCESS AND REVIEW

Question 28: Does your agency conduct a cost analysis or an audit on projects to compare LDs with actual costs incurred after the project is complete? If your agency conducts a cost analysis/audit on projects, provide a brief explanation of actions taken following the audit results. If possible, provide general findings from recent audits.

Total Responses	Yes	No
40	5	35
100%	12.50%	87.50%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	No	None
Alaska	Yes	We generally review LD rates every two years. The rates seem to hold for longer than two years.
Arkansas	No	None
California	No	None
Colorado	No	None
Connecticut	No	None
Delaware	No	None
Florida	No	None
Georgia	No	None
Hawaii	No	None
Iowa	No	None
Kansas	No	None
Kentucky	No	None
Louisiana	No	None
Massachusetts	No	None
Michigan	No	None
Minnesota	No	None
Mississippi	Yes	We utilize our legal and audit divisions to assist in coming up with LD amounts.
Missouri	No	None
Montana	No	None
Nevada	No	None
New Hampshire	No	None
New Jersey	Yes	This only happens if the Contractor contests the LDs specified. We do not have findings as this very rarely happens. In fact I have only seen this once in the last 14 years and the case is still in court.
North Carolina	No	None
North Dakota	No	None

Ohio	No	None
Oklahoma	No	None
Oregon	No	None
Pennsylvania	No	None
Rhode Island	No	None
South Carolina	No	None
South Dakota	No	None
Tennessee	Yes	We examine the actual cost expenditure to run each job. Our rates are based on these. These costs are examined after the job is closed.
Texas	No	None
Utah	No	None
Vermont	Yes	The cost analysis forms the basis of the rates used on the LD table. The rates are established based on actual charges to the project, with a best fit curve applied top the data, then the contract value ranges and LD's are determined.
Virginia	No	None
Washington	No	None
West Virginia	No	None
Wisconsin	No	None

E. AUDITING PROCESS AND REVIEW

Question 29: If your agency uses a standard schedule of LD rates, how often is it updated?

Total Responses	40	100%
More frequently than annually	0	0.00%
Every year	1	2.50%
Every 2 years	20	50.00%
Less Frequently than 2 years	14	35.00%
We use only project-specific LD rates	5	12.50%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Every 2 years	None
Alaska	Every 2 years	None
Arkansas	Less frequently than 2 years	None
California	Every 2 years	None
Colorado	Every 2 years	None
Connecticut	Every 2 years	None
Delaware	Every 2 years	None
Florida	Every 2 years	None
Georgia	Every 2 years	None
Hawaii	We use only project-specific LD rates	None
Iowa	Every 2 years	None
Kansas	Every 2 years	None
Kentucky	Less frequently than 2 years	None
Louisiana	Less frequently than 2 years	None
Massachusetts	Less frequently than 2 years	None

Responding State	Response	Comments
Nevada	We use only project-specific LD rates	None
New Hampshire	Every 2 years	None
New Jersey	We use only project-specific LD rates	None
North Carolina	Less frequently than 2 years	None
North Dakota	Every 2 years	None
Ohio	Every 2 years	None
Oklahoma	Every 2 years	None
Oregon	Less frequently than 2 years	None
Pennsylvania	Every 2 years	None
Rhode Island	Less frequently than 2 years	None
South Carolina	Less frequently than 2 years	None
South Dakota	Every 2 years	None
Tennessee	Every 2 years	None
Texas	We use only project-specific LD rates	None
Utah	Less frequently than 2 years	None

Michigan	Less frequently than 2 years	None
Minnesota	Every 2 years	None
Mississippi	Less frequently than 2 years	None
Missouri	Less frequently than 2 years	None
Montana	Every 2 years	None

Vermont	Every 2 years	None
Virginia	Less frequently than 2 years	None
Washington	We use only project-specific LD rates	None
West Virginia	Less frequently than 2 years	None
Wisconsin	Every year	None

F. LEGAL ISSUES

Question 30: Have your LD provisions or rates been challenged in court?

Total Responses	40	100%
Yes, within the last 5 years	2	5.00%
Yes, more than 5 years ago	4	10.00%
No	34	85.00%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Yes, more than 5 years ago	None
Alaska	No	None
Arkansas	No	None
California	No	None
Colorado	No	None
Connecticut	No	None
Delaware	No	None
Florida	Yes, more than 5 years ago	None
Georgia	No	None
Hawaii	No	None
Iowa	Yes, more than 5 years ago	None
Kansas	No	None
Kentucky	No	None
Louisiana	No	None
Massachusetts	No	None
Michigan	No	None
Minnesota	No	None
Mississippi	No	None
Missouri	No	None
Montana	Yes, more than 5 years ago	None
Nevada	No	None
New Hampshire	No	None
New Jersey	Yes, within the last 5 years	None

Responding State	Response	Comments
North Carolina	No	None
North Dakota	No	None
Ohio	No	None
Oklahoma	No	None
Oregon	No	None
Pennsylvania	Yes, within the last 5 years	None
Rhode Island	No	None
South Carolina	No	None
South Dakota	No	None
Tennessee	No	None
Texas	No	None
Utah	No	None
Vermont	No	None
Virginia	No	None
Washington	No	None
West Virginia	No	None
Wisconsin	No	None

F. LEGAL ISSUES

Question 31: If your LD provisions have been challenged in court, have any of these challenges been against projects with a contract value over $20 million? If your LD provisions have been challenged in court on contracts valued over $20 million, please provide Case Numbers, Case Titles, Dates, and Court Jurisdictions.

Total Responses	Yes	No
6	2	4
100%	33.33%	66.67%

Please use comment box to provide clarifying remarks.

Responding State	Response	Comments
Alabama	Yes	Will have to research this and provide later.
Florida	Yes	I don't have that information readily available and will have to obtain from the Department's legal office.
Iowa	No	None
Montana	No	None
New Jersey	No	None
Pennsylvania	No	None

F. LEGAL ISSUES

Question 32: If your LD provisions have been challenged in court, in general, have the rulings: (check all that apply)

Total Responses	6	100%
Upheld LD provisions or rates	1	16.67%
Overturned LD provisions or rates	1	16.67%
Mandated revision of LD provisions or rates	0	0.00%
Other	4	66.67%

Please use comment box to provide clarifying remarks.

Responding State	**Response**	**Comments**
Alabama	Other	Challenges have not affected LD provisions at all.
Florida	Other	Believe they were upheld but will have to confirm with legal office.
Iowa	Overturned	None
Montana	Upheld	None
New Jersey	Other	The case is still pending
Pennsylvania	Other	Settlement between time extensions and LDs assessed.

APPENDIX C

ORIGINAL ALDOT PROJECT DATABASE (UNCLEANED)

Sheet	Size	HDCSno	Project	County	OrigContAmt	Days/CompDt.	C/W	PcntUsed	PcntComp	CompDate	DaysUsed	EandIAmt	FinalAmt	MultiProj	FundPgm	CPMS_Proj
14-16	8		HPP-0035(510)	MONTGOMERY	$65,846,200.49	1-Dec-14	D	99.66	100	08/03/15	1163	$7,317,173.07	$65,161,850.34	Y	HPPL2	100016434
14-16	8		STMAAF-I020(324)	ST. CLAIR	$54,952,855.53	14-Jan-14	D	104.44	99.99	11/19/14	1557	$1,717,343.02	$26,009,050.57	N	NH01M	100041158
14-16	8		IM-STPAAF-BRF-I020(333)	TALLADEGA	$39,219,883.35	23-Nov-13	D	100	99.95	10/30/15	1171	$1,285,866.52	$23,529,392.91	Y	BROPE	100033440
14-16	8		IM-IMD-I020(325)	JEFFERSON	$38,557,846.61	11/22/2012	D	102.51	100	02/04/15	449	$3,104,573.74	$42,246,959.85	Y	IM04E	100042659
14-16	8		ACSTPAA-1702(904)	BALDWIN	$38,474,357.09	22-Jun-14	D	115.15	99	10/14/14	1124	$5,671,601.80	$51,626,983.12	N	L24AC	100048102
14-16	8		STMOAF-0192(901)	CALHOUN	$29,374,688.44	423	W	166	100	01/07/14	644	$2,526,771.59	$8,379,152.60	N	STOAC	100039149
14-16	8		IM-ACNHF-I020(332)	TALLADEGA	$29,157,751.77	11/20/2009	D	100	100	08/04/15	758	$2,077,347.56	$171,737.19	N	IM04L	100033401
14-16	8		IM-NHF-I020(339)	CLEBURNE	$29,029,976.88	1-May-15	D	99.07	100	05/10/16	744	$232,143.48	$28,218,600.51	N	NH01M	100056061
14-16	8		STPAAF-EOAPF-BRF-I010(301)	MOBILE	$26,394,942.37	1-Aug-13	D	113.49	99	11/10/14	1018	$67,185.13	$17,969,717.62	N	BRNM	100004939
14-16	8		IM-I059(336)	DEKALB	$24,999,332.84	3/25/2014	D	100	100	04/18/15	750	$1,762,614.26	$31,045,309.55	N	IM04E	100048519
14-16	8		EOAPF-HWYPF-BRF-0008(529)	SUMTER	$24,675,373.99	528	W	96	99.1	10/15/14	506	$1,247,322.11	$25,768,734.94	N	BROPE	100004512
14-16	8		IM-I065(414)	CONECUH	$21,303,756.81	24-Aug-13	D	111.11	99	06/11/15	639	$1,896,014.20	$19,812,760.14	N	IM04E	100055401
14-16	8		ACAPD-NHF-0355(503)	FRANKLIN	$19,242,659.91	397	W	104.79	99	12/10/14	416	$5,001,175.11	$21,930,470.93	N	APD8E	100009853
14-16	8		APD-IM-0004(521)	WALKER	$19,197,857.75	7-Nov-14	D	92.23	100	09/01/15	503	$841,315.57	$17,865,758.26	Y	AP100	100052995
14-16	8		IM-NHF-I020(327)	CALHOUN	$18,913,504.01	2-Nov-13	D	100	99.7	07/30/14	934	$1,543,338.70	$25,366,836.70	N	ACR05	100045422
14-16	8		STPOA-0025(518)	ETOWAH	$18,463,000.00	441	W	148	99	01/29/16	555	$1,241,894.95	$18,789,951.96	Y	STOAE	100008733
14-16	8		HPP-IM-STPOA-I085(311)	LEE	$18,255,545.09	12/10/2012	D	100	100	07/02/15	855	$220,908.35	$4,386,636.07	N	IM01M	100041200
14-16	8		IM-I059(365)	JEFFERSON	$17,791,857.40	1-Aug-15	D	52.88	100	05/11/15	257	$2,284,959.03	$33,403,306.47	N	IM01M	100055653
14-16	8		STPOAF-0013(544)	FRANKLIN	$17,711,338.11	520	W	103	100	06/02/15	535	$2,735,440.38	$19,038,748.26	N	STOAL	100050490
14-16	8		STMAAF-0001(537)	MADISON	$17,271,707.66	550	W	96	100	12/18/14	527	$2,105,294.37	$18,041,710.45	N	STAAC	100004925
14-16	8		IM-I065(412)	CONECUH	$17,062,508.31	1-Sep-14	D	109.58	99	07/09/15	606	$1,820,666.78	$17,514,865.85	N	IM01M	100053840
14-16	8		IM-NHF-I020(340)	CLEBURNE	$17,005,411.27	31-Oct-13	D	100	99	10/23/14	695	$1,208,390.32	$17,960,665.42	N	IM04E	100056060
14-16	8		IM-I085(334)	MACON	$16,827,994.53	2-Jul-14	D	100	100	06/22/15	523	$1,484,557.61	$17,003,051.38	N	IM01M	100054913
14-16	8		NHF-0013(545)	FRANKLIN	$14,790,416.92	400	W	100	99	09/28/15	401	$1,849,251.64	$15,567,884.45	N	NH01M	100050489
14-16	8		NHF-0012(544)	COFFEE	$14,787,502.02	350	W	99	99	04/06/15	349	$2,089,054.14	$16,779,242.45	N	NH04E	100004563
14-16	8		IM-IMD-I010(328)	MOBILE	$14,681,567.59	5-Sep-15	D	1488.89	99	06/28/16	669	$1,374,877.63	$14,360,220.37	N	IM01M	100049182
14-16	8		STPAA-8570(601)	MADISON	$14,332,223.27	360	W	99	100	05/31/14	359	$1,884,417.12	$4,032,531.26	N	STAAR	100041504
14-16	8		BR-I065(440)	BALDWIN	$14,101,156.53	315	W	92.7	96	07/25/16	293	$1,046,625.11	$14,920,611.22	N	BRNME	100059062
14-16	8		APD-0355(506)	FRANKLIN	$13,900,275.93	382	W	98.95	100	07/30/14	378	$2,179,111.56	$14,367,259.87	N	APD8E	100044740
14-16	8		EB-0053(509)	MADISON	$13,883,824.34	330	W	99.39	99	12/02/14	328	$1,748,445.58	$15,378,258.24	N	EBSPE	100037279
14-16	8		NHF-0067(501)	MORGAN	$12,867,144.79	195	W	100	100	06/17/15	195	$1,560,319.13	$10,935,841.55	N	NH04E	100040953
14-16	8		IM-I059(323)	DEKALB	$12,846,862.86	22-Nov-13	D	206	99	04/14/16	1571	$2,096,596.27	$20,092,532.14	N	IM04E	100040294
14-16	8		BR-0182(502)	BALDWIN	$12,169,710.49	340	W	99.41	100	02/01/16	338	$502,603.10	$11,822,294.66	N	BRSM	100040116
14-16	8		IM-I010(324)	BALDWIN	$12,123,995.85	15-Oct-13	D	108.97	100	09/12/14	474	-$10,567.59	$12,827,213.17	N	IM04L	100049175
14-16	8		STPOA-0275(502)	TALLADEGA	$11,876,708.56	315	W	100	100	05/13/15	306	$1,832,887.11	$2,463,012.98	N	STOAE	100009127
14-16	8		STPOAF-8829(600)	COLBERT	$11,594,864.84	350	W	99	100	10/26/15	347	$2,083,346.56	$10,855,632.78	N	STOAE	100009338
14-16	8		NHF-HPP-0012(517)	COFFEE	$11,449,459.87	499	W	108	99	08/28/15	539	$2,030,589.17	$13,962,282.27	N	NH04E	100004087
14-16	8		IM-I459(308)	JEFFERSON	$11,426,382.79	29-Aug-14	D	104.2	100	05/11/15	372	$397,787.86	$11,998,484.12	N	IM01M	100054991
14-16	8		IM-I010(319)	BALDWIN	$10,577,901.14	16-Oct-14	D	100	100	11/20/15	785	$1,755,065.83	$12,416,053.10	N	IM01M	100047689
12-14	8	6145	IM-NHF-I065(375)	MONTGOMERY	$79,590,663.00	10/15/2009	D	79	100	5/15/2013	192	4948045.46	93138811	Y	IM04L	100049492
12-14	8	3210	IM-ACNHF-I065(353)	SHELBY	$78,457,181.00	5/19/2011	D	99	100	7/24/2014	1391	9125026.88	77870360	Y	ACR05	100044675
12-14	8	3030	ACAPD-IM-NHF-BRF-I065(303)	JEFFERSON	$73,039,164.00	10/15/2007	D	99	100	5/18/2013	491	19077.11	77249236	Y	AC8L	100037452
12-14	8	1156	STMAAF-I059(342)	ETOWAH	$37,496,529.00	1/13/2013	D	100	100	6/13/2014	1313	3514717.58	46622671	N	STAAC	100049055
12-14	8	9039	ACBRF-0101(562)	CONECUH	$34,417,557.00	180	W	134	100	10/21/2011	241	1877.92	3251169	N	BROPA	100002623
12-14	8	3040	APD-471(522)	JEFFERSON	$33,871,072.00	1178	C	105	100	1/14/2012	1236	4793891.75	35760887	Y	APD8H	100009933
12-14	8	8074	NHF-0008(530),BRF-0008(536)	SUMTER	$33,765,031.00	500	C	99	100	4/23/2013	495	2708694.21	31629112	Y	NH04L	100004510
12-14	8	5094	NHF-I059(317)	TUSCALOOSA	$25,620,947.00	0	C	100	100	12/14/2013	0	1979995.67	27949529	N	NH04L	100042123
12-14	8	4124	ACSTPAAF-NCPD-0192(006)	CALHOUN	$24,225,583.00	385	W	105	100	3/20/2012	404	373881.53	27515585	N	DPIP	100039143
12-14	8	1119	BRF-310(17)	1ST.DIV.	$21,401,116.00	450	W	91	100	7/12/2012	409	1615900.47	23059008	Y	BRD9	100003051
12-14	8	3119	APD-471(45)	WALKER	$21,159,147.00	425	W	106	100	3/7/2012	450	2139642.48	21682341	N	APD8	100009935
12-14	8	3033	IM-NHF-I065(393)	JEFFERSON	$21,116,157.00	1/2/2012	D	100	100	3/27/2013	212	1920168.14	21693187	Y	NH04E	100053694
12-14	8	9104	NHF-0042(501)	MOBILE	$21,101,047.00	400	W	42	100	1/19/2012	168	7843245.02	64326815	N	NH04L	100040581
12-14	8	2067	ACSTPAAF-0124(900)	LAUDERDALE	$20,874,772.00	565	W	92	100	4/7/2012	519	1794112.35	22815105	N	ACR24	100016522
12-14	8	1022	STPOAF-1602(521)	DEKALB	$19,578,816.00	465	W	85	100	8/16/2012	395	1875025.51	19536161	N	STOAL	100016590
12-14	8	4135	ACSTPAA-0275(500)	TALLADEGA	$18,453,396.00	300	W	70	100	7/11/2013	210	2060615.88	21591604	N	STAAH	100009128
12-14	8	1072	APD-235(45), 1-565-5(69)	MADISON	$18,258,983.00	430	W	123	100	11/22/2011	528	1273130.39	22921860	Y	IREG	100011334
12-14	8	6128	NHF-0056(500) BRF-0102(527)	MONTGOMERY	$17,970,113.00	1/5/2006	D	134	100	10/18/2012	4078	2869442.78	19670278	Y	NH04	100004822
12-14	8	1144	STPOA-0025(514)	ETOWAH	$16,671,324.00	385	W	93	100	12/17/2012	358	1428639.81	17142894	N	STOAL	100008732
12-14	8	1224	NHF-0286(022)	MADISON	$16,232,572.00	340	W	99	100	3/5/2013	336	1557590.13	16318874	N	NH04L	100008281
12-14	8	9100	NHF-0013(548)	MOBILE	$15,687,566.00	9/30/2009	D	100	100	1/20/2012	3009	1137898.46	15631852	N	NH04L	100050449
12-14	8	4085	STPOA-0015(507) & IM-I085(31	LEE	$15,427,825.00	632	C	116	100	8/22/2012	733	1946575.71	15597156	Y	ACR20	100044564
12-14	8	2044	MGF-393(8)	FRANKLIN	$15,188,505.00	815	W	155	100	9/28/2012	1263	3299753.55	32089283	N	MGSP	100004658
12-14	8	6162	STMAAF-0009(509)	MONTGOMERY	$14,904,308.00	325	W	98	100	6/19/2014	318	2163909.44	18963444	N	STAAC	100004580
12-14	8	1090	NHF-0157(504)	MORGAN	$14,446,291.00	260	W	115	100	11/9/2011	299	1233351.35	17172257	Y	ACR05	100004689
12-14	8	1078	STPAA-8570(601)	MADISON	$14,332,223.00	360	W	99	100	5/31/2014	356	1882181.12	14810335	N	STAAR	100041504
12-14	8	5081	BRF-BRF-0006(516)	TUSCALOOSA	$14,081,455.00	514	W	100	100	5/3/2013	514	2734734.92	18686833	Y	BROPL	100045037

12-14	8	6023	IM-65-1(220)	BUTLER	$13,965,689.00	366	W	99	100	8/31/2013	362	1509892.73	14245192	N	IM98	100001669
12-14	8	9029	ACSTPAA-0181(500)	BALDWIN	$12,669,867.00	370	W	96	100	11/28/2013	355	13.1	15639656	N	L24AC	100044795
12-14	8	3032	APD-0471(503)	JEFFERSON	$12,518,918.00	300	W	97	100	10/5/2012	291	1026629.22	12994917	N	APD8L	100039623
12-14	8	4078	MGF-0001(516)	RUSSELL	$12,060,217.00	706	C	118	100	2/8/2012	833	1944633.09	15749386	N	MGSPH	100004758
12-14	8	1151	IM-I059(340)	ETOWAH	$12,021,460.00	1/15/2009	D	115	100	12/20/2011	3235	1191497.87	12299693	N	IM04L	100033210
12-14	8	1046	BRF-0035(502)	JACKSON	$11,790,332.00	325	W	95	100	12/18/2012	308	1118890.23	12314476	N	BROPL	100045261
12-14	8	4066	ACSTPAA-0077(501)	TALLADEGA	$11,210,400.00	270	W	109	100	12/28/2011	294	1548742.77	11579608	N	STAAL	100009086
12-14	8	8097	NHF-0008(534)	SUMTER	$11,116,766.00	250	W	100	100	1/14/2012	250	946625.06	11616272	N	NH04L	100038631
12-14	8	5087	STPOA-9650(600)	TUSCALOOSA	$10,843,677.00	300	W	90	100	7/12/2012	270	2048902.37	11451932	N	STOAL	100042220
12-14	8	4079	NHF-0001(520)	RUSSELL	$10,446,910.00	382	W	119	100	10/29/2013	454	1931980.81	15771828	N	NH04L	100004759
12-14	8	5120	ACNHF-0076(502)	TUSCALOOSA	$10,375,000.00	360	W	100	100	4/25/2012	360	2372024.7	11651237	N	NH04L	100004101
12-14	8	1102	MG-8570(600)	MADISON	$10,310,545.00	5/20/2005	D	106	100	8/28/2012	5125	1265153.45	10563789	Y	MGSL	100008307
12-14	8	9091	ST-049-039-001	MOBILE	$10,262,107.00	305	W	5	100	9/1/2011	15	1107452.72	11229844	N	STATC	100009216
12-14	8	6085	ACSTPAA-5110(104) & ACBR-511	MONTGOMERY	$10,141,061.00	836	C	112	100	7/16/2012	936	4200.3	10429792	Y	ACR24	100009226
10-12	8	9039	ACBRF-0101(562)	CONECUH	$34,417,557.00	180	W	134	100	10/21/2021	241	$1,877.92	$3,251,169.00	N	BROPA	100002623
10-12	8	3040	APD-471(522)	JEFFERSON	$33,871,072.00	1178	C	105	100	1/14/2014	1236	$4,793,891.75	$35,760,887.00	Y	APD8H	100009933
10-12	8	3062	IM-459-4(78)	JEFFERSON	$28,478,981.00	415	W	152	100	9/2/2002	630	$2,891,823.43	$30,499,558.00	N	IM98	100005121
10-12	8	3112	APD-0471(508),APD-0471(509)	WALKER	$24,611,237.00	1507	D	100	100	9/9/2009	1507	$1,693,911.77	$27,717,010.00	Y	CX54L	100009928
10-12	8	4124	ACSTPAAF-NCPD-0192(006)	CALHOUN	$24,225,583.00	385	W	105	100	3/20/2020	404	$373,881.53	$27,515,585.00	N	DPIP	100039143
10-12	8	9050	STPAAF-0113(500)	ESCAMBIA	$22,730,011.00	300	W	79	100	8/17/2017	237	$1,885,621.97	$26,642,573.00	N	STAAL	100046886
10-12	8	3119	APD-471(45)	WALKER	$21,159,147.00	425	W	106	100	3/7/2007	450	$2,139,642.48	$21,682,341.00	N	APD8	100009935
10-12	8	9104	NHF-0042(501)	MOBILE	$21,101,047.00	400	W	42	100	1/19/2019	168	$7,843,245.02	$64,326,815.00	N	NH04L	100040581
10-12	8	2067	ACSTPAAF-0124(900)	LAUDERDALE	$20,874,772.00	565	W	92	100	4/7/2007	519	$1,794,112.35	$22,815,105.00	N	ACR24	100016522
10-12	8	9044	BRM-7543(11)	MOBILE	$19,475,315.00	542	C	149	100	9/11/2011	807	$1,524,354.75	$21,114,016.00	N	BRDF	100003872
10-12	8	9106	STPAA-7571(601)	MOBILE	$18,810,388.00	735	W	82	100	1/22/2022	602	$2,819,367.47	$23,885,256.00	N	STAAH	100009304
10-12	8	1072	APD-235(45), 1-565-5(69)	MADISON	$18,258,983.00	430	W	123	100	11/22/2022	528	$1,273,130.39	$22,921,860.00	Y	IREG	100011334
10-12	8	2060	BRF-0017(505)	MARION	$17,197,947.00	821	W	97	100	8/19/2019	796	$1,462,380.68	$18,991,448.00	N	BRONH	100003295
10-12	8	9043	BRM-7543(10)	MOBILE	$16,396,251.00	499	C	168	100	9/12/2012	838	$1,124,550.36	$16,844,778.00	N	BRDF	100003871
10-12	8	9075	NHF-7571(600)	MOBILE	$15,763,289.00	150	C	106	100	11/5/2005	159	$2,173,093.51	$20,073,035.00	Y	NH04	100004846
10-12	8	9100	NHF-0013(548)	MOBILE	$15,687,566.00	3009	D	100	100	1/20/2020	3009	$1,137,898.46	$15,631,852.00	N	NH04L	100050449
10-12	8	5095	NHF-I059(315)	TUSCALOOSA	$14,836,176.00	2905	D	182	100	8/11/2011	8087	$1,360,007.51	$16,793,697.00	N	NH98	100040948
10-12	8	1090	NHF-0157(504)	MORGAN	$14,446,291.00	260	W	115	100	11/9/2009	299	$1,233,351.35	$17,172,257.00	Y	ACR05	100004689
10-12	8	1025	IM-ACSTPAAF-0007(505)	DEKALB	$13,316,994.00	400	W	99	100	8/30/1930	396	$288,192.35	$14,574,649.00	Y	ACR24	100004832
10-12	8	6075	NHF-I065(344)	MONTGOMERY	$13,245,469.00	107	D	102	100	10/9/2009	2509	$2,472,263.43	$14,181,577.00	N	NH04L	100005031
10-12	8	8067	IM-I059(331)	SUMTER	$12,418,608.00	1907	D	103	100	3/19/2019	5564	$727,554.64	$11,427,368.00	N	IM04L	100044848
10-12	8	4078	MGF-0001(516)	RUSSELL	$12,060,217.00	706	C	118	100	2/8/2008	833	$1,944,633.09	$15,749,386.00	N	MGSPH	100004758
10-12	8	1151	IM-I059(340)	ETOWAH	$12,021,460.00	1509	D	115	100	12/20/2020	3235	$1,191,497.87	$12,299,693.00	N	IM04L	100033210
10-12	8	9087	ERF-STPAAF-8700(901)	MOBILE	$11,714,000.00	682		113	100	7/13/2013	770	$1,050,931.95	$12,011,119.00	Y	ERH05	100047715
10-12	8	3009	NHF-0079(509)	BLOUNT	$11,558,098.00	67	W	144	100	10/22/2022	96	$106,806.63	$1,437,826.00	N	NH04L	100050640
10-12	8	4066	ACSTPAA-0077(501)	TALLADEGA	$11,210,400.00	270	W	109	100	12/28/2028	294	$1,548,742.77	$11,579,608.00	N	STAAL	100009086
10-12	8	1019	NHF-0157(502)	CULLMAN	$11,184,581.00	770	C	149	100	7/2/2002	1147	$858,068.91	$11,953,645.00	N	NH04	100004687
10-12	8	8097	NHF-0008(534)	SUMTER	$11,116,766.00	250	W	100	100	1/14/2014	250	$946,625.06	$11,616,272.00	N	NH04L	100038631
10-12	8	5087	STPOA-9650(600)	TUSCALOOSA	$10,843,677.00	300	W	90	100	7/12/2012	270	$2,048,902.37	$11,451,932.00	N	STOAL	100042220
10-12	8	5120	ACNHF-0076(502)	TUSCALOOSA	$10,375,000.00	360	W	100	100	4/25/2025	360	$2,372,024.70	$11,651,237.00	N	NH04L	100004101
10-12	8	9091	ST-049-039-001	MOBILE	$10,262,107.00	305	W	5	100	9/1/2001	15	$1,107,452.72	$11,229,844.00	N	STATC	100009216
10-12	8	3099	IMD-IM-I065(326)	SHELBY	$10,144,886.00	553	C	107	100	10/6/2006	591	$1,098,835.12	$9,964,471.00	N	IMDIS	100042090
10-12	8	3106	BRF-6403(201)	WALKER	$10,120,792.00	345	W	99	100	2/23/2023	341	$968,751.79	$11,035,406.00	N	BRONH	100013153
08-10	8	04080	IM-NHF-I020(326)	TALLADEGA	$28,411,763.00	765	W	100	100	8/22/2009	765	$5,198,753.01	$30,349,417.00	Y	IM04	100033411
08-10	8	03186	IM-NHF-I020(317)	ST. CLAIR	$26,798,852.00	631	C	112	100	3/6/2008	706	$2,965,604.69	$27,296,176.00	N	IM04	100042216
08-10	8	03102	IM-NHF-I020(320)	ST CLAIR	$25,608,369.00	2306	D	103	100	1/23/2008	4475	$3,737,424.44	$23,636,204.00	Y	IM04	100042219
08-10	8	03202	IM-NHF-I020(320)	ST CLAIR	$25,608,369.00	2306	D	103	100	1/23/2008	4475	$3,877,075.66	$26,636,204.00	Y	IM04	100042219
08-10	8	09050	STPAAF-0113(500)	ESCAMBIA	$22,730,011.00	300	W	79	100	8/17/2010	237	$1,885,621.97	$26,642,573.00	N	STAAL	100046886
08-10	8	03191	APD-0471(510)& APD-0471(512)	WALKER	$22,342,232.00	704	W	100	100	10/9/2008	704	$1,253,380.08	$24,673,436.00	Y	APDX	100009936
08-10	8	05083	ACHPP-ACNHF-0080(007)	TUSCALOOSA	$20,397,707.00	500	W	99	100	9/21/2007	495	$33,742.35	$20,883,414.00	Y	ACNH	100032587
08-10	8	09044	BRM-7543(11)	MOBILE	$19,475,315.00	542	C	149	100	9/11/2009	807	$1,524,354.75	$21,114,016.00	N	BRDF	100003872
08-10	8	03023	NHF-IM-I065(308)	JEFFERSON	$18,933,219.00	500	C	100	100	3/7/2008	500	$1,652,477.81	$20,739,689.00	Y	IM98	100005069
08-10	8	05090	NHF-I059(307)	TUSCALOOSA	$18,115,535.00	445	C	100	100	6/6/2009	445	$1,576,129.52	$18,912,317.00	N	NH98	100040947
08-10	8	08014	ACHPP-HPP-MCAA-MGF-0488(008)	CHOC/MAREN	$18,086,182.00	430	W	133	100	4/30/2008	571	$2,146,077.03	$26,967,584.00	Y	AHPP	100016584
08-10	8	09061	IM-I065(345)	ESCAMBIA	$17,717,680.00	400	C	100	100	6/24/2009	400	$1,327,438.67	$20,203,634.00	N	IM04L	100044669
08-10	8	02060	BRF-0017(505)	MARION	$17,197,947.00	821	W	97	100	8/19/2010	796	$1,462,380.68	$18,991,448.00	N	BRONH	100003295
08-10	8	09043	BRM-7543(10)	MOBILE	$16,396,251.00	499	C	168	100	9/12/2009	838	$1,124,550.36	$16,844,778.00	N	BRDF	100003871
08-10	8	04113	ACNHF-102(501)	TALLADEGA	$15,999,993.00	1110	C	110	100	9/11/2008	1221	$2,416,887.23	$17,749,131.00	N	ACR05	100032193
08-10	8	03120	APD-471(47)	WALKER	$15,554,877.00	720	C	120	100	12/22/2007	864	$1,727,707.00	$17,746,331.00	Y	ACAP	100009939
08-10	8	03138	IM-NHF-I059(214)	JEFFERSON	$15,470,482.00	0		100	100	3/5/2008	0	$954,193.43	$14,472,309.00	Y	IMNT	100033205
08-10	8	03070	APD-0471(504)	JEFFERSON	$14,701,423.00	623	W	81	100	4/1/2008	504	$866,591.60	$13,669,494.00	N	CX54L	100009940
08-10	8	02079	APD-471(74)*DELTA CONST., IN	2ND & 3RD	$14,111,591.00	540	W	111	100	3/16/2009	599	$1,738,240.82	$14,481,641.00	N	APD8	100033460
08-10	8	03051	APD-0471(530)	WALKER	$13,415,809.00	107	D	101	100	5/6/2008	708	$872,495.98	$15,275,672.00	Y	APD8L	100047361

08-10	8	06075	NHF-I065(344)	MONTGOMERY	$13,245,469.00	107	D	102	100	10/9/2009	2509	$2,472,263.43	$14,181,577.00	N	NH04L	100005031
08-10	8	03012	APD-471(46)	WALKER	$13,159,775.00	830	C	96	100	10/9/2008	796	$1,746,574.02	$14,419,833.00	N	APD54	100009937
08-10	8	02069	APD-471(521)	MARION/WAL	$13,151,954.00	360	W	100	100	12/17/2008	360	$628,026.96	$13,222,346.00	N	APD8	100009949
08-10	8	03045	ACIM-IM-I059(327)	JEFFERSON	$12,980,887.00	0		102	100	1/25/2008	0	$253,790.18	$14,638,794.00	Y	ACR01	100044699
08-10	8	08067	IM-I059(331)	SUMTER	$12,418,608.00	1907	D	103	100	3/19/2010	5564	$727,554.64	$11,427,368.00	N	IM04L	100044848
08-10	8	02050	ACBRF-0101(560)	LAUDERDALE	$12,353,523.00	675	W	90	100	9/10/2008	607	$100.40	$12,405,410.00	Y	ACR10	100002446
08-10	8	05100	ACNHF-I059(314)	5H DIV. CO	$11,658,047.00	483	C	104	100	3/6/2008	502	$1,656,521.08	$12,342,157.00	N	ACR05	100039195
08-10	8	01177	NHF-286(21)	MADISON	$11,651,499.00	981	C	130	100	11/1/2008	1275	$1,308,067.20	$11,791,386.00	Y	NHSP	100008282
08-10	8	03009	NHF-0079(509)	BLOUNT	$11,558,098.00	67	W	144	100	10/22/2009	96	$106,806.63	$1,437,826.00	N	NH04L	100050640
08-10	8	04151	NHF-0001(512)	RUSSELL	$10,960,478.00	512	C	128	100	11/30/2007	655	$839,919.93	$10,507,017.00	N	NH04	100004760
08-10	8	01014	IM-I065(315)	CULLMAN	$10,251,555.00	106	D	128	100	1/23/2008	3735	$1,010,421.95	$12,470,979.00	N	IM04	100040284
08-10	8	09004	BRF-0042(502)	BALDWIN	$10,233,889.00	943	C	111	100	10/9/2008	1046	$1,112,726.83	$10,680,628.00	N	ONBR	100003526
05-08	8	6066	BR-201(11)	MACON	$55,601,668.00	276	W	109	100	4/4/2006	300	$566,336.83	$5,810,820.00	N	ONBR	100002787
05-08	8	3186	IM-NHF-I020(317)	ST. CLAIR	$26,798,852.00	631	C	112	100	3/6/2008	706	$2,965,604.69	$27,296,176.00	N	IM04	100042216
05-08	8	3202	IM-NHF-I020(320)	ST CLAIR	$25,608,369.00	2306	D	103	100	1/23/2008	4475	$3,877,075.66	$26,636,204.00	Y	IM04	100042219
05-08	8	2037	ACHPP-124(006)&(007)	LAUDERDALE	$20,486,034.00	464	W	98	100	9/1/2006	454	$29,057.99	$21,024,375.00	Y	ONBR	100016578
05-08	8	5083	ACHPP-ACNHF-0080(007)	TUSCALOOSA	$20,397,707.00	500	W	99	100	9/21/2007	495	$33,742.35	$20,883,414.00	Y	ACNH	100032587
05-08	8	3094	APD-471(14)	WALKER	$19,415,331.00	420	W	100	100	6/10/2006	420	$2,588,764.84	$25,103,996.00	N	APD8	100009925
05-08	8	3023	NHF-IM-I065(308)	JEFFERSON	$18,933,219.00	500	C	100	100	3/7/2008	500	$1,652,477.81	$20,739,689.00	Y	IM98	100005069
05-08	8	3113	ACI-I065(329)	JEFFERSON	$18,877,933.00	365	C	88	100	7/26/2005	321	$1,807,758.54	$21,210,559.00	N	IREG	100010811
05-08	8	3093	APD-471(39)	WALKER	$17,017,062.00	360	W	100	100	6/16/2005	360	$528.69	$18,168,366.00	N	APD8	100009927
05-08	8	2067	APD-471(33)	2ND & 3RD	$16,510,553.00	450	W	102	100	12/15/2005	459	$3,035.53	$24,514,989.00	N	APD8	100009950
05-08	8	3120	APD-471(47)	WALKER	$15,554,877.00	720	C	120	100	12/22/2007	864	$1,727,707.00	$17,746,331.00	Y	ACAP	100009939
05-08	8	3138	IM-NHF-I059(214)	JEFFERSON	$15,470,482.00	0		100	100	3/5/2008	0	$954,193.43	$14,472,309.00	Y	IMNT	100033205
05-08	8	3070	APD-0471(504)	JEFFERSON	$14,701,423.00	623	W	81	100	4/1/2008	504	$866,591.60	$13,669,494.00	N	CX54L	100009940
05-08	8	3160	APD-471(513)	WALKER	$13,866,304.00	550	C	100	100	3/1/2007	550	$618,148.33	$15,088,201.00	N	APD8	100038102
05-08	8	3056	APD-471(54)	JEFFERSON	$13,858,327.00	421	W	100	100	8/26/2005	421	$1,851,409.09	$15,377,287.00	N	APD9	100009942
05-08	8	3182	APD-471(506)	WALKER	$13,169,204.00	700	C	84	100	6/28/2006	588	$570,205.68	$13,259,346.00	N	CX54J	100009918
05-08	8	3045	ACIM-IM-I059(327)	JEFFERSON	$12,980,887.00	0		102	100	1/25/2008	0	$253,790.18	$14,638,794.00	Y	ACR01	100044699
05-08	8	3022	APD-471(77)	JEFFERSON	$12,466,740.00	447	W	100	100	7/7/2006	447	$1,208,652.20	$16,037,072.00	N	APD9	100009921
05-08	8	3127	APD-471(518)	JEFFERSON	$11,834,696.00	800	C	89	100	10/7/2005	712	$680,513.85	$11,886,404.00	N	APD8	100042406
05-08	8	5100	ACNHF-I059(314)	5H DIV. CO	$11,658,047.00	483	C	104	100	3/6/2008	502	$1,656,521.08	$12,342,157.00	N	ACR05	100039195
05-08	8	3139	IM-I020(322)	ST. CLAIR	$11,529,338.00	104	D	497	100	4/3/2007	8416	$1,426,003.66	$11,339,726.00	N	IM98	100038971
05-08	8	2014	MGF-0124(008)	COLBERT	$11,225,975.00	361	W	92	100	4/7/2007	332	$1,437,018.57	$11,187,969.00	N	MGSP	100016520
05-08	8	4151	NHF-0001(512)	RUSSELL	$10,960,478.00	512	C	128	100	11/30/2007	655	$839,919.93	$10,507,017.00	N	NH04	100004760
05-08	8	9087	ACIM-IM-I010(327)	MOBILE	$10,730,938.00	320	W	95	100	6/10/2006	304	$410,860.10	$10,723,841.00	N	IM98	100004942
05-08	8	4001	HPP-0192(2)	CALHOUN	$10,529,621.00	375	W	99	100	3/1/2007	371	$1,769,702.62	$11,486,078.00	N	HPPP	100016531
05-08	8	4051	IM-85-1(131)	LEE	$10,427,610.00	507	C	107	100	6/1/2005	542	$1,374,537.51	$11,257,316.00	N	IM98	100005091
05-08	8	1014	IM-I065(315)	CULLMAN	$10,251,555.00	106	D	128	100	1/23/2008	3735	$1,010,421.95	$12,470,979.00	N	IM04	100040284
04-05	8	2037	ACHPP-124(006)&(007)	LAUDERDALE	$20,486,034.00	464	W	98	100	8/23/2004	454	$29,057.99				
04-05	8	3094	APD-471(14)	WALKER	$19,415,331.00	420	W	100	100	4/2/2004	420	$2,588,764.84				
04-05	8	3113	ACI-I065(329)	JEFFERSON	$18,877,933.00	365	C	88	100	2/20/2004	321	$1,807,758.54				
04-05	8	3182	APD-471(506)	WALKER	$13,169,204.00	700	C	84	100	9/1/2005	588	$570,205.68				
04-05	8	3022	APD-471(77)	JEFFERSON	$12,466,740.00	447	W	100	100	8/31/2004	447	$1,208,652.20				
04-05	8	3127	APD-471(518)	JEFFERSON	$11,834,696.00	800	C	89	100	4/29/2005	712	$680,513.85				
04-05	8	9087	ACIM-IM-I010(327)	MOBILE	$10,730,938.00	320	W	95	100	4/29/2005	304	$410,860.10				
03-05	8	2037	ACHPP-124(006)&(007)	LAUDERDALE	$20,486,034.00	464	W	98	100	8/23/2004	454	$29,057.99				
03-05	8	3022	APD-471(77)	JEFFERSON	$12,466,740.00	447	W	100	100	8/31/2004	447	$1,208,652.20				
03-05	8	3037	APD-471(57)	JEFFERSON	$12,924,031.00	408	W	96	100	8/27/2003	391	$1,346,599.32				
03-05	8	3039	APD-471(36)	JEFFERSON	$24,440,147.00	400	W	100	100	11/18/2003	400	$1,980,667.79				
03-05	8	3046	APD-471(58)	JEFFERSON	$16,959,487.00	452	W	100	100	11/26/2003	452	$2,024,967.75				
03-05	8	3056	APD-471(54)	JEFFERSON	$13,858,327.00	421	W	100	100	4/18/2003	421	$1,851,409.09				
03-05	8	3093	APD-471(39)	WALKER	$17,017,062.00	360	W	100	100	5/13/2003	360	$528.69				
03-05	8	3094	APD-471(14)	WALKER	$19,415,331.00	420	W	100	100	4/2/2004	420	$2,588,764.84				
03-05	8	4101	NHF-422(29)	RUSSELL	$12,846,920.00	350	W	115	100	11/12/2003	402	$1,578,999.85				
03-05	8	5098	HPP-ACHPP-0080(006)	TUSCALOOSA	$12,997,911.00	275	W	99	100	6/11/2003	272	$893,326.01				
03-05	8	6066	BR-201(11)	MACON	$55,601,668.00	276	W	109	100	8/1/2003	300	$566,336.83				
03-05	8	9087	ACIM-IM-I010(327)	MOBILE	$10,730,938.00	320	W	95	100	4/29/2005	304	$410,860.10				
03-05	8	9094	IM-MGF-65-1(252)	MOBILE	$24,759,806.00	400	W	100	100	9/11/2003	400	$3,889,615.74				

APPENDIX D

CLEAN ALDOT PROJECT DATABASE (120 PROJECTS)

FA Project	County	Project Region	Original Contract Time	Contract Type	Original No. of Days	Time Extensions Granted (Days)	Total Allowed Time (Days)	Total Days Used	Status (Early/Late)	No. of Days (Early/Late)	Project Length (miles)
ACHPP-124 (006)&(007)	LAUDERDALE	N	300	W	300	168	468	455	Early	13	0.481
APD-DE-471(39)	WALKER	WC	360	W	360	20	380	376	Early	4	5.555
APD-471 (74)	MARION (2ND & 3RD)	WC	500	W	500	5	505	531	Late	-26	0.168
ACHPP-HPP-MCAA-MGF-0488(008)	CHOC/MAREN	SW	400	W	400	226	626	572	Early	54	1.401
ACHPP-ACNHF-0088(007)	TUSCALOOSA	WC	500	W	500	0	500	496	Early	4	0.977
MGF-393 (8)	FRANKLIN	N	400	W	400	328	728	928	Late	-200	7.084
BRF-310(17)	MORGAN (1ST.DIV.)	N	450	W	450	57	507	597	Late	-90	0.985
NHF-IM-1065(308)	JEFFERSON	EC	8/1/2003	D	502	54	556	558	Late	-2	9.112
NHF-I059(307)	TUSCALOOSA	WC	445	C	445	0	445	449	Late	-4	5.33
APD-471(45)	WALKER	WC	425	W	425	7	432	466	Late	-34	3.025
APD-471(47)	WALKER	WC	720	C	720	212	932	982	Late	-50	4.287
APD-471(46)	WALKER	WC	750	C	750	218	968	928	Early	40	3.302
ACNHF-I059(314)	TUSCALOOSA (5TH)	WC	7/1/2003	D	306	184	490	516	Late	-26	4.183
ACNHF-102(501)	TALLADEGA	EC	12/1/2004	D	857	336	1193	1012	Early	181	7.809
ACBRF-0101(560)	LAUDERDALE	N	550	W	550	125	675	607	Early	68	1.461
APD-471(518)	JEFFERSON	EC	800	C	800	0	800	717	Early	83	0.27
ACI-I065(329)	JEFFERSON	EC	11/24/2003	D	365	0	365	320	Early	45	1.517
ACIM-IM-I010(327)	MOBILE	SW	320	W	320	0	320	304	Early	16	1.382
IM-NHF-I059(214)	JEFFERSON	EC	388	C	388	7	395	427	Late	-32	5.056
APD-471(513)	WALKER	WC	550	C	550	0	550	593	Late	-43	0.406
APD-471(521)	MARION/WAL	WC	360	W	360	24	384	366	Early	18	5.669
NHF-I059(315)	TUSCALOOSA	WC	7/1/2004	D	401	391	792	703	Early	89	5.13
IM-1020(322)	ST. CLAIR	EC	7/1/2004	D	393	82	475	469	Early	6	6.314
MG-8570(600)	MADISON	N	1/1/2005	D	509	139	648	648	On Time	0	4.093
NHF-286(21)	MADISON	N	750	C	750	231	981	981	On Time	0	1.501
APD-471(506)	WALKER	WC	700	C	700	0	700	600	Early	100	0.234
IM-1020(317)	ST. CLAIR	EC	570	C	570	68	638	638	On Time	0	4.871
NHF-0157(502)	CULLMAN	N	500	C	500	270	770	746	Early	24	7.084
BRF-0042(502)	BALDWIN	SW	780	C	780	179	959	1060	Late	-101	1.021
STPOA-0015(507) & IM-I085(318)	LEE	SE	9/1/2005	D	478	59	537	616	Late	-79	1.712
IM-NHF-I020(320)	ST CLAIR	EC	7/15/2006	D	720	35	755	747	Early	8	4.267
NHF-0001(512)	RUSSELL	SE	400	C	400	112	512	512	On Time	0	4.658
NHF-0056(500) BRF-0102(527)	MONTGOMERY	SE	8/1/2006	D	674	190	864	925	Late	-61	1.763
NHF-7571(600)	MOBILE	SW	750	C	750	175	925	798	Early	127	2.64
APD-0471(504)	JEFFERSON	EC	623	W	623	0	623	623	On Time	0	4.421
MGF-0001(516)	RUSSELL	SE	600	C	600	106	706	834	Late	-128	7.48
STPAA-7571(601)	MOBILE	SW	735	W	735	216	951	772	Early	179	5.703
IMD-IM-I065(326)	SHELBY	EC	510	C	510	43	553	590	Late	-37	1.073
APD-0471(508),APD-0471(509)	WALKER	WC	730	W	730	60	790	782	Early	8	7.074
IM-NHF-I020(326)	TALLADEGA	EC	765	W	765	0	765	825	Late	-60	5.378
APD-0471(510)& APD-0471(512)	WALKER	WC	704	W	704	0	704	645	Early	59	7.588
BRF-0017(505)	MARION	WC	821	W	821	0	821	808	Early	13	2.275
APD-471(522)	JEFFERSON	EC	1095	C	1095	141	1236	1216	Early	20	2.512
IM-1065(315)	CULLMAN	N	365	W	365	110	480	480	On Time	0	13.035
BRF-6403(201)	WALKER	WC	345	W	345	0	345	342	Early	3	0.567
IM-ACSTPAAF-0007(505)	DEKALB	N	400	W	400	0	400	397	Early	3	1.516
ACIM-IM-I059(327)	JEFFERSON	EC	332	C	332	0	332	337	Late	-5	7.895
NHF-0157(504)	MORGAN	N	260	W	260	46	306	305	Early	1	12.759
ACSTPAAF-0124(900)	LAUDERDALE	N	550	W	550	55	605	504	Early	101	1.269
ACSTPAAF-NCPD-0192(006)	CALHOUN	EC	385	W	385	106	491	469	Early	22	2.756
NHF-I065(344)	MONTGOMERY	SE	12/1/2007	D	613	43	656	624	Early	32	0.576
NHF-0001(520)	RUSSELL	SE	300	W	300	119	419	453	Late	-34	4.8
IM-1065(345)	ESCAMBIA	SW	400	C	400	125	525	400	Early	125	12.086
APD-0471(530)	WALKER	WC	6/1/2007	D	338	21	359	342	Early	17	10.587
ACSTPAA-0275(500)	TALLADEGA	EC	300	W	300	0	300	211	Early	89	6.406
NHF-0008(530),BRF-0008(536)	SUMTER	WC	500	C	500	0	500	495	Early	5	5.629
ACNHF-0076(502)	TUSCALOOSA	WC	315	W	315	74	389	382	Early	7	2.129
NHF-0042(501)	MOBILE	SW	400	W	400	511	911	819	Early	92	7.965
ACSTPAA-0077(501)	TALLADEGA	EC	270	W	270	10	280	280	On Time	0	3.977
NHF-I059(317)	TUSCALOOSA	WC	7/15/2009	D	789	0	789	791	Late	-2	5.814
NHF-0008(534)	SUMTER	WC	250	W	250	0	250	250	On Time	0	5.057
IM-1059(331)	SUMTER	WC	12/15/2007	D	207	0	207	215	Late	-8	17.877
IM-NHF-I065(375)	MONTGOMERY	SE	10/15/2009	D	846	0	846	851	Late	-5	4.613
STPAAF-0113(500)	ESCAMBIA	SW	300	W	300	0	300	236	Early	64	13.473
BRF-0035(502)	JACKSON	N	325	W	325	60	385	362	Early	23	0.277
IM-1059(340)	ETOWAH	N	11/1/2008	D	416	75	491	490	Early	1	7.268
ACAPD-IM-NHF-BRF-I065(303)	JEFFERSON	EC	10/15/2010	D	1104	0	1104	1094	Early	10	2.22
IM-ACNHF-I020(332)	TALLADEGA	EC	11/20/2009	D	739	70	809	755	Early	54	3.655
ST-049-039-001	MOBILE	SW	300	W	300	30	330	315	Early	15	1.715
NHF-0286(022)	MADISON	N	340	W	340	0	340	335	Early	5	1.144
EBF-BRF-0006(516)	TUSCALOOSA	WC	450	W	450	144	594	560	Early	34	2.821
ERF-STPAAF-8700(901)	MOBILE	SW	8/14/2009	D	550	121	671	744	Late	-73	10.661
STPOA-0025(514)	ETOWAH	N	385	W	385	0	385	365	Early	20	7.751
NHF-0013(548)	MOBILE	SW	9/30/2009	D	540	0	540	540	On Time	0	0.697
STPOAF-1602(521)	DEKALB	N	465	W	465	0	465	393	Early	72	1.452
APD-0471(503)	JEFFERSON	EC	300	W	300	19	319	339	Late	-20	1.321
IM-ACNHF-I065(353)	SHELBY	EC	7/1/2011	D	990	126	1116	1046	Early	70	5.451
STPOA-9650(600)	TUSCALOOSA	WC	300	W	300	0	300	269	Early	31	2.272
STMAAF-I059(342)	ETOWAH	N	6/15/2011	D	748	607	1355	1355	On Time	0	10.91
ACSTPAA-0181(500)	BALDWIN	SW	370	W	370	75	445	429	Early	16	4.071
STMAAF-0001(537)	MADISON	N	550	W	550	0	550	527	Early	23	1.557
STMAAF-I020(324)	ST. CLAIR	EC	1-Oct-12	D	1088	470	1558	1558	On Time	0	8.061
STMOAF-0192(901)	CALHOUN	EC	390	W	390	90	480	644	Late	-164	2.821
STMAAF-0009(509)	MONTGOMERY	SE	325	W	325	109	434	460	Late	-26	4.763
STPOAF-0013(544)	FRANKLIN	N	520	W	500	55	555	535	Early	20	0.482
STPAA-8570(601)	MADISON	N	360	W	360	0	360	359	Early	1	1.61
STPOA-0275(502)	TALLADEGA	EC	300	W	300	15	315	300	Early	15	6.437
HPP-IM-STPOA-I085(311)	LEE	SE	7/1/2012	D	648	162	810	810	On Time	0	1.604
IM-STPAAF-BRF-I020(333)	TALLADEGA	EC	1-Jun-13	D	934	250	1184	1172	Early	12	4.478
EOAPF-HWYPF-BRF-0008(529)	SUMTER	WC	475	W	475	53	528	506	Early	22	5.426
STPAAF-EOAPF-BRF-I010(301)	MOBILE	SW	1-Aug-13	D	897	135	1032	1018	Early	14	3.831
EB-0053(509)	MADISON	N	330	W	330	0	330	328	Early	2	4.602
ACAPD-NHF-0355(503)	FRANKLIN	N	325	W	325	72	397	416	Late	-19	5.84
IM-NHF-I065(393)	JEFFERSON	EC	12/16/2011	D	281	16	297	297	On Time	0	2.341
NHF-HPP-0012(517)	COFFEE	SE	300	W	300	237	537	537	On Time	0	4.122
APD-0355(506)	FRANKLIN	N	340	W	340	42	382	378	Early	4	7.859
HPP-0035(510)	MONTGOMERY	SE	1-Dec-14	D	1167	0	1167	1163	Early	4	3.418
ACSTPAA-1702(904)	BALDWIN	SW	22-Jun-14	D	978	329	1307	1092	Early	215	6.734
IM-NHF-I020(340)	CLEBURNE	EC	1-Sep-13	D	637	60	697	695	Early	2	1.859
IM-1059(323)	DEKALB	N	1-Aug-13	D	592	987	1579	1579	On Time	0	19.163
IM-NHF-I020(327)	CALHOUN	EC	1-Sep-13	D	640	62	702	722	Late	-20	7.983
IM-1065(414)	CONECUH	SW	1-Aug-13	D	603	23	626	639	Late	-13	12.304
IM-1059(336)	DEKALB	N	11/15/2013	D	505	261	766	749	Early	17	23.319
IM-I010(324)	BALDWIN	SW	15-Oct-13	D	460	30	490	472	Early	18	8.941
NHF-0067(501)	MORGAN	N	195	W	195	0	195	195	On Time	0	2.778
STPOAF-8829(600)	COLBERT	N	320	W	320	30	350	347	Early	3	1.903
NHF-0012(544)	COFFEE	SE	350	W	350	0	350	349	Early	1	5.582
STPOA-0025(518)	ETOWAH	N	375	W	375	96	471	555	Late	-84	14.471
IM-IMD-I020(325)	JEFFERSON	EC	11/22/2013	D	438	0	438	449	Late	-11	9.813
NHF-0013(545)/EBF-STPAAF-0013(545)	FRANKLIN	N	400	W	400	0	400	401	Late	-1	0.311
IM-NHF-I020(339)	CLEBURNE	EC	1-May-15	D	752	0	752	744	Early	8	4.29
IM-1065(412)	CONECUH	SW	1-Sep-15	D	553	30	583	606	Late	-23	10.268
IM-1085(334)	MACON	SE	1-Jun-14	D	492	31	523	523	On Time	0	14.736
IM-I010(319)	BALDWIN	SW	16-Oct-14	D	588	0	588	784	Late	-196	1.084
IM-1459(308)	JEFFERSON	EC	29-Aug-14	D	352	16	368	373	Late	-5	5.404
BR-0182(502)	BALDWIN	SW	235	W	235	105	340	338	Early	2	0.378
IM-IMD-I010(328)	MOBILE	SW	22-Jul-15	D	518	148	666	669	Late	-3	8.676
IM-1059(365)	JEFFERSON	EC	1-Aug-15	D	486	0	486	257	Early	229	4.143
APD-IM-0004(521)	WALKER	WC	7-Nov-14	D	206	0	206	190	Early	16	7.875
BR-1065(440)	BALDWIN	SW	250	W	250	65	315	293	Early	22	6.079

Project Type	2-Earthwork ($)	3-Bases ($)	4-Surfacing & Pavements ($)	5-Structures ($)	6-Incidentals ($)	7-Traffic Control Devices/Highway Lighting ($)	9-Training/Lump Sum ($)
Bridges	$258,052	$0	$0	$18,058,244	$2,168,538	$0	$1,200
Grade, Drain, Pave, Signing, Bridges, and Bridge Culverts	$3,231,751	$1,430,507	$3,774,721	$5,384,107	$2,642,332	$548,844	$4,800
Bridges (Dual)	$349,500	$0	$0	$12,236,035	$1,487,846	$3,410	$34,800
Bridge and Approaches (Grade, Drain, Pave, and Traffic Stripe)	$852,884	$52,626	$210,453	$14,691,636	$2,161,539	$82,244	$34,800
Grade, Drain, Pave, Traffic Stripe, Signing, Signals, and Bridge	$2,005,681	$364,435	$768,199	$14,086,092	$2,805,575	$362,925	$4,800
Grade, Drain and Partial Base/Pave and Bridge Culvert	$7,916,483	$77,036	$204,746	$3,182,467	$3,748,149	$54,825	$4,800
Bridge Replacement and Approaches	$2,852,435	$89,646	$384,010	$15,323,223	$2,516,474	$230,528	$4,800
Additional Lanes and Bridge Widening	$1,428,058	$1,303,997	$7,504,025	$4,506,400	$3,285,987	$901,152	$3,600
Additional Lanes Including Bridge Widening and Raising and Vehicular Counting Detectors	$0	$0	$0	$0	$0	$0	$18,115,535
Grade, Drainage, Partial Pavement, Bridge and Bridge Culvert	$11,480,148	$205,409	$332,460	$5,463,554	$3,609,738	$63,038	$4,800
Grade, Drain, Partial Base and Pave, Signing and Bridges	$8,385,079	$253,727	$272,219	$3,414,455	$3,119,002	$105,595	$4,800
Grade, Drainage, Bridges and Bridge Culvert	$7,493,347	$177,235	$93,964	$2,502,209	$2,710,251	$176,769	$6,000
Additional Lanes (Grade, Drainage, Pavement and Signing)	$2,423,191	$1,384,585	$4,595,488	$398,701	$2,160,195	$692,286	$3,600
Additional Lanes (Including Grade, Drainage, Pavement, Bridge, Bridge Culvert, UST Removal and Signing)	$3,458,764	$2,141,202	$2,855,829	$2,145,742	$4,970,149	$424,308	$4,000
Bridge Replacement and Approaches	$1,696,955	$358,697	$1,996,412	$5,653,228	$2,144,129	$500,502	$3,600
Bridges (Dual)	$362,250	$0	$0	$10,703,309	$755,342	$8,995	$4,800
Interchange Improvements (Including Bridges)	$3,209,283	$0	$3,046,366	$4,790,462	$3,869,866	$3,957,158	$4,800
Interchange Improvement including dual Bridges (i-10)	$1,892,402	$882,858	$2,353,194	$2,718,298	$2,030,675	$849,510	$4,000
Additional Lanes including Lighting and Traffic Counting Units	$2,979,407	$1,682,079	$5,683,385	$341,535	$3,564,418	$1,216,059	$3,600
Bridges (7)	$1,060,634	$0	$0	$10,808,478	$1,979,960	$12,432	$4,800
Grade and Drain (Partial), Pavement, Traffic Stripe and Signing	$1,060,122	$2,321,871	$7,617,161	$0	$1,796,040	$351,960	$4,800
Additional Lanes and Bridge Widening	$2,214,483	$1,854,807	$6,835,093	$460,226	$2,564,264	$902,504	$4,800
Grade, Drainage, Pavement, and Concrete Barrier (Additional Lanes)	$643,428	$1,371,657	$4,786,830	$325,546	$3,447,647	$950,631	$3,600
GRADE, DRAINAGE, PAVEMENT, SIGNALS & LANDSCAPING	$1,991,518	$1,225,781	$2,808,965	$1,592,983	$2,265,884	$421,414	$4,000
Grade, Drainage, Pavement, Signing and Signals	$1,660,665	$395,799	$1,581,794	$2,277,268	$4,948,357	$785,215	$2,400
Bridges-Dual (Partial Grade & Drain)	$51,383	$0	$0	$11,818,110	$1,288,404	$5,308	$6,000
Additional Lane including Bridge, Bridge Raising and Signalization	$2,163,211	$1,902,010	$11,123,987	$3,985,691	$5,982,680	$1,636,473	$4,800
Base and Pavement, Partial Grade and Drain	$1,218,649	$1,383,818	$5,861,984	$10,629	$2,265,186	$440,715	$3,600
Bridge Replacement and Approaches	$1,110,158	$110,500	$416,469	$6,711,203	$1,680,328	$201,631	$3,600
Grade, Drain, Pave, Bridges, Signals, & Lighting (Roadway Improvements)	$2,281,283	$1,166,002	$3,120,352	$4,144,496	$3,416,805	$1,294,688	$4,200
Additional Lanes (Including Bridges)	$2,314,766	$1,587,022	$10,024,014	$2,844,140	$7,138,097	$1,695,531	$4,800
Additional Lanes & Relocation (Grade, Drainage and Bridges)	$3,448,003	$0	$389,306	$4,181,675	$2,915,081	$19,214	$7,200
ADDITIONAL LANES (INCLUDING BRIDGES, SIGNALS & LIGHTING)	$2,897,174	$382,872	$2,683,772	$3,182,899	$7,235,805	$1,582,191	$5,400
Additional Lanes (Grade, Drainage, Pavement, Bridges and Signals)	$4,361,756	$881,063	$2,561,869	$4,598,768	$2,751,115	$606,318	$2,400
Base amd Pavement	$1,391,448	$3,903,259	$7,757,973	$0	$1,581,889	$62,054	$4,800
Additional Lanes (Grade, Drainage and Bridge Culverts)	$4,474,644	$0	$1,034,100	$3,224,471	$3,292,299	$32,303	$2,400
Grade, Drainage, Pavement, Signals and Signing)	$4,041,105	$1,771,637	$3,424,049	$2,848,434	$6,346,139	$376,624	$2,400
Interchange Modifications (Grade, Drainage, Pavement, Lighting, Signing and Signals)	$1,521,621	$455,501	$3,099,887	$294,366	$2,237,753	$2,533,959	$1,800
Pavement	$1,237,281	$5,980,695	$13,382,776	$0	$3,945,976	$60,908	$3,600
Additional Lanes	$3,275,860	$1,985,832	$12,151,940	$944,995	$8,379,608	$1,669,928	$3,600
Base and Pavement	$1,242,898	$5,258,904	$12,998,458	$0	$2,745,131	$92,642	$4,200
Bridge Replacement and Approaches	$2,875,191	$499,422	$1,522,913	$8,207,862	$3,866,108	$222,851	$3,600
Grade, Drain, Partial Base & Pave and Bridge	$16,850,776	$14,571	$1,032,224	$9,555,962	$6,357,154	$56,785	$3,600
Pavement Rehabilitation (Concrete), Resurfacing, and Traffic Stripe	$143,798	$0	$9,343,279	$21,250	$367,800	$374,228	$1,200
Bridge Replacement and Approaches	$744,112	$29,964	$232,102	$7,547,676	$1,515,960	$49,178	$1,800
Additional Lanes (Including Bridge and Bridge Culvert)	$1,779,371	$380,820	$2,271,937	$3,378,679	$4,796,717	$707,071	$2,400
Pavement Rehabilitation (Concrete)	$4,141,728	$0	$4,604,652	$0	$3,823,323	$409,985	$1,200
ADDITIONAL LANES (BASE, PAVE, PARTIAL GRADE & DRAIN)	$1,325,532	$2,414,523	$6,281,495	$914,849	$3,077,724	$429,768	$2,400
GRADE, DRAIN, PAVEMENT, BRIDGES, SIGNALS & LIGHTING	$3,375,118	$1,509,476	$2,928,175	$7,282,362	$3,682,619	$2,093,421	$3,600
Grade and Drainage	$11,742,804	$37,845	$503,505	$3,739,682	$6,601,144	$25,003	$1,575,600
Bridge Widening and Approaches	$456,241	$29,713	$68,127	$9,910,041	$1,890,255	$748,692	$142,400
Base, Pave and Partial Grade and Drain	$1,401,874	$3,021,456	$4,709,532	$32,447	$1,072,480	$207,320	$1,800
Other- Drainage Extensions, Planing, Resurfacing, Traffic Stripe and Guardrail	$261,400	$7,189	$14,032,638	$129,228	$2,768,540	$504,985	$13,700
Pavement (Ultimate), Traffic Stripe, Signing and Lighting	$19,368	$0	$9,776,283	$0	$927,099	$2,691,859	$1,200
Grade, Drainage, Partial Base and Pave and Bridge	$6,185,130	$211,036	$1,532,900	$4,468,359	$6,438,793	$130,822	$898,600
Additional Lanes (Grade, Drainage, Pavement, Bridges and UST Removal)	$4,744,581	$1,049,278	$7,301,948	$12,415,008	$5,728,902	$520,514	$2,004,800
Additional Lanes (Grade, Drainage, Pavement, Signing and Signals)	$1,383,975	$1,359,526	$3,201,431	$1,324,901	$2,280,748	$511,618	$312,800
Grade, Drainage, Bridges and Bridge Culverts on the Relocation	$7,404,023	$0	$336,000	$8,317,303	$3,976,455	$65,035	$1,002,232
Grade, Drainage and Pavement (Relocation)	$3,284,001	$839,462	$2,526,937	$924,687	$2,907,140	$133,602	$594,572
Additional Lanes (Grade, Drainage, Pavement and Concrete Barrier Rail)	$1,617,538	$3,106,513	$11,954,197	$733,413	$5,941,403	$1,063,883	$1,204,000
Additional Lanes (WBR) (Partial Grade and Drain, Pavement, Signal and Signing)	$1,417,537	$1,103,604	$5,305,626	$136,085	$2,127,527	$592,588	$433,800
PLANING, RESURFACING, TRAFFIC STRIPE & SAFETY IMPROVEMENTS	$1,003,159	$262,900	$9,104,672	$0	$768,312	$878,366	$401,200
Additional Lanes (Grade, Drainage, Pavement, Concrete Pavement Rubblization, Bridge Widening, Lighting, Signing and Signals)	$9,967,771	$591,600	$23,983,384	$13,358,399	$17,534,463	$11,551,334	$2,603,712
Additional Lanes, (Grade, Drainage, Pavement and Bridges)	$2,958,033	$4,245,311	$8,662,646	$1,819,429	$3,798,827	$1,095,965	$149,800
Bridge Replacement (Partial, Phase I	$292,514	$0	$0	$10,147,674	$1,320,359	$27,386	$2,400
Pavement Rehabilitation (Concrete)	$462,020	$3,508,375	$5,432,915	$6,500	$2,011,034	$599,914	$704
ADDITIONAL LANES (GRADE, DRAINAGE, PAVEMENT AND BRIDGES)	$8,227,686	$2,654,279	$9,018,347	$34,606,900	$10,309,102	$7,818,371	$404,480
Additional Lanes (Grade, Drainage, Pavement and Bridges)	$2,575,890	$1,563,035	$9,088,176	$7,909,131	$6,288,616	$1,729,303	$3,600
Grade, Drainage, Pavement, Signal and Bridges (Relocation)	$1,517,434	$805,676	$1,472,885	$4,621,995	$1,446,306	$397,811	$0
Additional Lanes (Grade, Drainage, Pavement, Bridges, Lighting and Signing)	$993,731	$228,507	$1,454,744	$10,093,997	$2,593,638	$866,155	$1,800
Additional Lanes (Pavement, Partial Grade and Drain and Bridges	$1,172,885	$2,683,798	$4,112,635	$3,660,693	$2,156,891	$291,896	$2,656
Other- Fog Warning System Repair	$0	$0	$0	$0	$1,194,960	$10,446,555	$72,485
Grade, Drainage and Partial Base and Pave (Relocation)	$6,519,373	$244,563	$1,510,667	$3,446,155	$4,732,670	$215,497	$2,400
Interchange (Grade, Drainage, Pavement, Lighting, Signing and Bridges)	$3,083,224	$545,160	$1,743,439	$3,768,499	$4,754,447	$1,790,973	$1,824
Interchange (Grade, Drainage, Pavement and Bridges)	$6,484,498	$805,854	$3,177,521	$5,282,486	$3,054,047	$772,010	$2,400
Grade, Drainage and Partial Base and Pave	$7,561,574	$0	$131,152	$832,699	$3,942,198	$49,495	$1,800
Additional Lanes (Grade, Drainage, Pavement, Bridge Widening and Raising, Signing, Signals and Lighting)	$3,205,984	$5,993,742	$30,587,493	$19,819,475	$13,990,796	$4,854,890	$4,800
Additional Lanes (Grade, Drainage and Pavement)	$2,195,670	$1,807,893	$4,433,375	$340,819	$1,643,842	$420,277	$1,800
Pavement Rehabilitation (Concrete) with Unbonded Concrete Overlay (Includes Bridge Raising and Widening)	$2,283,706	$4,344,235	$18,565,664	$2,266,514	$6,761,842	$3,270,968	$3,600
Additional Lanes (Grade, Drainage, Pavement and Signals)	$956,896	$1,136,705	$5,527,252	$208,626	$4,161,390	$706,598	$2,400
Grade, Drainage, Pavement, Retaining Walls, Lighting and Bridges	$1,313,664	$283,527	$1,546,288	$9,400,050	$3,177,138	$1,547,440	$3,600
Additional Lanes (Grade, Drainage, Pavement and Bridges)	$9,584,641	$3,765,002	$14,589,659	$12,775,673	$12,098,422	$2,134,659	$4,800
Grade, Drainage, Bridges and Partial Base and Pave	$11,134,420	$171,891	$1,001,103	$6,657,830	$9,791,315	$613,330	$4,800
Additional Lanes (Grade, Drainage, Pavement, UST Removal and Signing)	$4,328,009	$1,106,479	$5,889,236	$753,991	$2,358,211	$464,781	$3,600
Bridges (Dual)	$160,948	$0	$0	$15,064,613	$2,473,607	$8,570	$3,600
Grade, Drainage, Pavement, Signing, Lighting, Signals and Bridges	$955,760	$427,836	$2,630,110	$5,726,210	$2,751,486	$1,838,421	$2,400
Grade and Drain (Partial), Pavement and Landfill Removal	$1,757,167	$2,165,432	$6,809,134	$20,019	$706,561	$416,595	$1,800
Interchange (Grade, Drainage, Pavement, Signing and Bridge)	$4,710,727	$1,268,923	$5,633,309	$2,947,924	$2,371,186	$1,319,875	$3,600
ADDITIONAL LANES (GRADE, DRAIN, PAVEMENT, BRIDGE & SIGNALS)	$2,697,173	$2,032,666	$12,039,767	$14,171,010	$6,261,572	$2,012,894	$4,800
Additional Lanes (Grade, Drainage, Pavement and Bridges	$3,768,812	$1,611,955	$7,250,119	$6,354,442	$4,627,964	$1,056,082	$6,000
Additional Lanes (Grade, Drainage, Pavement, Signing and Bridges)	$1,023,852	$2,025,339	$11,237,541	$4,803,169	$4,750,251	$2,551,190	$3,600
Additional Lanes (Grade, Drainage,Pavement and Signals	$3,321,181	$677,771	$4,409,455	$2,434,386	$2,534,943	$504,288	$1,800
Pavement, Partial Grade and Drain, Bridge Coating, Signing and Traffic Stripe	$2,426,169	$3,396,242	$8,519,566	$342,933	$3,896,184	$659,166	$2,400
Grade, Drain, Pavement, ITS and Lighting (Reconstruction)	$1,181,546	$84,856	$12,037,608	$274,328	$4,579,031	$2,931,339	$27,450
Additional Lanes (Grade, Drainage, Partial Base and Pave and Signals)	$2,615,861	$1,064,158	$1,936,060	$2,891,353	$2,662,821	$276,807	$2,400
Grade and Drain (Partial) and Base and Pavement	$1,048,081	$2,652,291	$7,503,733	$59,784	$2,028,307	$606,280	$1,800
Grade, Drainage, Partial Pavement and Bridges	$6,410,638	$2,079,658	$3,394,083	$42,453,555	$10,354,846	$1,145,292	$8,128
Grade, Drainage, Pavement, Bridges and Bridge Culverts	$4,133,413	$0	$8,042,377	$17,250,878	$8,496,628	$546,580	$4,480
ADDITIONAL LANES (GRADE, DRAIN, PAVE AND BRIDGE WIDENING)	$1,502,995	$0	$8,457,900	$3,356,120	$2,661,989	$1,024,999	$1,408
Pavement Rehabilitation (Concrete)	$67,789	$0	$8,879,247	$17,740	$3,328,237	$553,146	$704
Pavement Rehabilitation and Additional Lanes (Grade, Drainage, Pavement and Bridge Widening	$1,771,637	$412,485	$11,871,595	$1,325,693	$2,685,236	$845,450	$1,408
Planing, Resurfacing and Traffic Stripe	$1,602,544	$0	$12,369,081	$1,708,689	$5,156,137	$466,106	$1,200
PAVEMENT REHABILITATION (concrete)	$547,279	$0	$22,209,490	$0	$1,525,052	$716,311	$1,200
Planing, Resurfacing, Drainage and Bridge Rail Retrofit	$622,292	$0	$8,133,183	$497,459	$2,591,627	$278,027	$1,408
Additional Lanes (Grade, Drainage, Pavement, Bridges and Signals)	$620,843	$414,241	$7,178,460	$1,467,162	$2,050,522	$1,134,508	$1,408
Other- Widening (Grade, Drainage, Pavement, Signing and Signal Modification)	$1,881,228	$1,017,647	$3,394,565	$474,248	$4,513,699	$312,070	$1,408
Additional Lanes (Partial Grade and Drain and Pavement)	$2,155,271	$1,644,610	$7,072,859	$368,172	$3,079,307	$465,484	$1,800
Base, Pave, Partial Grade and Drain and Signals	$1,658,476	$3,916,483	$9,277,192	$294,447	$2,627,090	$687,904	$1,408
Pavement Reconstruction and Rehabilitation	$3,520,454	$0	$22,108,988	$1,660,689	$7,933,469	$3,331,419	$2,816
Other- Relocation of SR-13 from county rd 79 at dime north to near spruce pine mainline bridges over gas branch	$329,526	$0	$0	$11,973,689	$2,475,606	$10,188	$1,408
Additional Lanes (Grade, Drainage, Pavement, Lighting and Signing)	$1,561,819	$3,034	$18,821,374	$1,081,397	$6,338,958	$1,220,003	$3,392
PLANING, RESURFACING, TRAFFIC STRIPE, DRAINAGE AND GUARDRAIL	$1,262,589	$0	$10,613,272	$1,551,635	$3,315,875	$317,712	$1,424
Planing, Resurfacing, Drainage and Traffic Stripe	$506,750	$6,000	$11,935,856	$61,796	$3,770,035	$546,358	$1,200
Grade, Drain, Base, Pave, Signs and Bridges	$1,987,986	$653,006	$2,397,932	$2,354,559	$2,737,731	$445,262	$1,424
Pavement Rehabilitation (Planing, Resurfacing, Guardrail, Traffic Counting Units and Traffic Stripe)	$96,474	$0	$8,851,300	$0	$2,128,891	$348,309	$1,408
Grade, Drain, Base, Pave, Bridge (Precast) and Seawall Replacement	$0	$608,548	$131,607	$355,745	$7,855,872	$3,092,142	$125,797
Planing, Resurfacing, Guardrail, Bridge Jacking, Pedestrian Bridge Removal, Signals, and Bridge Rail Retrofit	$398,891	$94,755	$9,959,423	$946,169	$2,178,971	$1,101,951	$1,408
Other- Polymer Modified Open Graded Friction Course, Concrete Slab Replacement, Guardrail and Median Barrier Replacement, Brid	$769,832	$15,311	$7,719,261	$274,652	$6,490,467	$2,521,086	$1,248
Planing, Ultimate Paving, and Traffic Stripe	$388,368	$0	$13,824,227	$5,947	$4,032,006	$946,477	$832
Bridge Various Repairs	$0	$0	$0	$12,123,940	$1,692,152	$282,824	$2,240

Orig. Cont. Value (OCV), $	Final Project Value ($)	Total E&I Amt ($)	Letting Year	Letting Date	Start Date	Midway Date	comp date	Schedule LD Rate according to Let Date	Daily E&I Cost
$20,486,034	$21,024,375	$1,788,571	1998	11/6/1998	5/26/2003	1/8/2004	8/23/2004	$2,000	$3,931
$17,017,062	$18,168,366	$2,267,976	1999	9/24/1999	5/2/2002	11/6/2002	5/13/2003	$2,000	$6,032
$14,111,591	$14,481,641	$1,738,241	2000	9/29/2000	2/13/2004	1/2/2005	11/23/2005	$2,000	$3,274
$18,086,182	$26,967,584	$2,146,077	2001	1/26/2001	10/11/2003	7/23/2004	5/5/2005	$2,000	$3,752
$20,397,707	$20,883,414	$1,932,832	2001	3/30/2001	12/3/2003	8/7/2004	4/12/2005	$2,000	$3,897
$15,188,505	$32,089,283	$3,299,754	2001	6/29/2001	8/16/2004	11/23/2005	3/2/2007	$2,000	$3,556
$21,401,116	$23,059,008	$1,615,900	2002	1/11/2002	4/4/2002	7/21/2005	11/7/2008	$2,000	$2,707
$18,933,219	$20,739,689	$1,652,478	2002	3/1/2002	3/18/2002	1/30/2003	12/14/2003	$1,200	$2,961
$18,115,535	$18,912,317	$1,576,130	2002	3/1/2002	4/8/2002	3/12/2003	2/13/2004	$1,200	$3,510
$21,159,147	$21,682,341	$2,139,642	2002	3/1/2002	6/20/2002	4/28/2004	3/8/2006	$2,000	$4,592
$15,554,877	$17,746,331	$1,727,707	2002	3/29/2002	5/16/2002	12/25/2003	8/5/2005	$1,200	$1,759
$13,159,775	$14,419,833	$1,746,574	2002	4/26/2002	6/28/2002	1/28/2005	9/1/2007	$1,200	$1,882
$11,658,047	$12,342,157	$1,656,521	2002	6/28/2002	8/30/2002	2/26/2004	8/25/2005	$1,200	$3,210
$15,999,993	$17,749,131	$2,416,887	2002	6/28/2002	7/29/2002	7/19/2004	7/10/2006	$1,200	$2,388
$12,353,523	$12,405,410	$2,680,471	2002	7/26/2002	7/3/2005	5/2/2006	3/2/2007	$2,000	$4,416
$11,834,696	$11,886,404	$680,514	2002	9/27/2002	1/7/2003	3/3/2004	4/29/2005	$1,200	$949
$18,877,933	$21,210,559	$1,807,759	2002	11/1/2002	11/25/2002	7/9/2003	2/20/2004	$1,200	$5,649
$10,730,938	$10,723,841	$410,860	2002	12/4/2002	3/19/2003	4/8/2004	4/29/2005	$2,000	$1,352
$15,470,482	$14,472,309	$954,193	2003	1/17/2003	2/10/2003	4/21/2004	7/1/2005	$1,200	$2,235
$13,866,304	$15,088,201	$618,148	2003	1/17/2003	4/1/2003	5/29/2004	7/27/2005	$1,200	$1,042
$13,151,954	$13,222,346	$628,027	2003	1/17/2003	9/15/2003	3/5/2005	8/25/2006	$2,000	$1,716
$14,836,176	$16,793,697	$1,360,008	2003	4/25/2003	1/24/2004	1/9/2005	12/27/2005	$1,200	$1,935
$11,529,338	$11,339,726	$1,426,004	2003	4/25/2003	7/7/2006	2/26/2007	10/19/2007	$1,200	$3,041
$10,310,545	$10,563,789	$1,265,153	2003	7/25/2003	8/11/2003	6/30/2004	5/20/2005	$1,200	$1,952
$11,651,499	$11,791,386	$1,308,067	2003	8/22/2003	10/16/2003	2/24/2005	7/6/2006	$1,200	$1,333
$13,169,204	$13,259,346	$570,206	2003	9/26/2003	2/2/2004	11/16/2004	9/1/2005	$1,200	$950
$26,798,852	$27,296,176	$2,965,605	2003	12/5/2003	3/5/2005	10/12/2005	5/22/2006	$1,200	$4,648
$11,184,581	$11,953,645	$858,069	2004	4/2/2004	4/26/2004	2/13/2006	12/3/2007	$1,200	$1,150
$10,233,889	$10,680,628	$1,112,727	2004	4/2/2004	6/3/2004	5/13/2006	4/22/2008	$1,200	$1,050
$15,427,825	$15,597,156	$1,946,576	2004	4/30/2004	5/12/2004	8/11/2006	11/9/2008	$1,200	$3,160
$25,608,369	$26,636,204	$3,877,076	2004	6/25/2004	9/25/2004	10/3/2005	10/12/2006	$1,200	$5,190
$10,960,478	$10,507,017	$839,920	2004	7/30/2004	8/30/2004	7/5/2005	5/11/2006	$1,200	$1,640
$17,970,113	$19,670,278	$2,869,443	2004	8/27/2004	7/12/2006	10/17/2007	1/22/2009	$1,200	$3,102
$15,763,289	$20,073,035	$2,173,094	2004	11/5/2004	1/22/2005	6/10/2007	10/26/2009	$1,200	$2,723
$14,701,423	$13,669,494	$866,592	2004	11/5/2004	1/4/2005	11/25/2005	10/16/2006	$2,000	$1,391
$12,060,217	$15,749,386	$1,944,633	2005	2/23/2005	4/19/2005	2/10/2007	12/4/2008	$1,200	$2,332
$18,810,388	$23,885,256	$2,819,367	2005	2/23/2005	5/16/2005	6/23/2007	07/31/09	$2,000	$3,652
$10,144,886	$9,964,471	$1,098,835	2005	2/23/2005	4/27/2005	9/7/2006	1/18/2008	$1,200	$1,862
$24,611,237	$27,717,010	$1,693,912	2005	3/25/2005	5/27/2007	6/21/2008	7/17/2009	$2,000	$2,166
$28,411,763	$30,349,417	$5,198,753	2005	5/27/2005	7/7/2005	8/23/2006	10/10/2007	$2,000	$6,302
$22,342,232	$24,673,436	$1,253,380	2005	5/27/2005	7/26/2006	2/22/2007	9/21/2007	$2,000	$1,943
$17,197,947	$18,991,448	$1,462,381	2005	7/29/2005	9/12/2005	1/5/2007	4/30/2008	$2,000	$1,810
$33,871,072	$35,760,887	$4,793,892	2005	7/29/2005	10/20/2005	11/13/2007	12/7/2009	$1,200	$3,942
$10,251,555	$12,470,979	$1,010,422	2005	7/29/2005	4/15/2006	12/11/2006	8/8/2007	$2,000	$2,105
$10,120,792	$11,035,406	$968,752	2005	8/26/2005	3/18/2006	11/4/2007	6/22/2009	$2,000	$2,833
$13,316,994	$14,574,649	$288,192	2005	9/30/2005	12/7/2005	5/19/2007	10/28/2008	$2,000	$726
$12,980,887	$14,638,794	$253,790	2005	9/30/2005	11/11/2005	8/16/2006	5/22/2007	$1,200	$753
$14,446,291	$17,172,257	$1,233,351	2005	11/4/2005	12/27/2005	5/29/2007	10/28/2008	$2,000	$4,044
$20,874,772	$22,815,105	$1,794,112	2005	12/2/2005	3/25/2006	6/4/2007	8/14/2008	$2,000	$3,560
$24,225,583	$27,515,585	$373,882	2006	1/13/2006	5/4/2006	12/7/2008	7/14/2011	$2,000	$797
$13,245,469	$14,181,577	$2,472,263	2006	2/22/2006	11/7/2006	9/15/2007	7/23/2008	$1,200	$3,962
$10,446,910	$15,771,828	$1,931,981	2006	3/31/2006	6/28/2006	4/29/2009	3/1/2012	$2,000	$4,265
$17,717,680	$20,203,634	$1,327,439	2006	4/28/2006	7/11/2006	6/9/2007	5/7/2008	$1,200	$3,319
$13,415,809	$15,275,672	$872,496	2006	4/28/2006	9/22/2006	3/12/2007	8/30/2007	$1,200	$2,551
$19,865,641	$21,591,604	$2,060,616	2006	5/26/2006	8/17/2006	4/27/2008	1/6/2010	$2,000	$9,766
$33,765,031	$31,629,112	$2,708,694	2006	6/30/2006	9/7/2006	3/12/2008	9/15/2009	$1,200	$5,472
$10,375,000	$11,651,237	$2,372,025	2006	6/30/2006	9/18/2006	9/12/2008	9/7/2010	$2,000	$6,209
$21,101,047	$64,326,815	$7,843,245	2006	6/30/2006	9/11/2006	3/14/2008	9/16/2009	$2,000	$9,577
$11,210,400	$11,579,608	$1,548,743	2006	7/28/2006	9/20/2006	1/10/2008	5/1/2009	$2,000	$5,531
$25,620,947	$27,949,529	$1,979,996	2007	2/28/2007	6/16/2008	7/16/2009	8/16/2010	$1,200	$2,503
$11,116,766	$11,616,272	$946,625	2007	3/28/2007	7/16/2007	1/2/2009	6/22/2010	$2,000	$3,787
$12,418,608	$11,427,368	$727,555	2007	3/28/2007	5/23/2007	2/19/2008	11/17/2008	$1,200	$3,384
$79,590,663	$93,138,811	$4,948,045	2007	5/18/2007	2/4/2008	4/4/2009	6/4/2010	$1,200	$5,814
$22,730,011	$26,642,573	$1,885,622	2007	6/29/2007	9/12/2007	8/27/2008	8/12/2009	$2,000	$7,990
$11,790,332	$12,314,476	$1,118,890	2007	6/29/2007	9/28/2007	1/28/2009	6/1/2010	$2,000	$3,091
$12,021,460	$12,299,693	$1,191,498	2007	7/27/2007	9/13/2007	5/31/2008	2/17/2009	$1,200	$2,432
$73,039,164	$77,249,236	$5,993,125	2007	9/12/2007	7/23/2009	1/21/2011	7/21/2012	$1,200	$5,478
$29,157,752	$34,287,248	$2,077,348	2007	9/28/2007	10/16/2008	10/28/2009	11/10/10	$1,200	$2,751
$10,262,107	$11,229,844	$1,107,453	2007	9/28/2007	12/31/2007	11/23/2008	10/17/2009	$2,000	$3,516
$16,232,572	$16,318,874	$1,557,590	2007	11/2/2007	1/21/2008	3/24/2009	5/27/2010	$2,000	$4,650
$14,081,455	$18,686,833	$2,734,735	2007	12/7/2007	4/24/2008	12/3/2009	7/14/2011	$2,000	$4,883
$11,714,000	$12,011,119	$1,050,932	2007	12/7/2007	4/9/2008	4/16/2009	4/23/2010	$1,200	$1,413
$16,671,324	$17,142,894	$1,428,640	2008	2/29/2008	5/28/2008	8/4/2009	10/12/2010	$3,600	$3,914
$15,687,566	$15,631,852	$1,137,898	2008	2/29/2008	4/9/2008	5/23/2009	7/6/2010	$1,800	$2,107
$19,578,816	$19,536,161	$1,875,026	2008	3/28/2008	6/12/2008	5/23/2010	5/3/2012	$3,600	$4,771
$12,518,918	$12,994,917	$1,026,629	2008	5/30/2008	9/18/2008	3/22/2010	9/23/2011	$3,600	$3,028
$78,457,181	$77,870,360	$9,125,027	2008	8/15/2008	9/19/2009	2/24/2011	7/31/2012	$1,800	$8,724
$10,843,677	$11,451,932	$2,048,902	2008	8/29/2008	10/23/2008	10/26/2009	10/29/2010	$3,600	$7,617
$37,496,529	$46,622,671	$3,514,718	2009	4/10/2009	6/22/2009	4/30/2011	3/8/2013	$1,800	$2,594
$12,699,867	$15,639,656	$2,665,426	2009	4/24/2009	9/25/2012	4/27/2013	11/28/2013	$3,600	$6,213
$17,271,708	$18,041,710	$2,105,294	2009	6/26/2009	8/25/2009	9/6/2013	09/17/13	$3,600	$3,995
$54,952,856	$75,656,428	$1,717,343	2009	7/31/2009	8/14/2010	10/1/2012	11/19/14	$1,800	$1,102
$29,374,688	$34,767,104	$2,526,772	2009	7/31/2009	4/3/2012	2/19/2013	01/07/14	$3,600	$3,924
$14,904,308	$18,963,444	$2,163,909	2009	9/25/2009	12/7/2009	5/13/2011	10/17/2012	$3,600	$4,704
$17,711,338	$19,038,748	$2,735,440	2009	11/6/2009	2/22/2010	8/29/2013	03/05/13	$3,600	$5,113
$14,332,223	$14,810,335	$1,884,417	2010	6/25/2010	9/16/2010	1/5/2012	04/26/13	$3,600	$5,249
$11,876,709	$14,275,818	$1,832,887	2010	7/30/2010	6/29/2013	11/26/2013	04/25/14	$3,600	$6,110
$18,255,545	$20,455,791	$220,908	2010	7/30/2010	5/4/2011	6/12/2012	07/22/13	$1,800	$273
$39,219,883	$44,451,058	$1,285,867	2010	9/24/2010	8/14/2012	3/23/2014	10/30/15	$1,800	$1,097
$24,675,374	$25,768,735	$1,247,322	2010	11/5/2010	1/11/2011	11/27/2012	10/15/14	$3,600	$2,465
$26,394,942	$32,710,455	$3,626,856	2010	12/3/2010	1/27/2012	6/19/2013	11/10/14	$1,800	$3,563
$13,883,824	$15,362,466	$1,748,446	2010	12/3/2010	2/13/2011	1/7/2013	12/02/14	$3,600	$5,331
$19,242,660	$21,930,471	$5,001,175	2011	1/14/2011	3/17/2011	1/27/2013	12/10/14	$3,600	$12,022
$21,116,157	$21,693,187	$1,920,168	2011	1/28/2011	3/11/2011	11/10/2011	7/11/2012	$1,800	$6,465
$11,449,460	$20,186,243	$2,030,589	2011	4/29/2011	8/3/2011	8/15/2013	08/28/15	$3,600	$3,781
$13,900,276	$14,367,260	$2,179,112	2011	7/29/2011	10/7/2011	3/3/2013	07/30/14	$3,600	$5,765
$65,846,200	$66,390,982	$7,317,173	2011	8/12/2011	9/22/2011	8/27/2013	08/03/15	$1,800	$6,292
$38,474,357	$51,585,467	$5,671,602	2011	8/26/2011	10/18/2011	4/16/2013	10/14/14	$1,800	$5,194
$17,005,411	$17,960,665	$1,208,390	2011	9/30/2011	12/1/2012	11/11/2013	10/23/14	$1,550	$1,739
$12,846,863	$18,054,918	$2,096,596	2011	9/30/2011	12/18/2011	2/14/2014	04/14/16	$1,800	$1,328
$18,913,504	$21,744,477	$1,543,339	2011	9/30/2011	12/2/2011	3/31/2013	07/30/14	$1,800	$2,138
$21,303,757	$20,384,713	$1,896,014	2011	9/30/2011	12/8/2011	9/8/2013	06/11/15	$1,800	$2,967
$24,999,333	$31,045,310	$1,762,614	2012	4/27/2012	6/29/2012	7/15/2013	07/31/14	$1,550	$2,353
$12,123,996	$12,827,213	$1,848,004	2012	4/27/2012	5/28/2013	1/19/2014	09/12/14	$1,550	$3,915
$12,867,145	$11,024,013	$1,560,319	2012	6/29/2012	10/9/2012	2/11/2014	06/17/15	$3,100	$8,002
$11,594,865	$10,851,495	$2,083,347	2012	6/29/2012	9/5/2012	4/1/2014	10/26/15	$3,100	$6,004
$14,787,502	$16,779,242	$2,089,054	2012	7/27/2012	11/15/2012	1/25/2014	04/06/15	$3,100	$5,986
$18,463,000	$19,032,846	$1,241,895	2012	7/27/2012	9/27/2012	5/29/2014	01/29/16	$3,100	$2,238
$38,557,847	$42,246,960	$3,104,574	2012	7/27/2012	3/14/2013	10/24/2013	06/06/14	$1,550	$6,914
$14,790,417	$15,605,257	$1,849,252	2012	11/2/2012	2/1/2013	5/31/2014	09/28/15	$3,100	$4,612
$29,029,977	$29,975,915	$232,143	2012	12/7/2012	4/10/2013	10/25/2014	05/10/16	$1,550	$312
$17,062,508	$17,803,681	$1,820,667	2012	12/7/2012	2/26/2013	5/3/2014	07/09/15	$1,550	$3,004
$16,827,995	$17,136,740	$1,484,558	2012	12/12/2012	1/31/2013	4/12/2014	06/22/15	$1,550	$2,839
$10,577,901	$12,416,053	$1,755,066	2013	1/25/2013	3/11/2013	7/16/2014	11/20/15	$1,550	$2,239
$11,426,383	$11,998,484	$397,788	2013	7/26/2013	9/12/2013	7/12/2014	05/11/15	$1,550	$1,066
$12,169,710	$11,822,295	$502,603	2013	8/30/2013	12/2/2013	1/1/2015	02/01/16	$3,100	$1,487
$14,681,568	$14,992,779	$1,374,878	2013	12/6/2013	2/20/2014	4/25/2015	06/28/16	$1,550	$2,055
$17,791,857	$33,403,306	$2,284,959	2014	2/28/2014	8/27/2014	1/2/2015	05/11/15	$1,550	$8,891
$19,197,858	$17,865,758	$841,316	2014	2/28/2014	4/16/2014	12/23/2014	09/01/15	$1,550	$4,428
$14,101,157	$14,943,812	$1,046,625	2014	11/7/2014	2/2/2015	10/29/2015	07/25/16	$3,100	$3,572

APPENDIX E

SURVEY OF LIQUIDATED DAMAGE RATES FOR HIGH CONTRACT VALUE PROJECTS

"§108.10 Failure to Complete Work Within Contract Time.

Should the Contractor, or in case of default, the surety, fail to complete the work within the time stipulated in the contract or the adjusted time as granted under the provisions of Article 108.09, a deduction for each calendar day or work day that any work shall remain uncompleted, an amount indicated by the Liquidated Damages Schedule shown in Article 108.11 or provided in the contract documents shall be deducted from any monies due to the Contractor on monthly estimates. Any adjustments due to approved time extensions or overruns in the contract amount will be made on the monthly, semi-final or final estimate as may be appropriate.

Liquidated damages assessed as provided in these Specifications is not a penalty but is intended to compensate the State for increased time in administering the contract, supervision, inspection and engineering, particularly that engineering and inspection which requires maintaining normal field project engineering forces for a longer time on any construction operation or phase than originally contemplated when the contract period was agreed upon in the contract.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may be extended, will in no way operate as a waiver on the part of the Department of any of its rights under contract.

§108.11 Schedule of Liquidated Damages.

Original Contract Amount		Liquidated Damages Daily Charge	
More Than	To and including	Calendar Day or Fixed Date	Work Day
$ 0	$ 100,000	$ 120	$ 200
100,000	200,000	180	300
200,000	500,000	300	500
500,000	1,000,000	480	800
1,000,000	2,000,000	660	1,100
2,000,000	5,000,000	840	1,400
5,000,000	10,000,000	1,020	1,700
10,000,000	- - - - - - - - - - -	1,200	2,000

When the contract time is on the calendar day or date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used."

Schedule of Liquidated Damages per ALDOT Standard Specification (*ALDOT, 2002*)

"§108.10 Failure to Complete Work Within Contract Time.

Should the Contractor, or in case of default, the surety, fail to complete the work within the time stipulated in the contract or the adjusted time as granted under the provisions of Article 108.09, a deduction for each calendar day or work day that any work shall remain uncompleted, an amount indicated by the Liquidated Damages Schedule shown in Article 108.11 or provided in the contract documents shall be deducted from any monies due to the Contractor on monthly estimates. Any adjustments due to approved time extensions or overruns in the contract amount will be made on the monthly, semi-final or final estimate as may be appropriate.

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§108.11 Schedule of Liquidated Damages.

Original Contract Amount		Liquidated Damages Daily Charge	
More Than	To and including	Calendar Day or Fixed Date	Work Day
$ 0	$ 100,000	$ 120	$ 200
100,000	200,000	180	300
200,000	500,000	300	500
500,000	1,000,000	480	800
1,000,000	2,000,000	660	1,100
2,000,000	5,000,000	840	1,400
5,000,000	10,000,000	1,020	1,700
10,000,000	- - - - - - - - - - -	1,200	2,000

When the contract time is on the calendar day or date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used."

Schedule of Liquidated Damages per ALDOT Standard Specification (*ALDOT, 2006*)

"§108.10 Failure to Complete Work Within Contract Time.
Should the Contractor, or in case of default, the surety, fail to complete the work within the time stipulated in the contract or the adjusted time as granted under the provisions of Article 108.09, a deduction for each calendar day or work day that any work shall remain uncompleted, an amount indicated by the Liquidated Damages Schedule shown in Article 108.11 or provided in the contract documents shall be deducted from any monies due to the Contractor on monthly estimates. Any adjustments due to approved time extensions or overruns in the contract amount will be made on the monthly, semi-final or final estimate as may be appropriate.
Liquidated damages assessed as provided in these Specifications is not a penalty but is intended to compensate the State for increased time in administering the contract, supervision, inspection and engineering, particularly that engineering and inspection which requires maintaining normal field project engineering forces for a longer time on any construction operation or phase than originally contemplated when the contract period was agreed upon in the contract.
Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may be extended, will in no way operate as a waiver on the part of the Department of any of its rights under contract.
§108.11 Schedule of Liquidated Damages.

Original Contract Amount		Liquidated Damages Daily Charge	
More Than	To and including	Calendar Day or Fixed Date	Work Day
$ 0	$ 500,000	$ 250	$ 500
500,000	1,000,000	500	1000
1,000,000	2,000,000	900	1800
2,000,000	5,000,000	1300	2600
5,000,000	10,000,000	1600	3200
10,000,000	- - - - - - - - - - -	1800	3600

When the contract time is on the calendar day or date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used."

Schedule of Liquidated Damages per ALDOT Standard Specification (*ALDOT, 2008*)

"§108.10 Failure to Complete Work Within Contract Time.
Should the Contractor, or in case of default, the surety, fail to complete the work within the time stipulated in the contract or the adjusted time as granted under the provisions of Article 108.09, a deduction for each calendar day or work day that any work shall remain uncompleted, an amount indicated by the Liquidated Damages Schedule shown in Article 108.11 or provided in the contract documents shall be deducted from any monies due to the Contractor on monthly estimates. Any adjustments due to approved time extensions or overruns in the contract amount will be made on the monthly, semi-final or final estimate as may be appropriate.
Liquidated damages assessed as provided in these Specifications is not a penalty but is intended to compensate the State for increased time in administering the contract, supervision, inspection and engineering, particularly that engineering and inspection which requires maintaining normal field project engineering forces for a longer time on any construction operation or phase than originally contemplated when the contract period was agreed upon in the contract.
Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may be extended, will in no way operate as a waiver on the part of the Department of any of its rights under contract.
§108.11 Schedule of Liquidated Damages.

Original Contract Amount		Liquidated Damages Daily Charge	
More Than	To and including	Calendar Day or Fixed Date	Work Day
$ 0	$ 100,000	$ 200	$ 400
100,000	500,000	550	1100
500,000	1,000,000	900	1800
1,000,000	2,000,000	1350	2700
2,000,000	- - - - - - - - - - -	1550	3100

When the contract time is on the calendar day or date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used."

Schedule of Liquidated Damages per ALDOT Standard Specification (*ALDOT, 2012*)

"§108.10 Failure to Complete Work Within Contract Time.

Should the Contractor, or in case of default, the surety, fail to complete the work within the time stipulated in the contract or the adjusted time as granted under the provisions of Article 108.09, a deduction for each calendar day or work day that any work shall remain uncompleted, an amount indicated by the Liquidated Damages Schedule shown in Article 108.11 or provided in the contract documents shall be deducted from any monies due to the Contractor on monthly estimates. Any adjustments due to approved time extensions or overruns in the contract amount will be made on the monthly, semi-final or final estimate as may be appropriate.

Liquidated damages assessed as provided in these Specifications is not a penalty but is intended to compensate the State for increased time in administering the contract, supervision, inspection and engineering, particularly that engineering and inspection which requires maintaining normal field project engineering forces for a longer time on any construction operation or phase than originally contemplated when the contract period was agreed upon in the contract.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may be extended, will in no way operate as a waiver on the part of the Department of any of its rights under contract.

§108.11 Schedule of Liquidated Damages.

Original Contract Amount		Liquidated Damages Daily Charge	
More Than	To and including	Calendar Day or Fixed Date	Work Day
$ 0	$ 200,000	$ 550	$ 1100
200,000	500,000	750	1500
500,000	1,000,000	950	1900
1,000,000	2,000,000	1250	2500
2,000,000	5,000,000	1650	3300
5,000,000	10,000,000	1850	3700
10,000,000	- - - - - - - - - - -	2500	5000

When the contract time is on the calendar day or date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used."

Schedule of Liquidated Damages per ALDOT Standard Specification (*ALDOT, 2018*)

APPENDIX F

ALDOT SPSS LD RATE CALCULATION GUIDELINES

SPSS Liquidated Damages Equation Methodology

SPREADSHEET CREATION

In a new Excel spreadsheet, place all ALDOT projects with original contract values >$10 million, starting with projects let the year previous to the year for rate calculation. For example, to calculate LD rates for 2019, begin with projects let in 2018. The items listed below are what should be collected for each project.

Data to Gather for Spreadsheet Creation:

i. ProjectID (to provide a layer of verification between spreadsheet and SPSS database)
ii. Original Number of Contract Days
iii. Time Extensions Granted (Days)
iv. Total Allowed Time (Days; Orig. # of Days plus time extensions granted)
v. Total Days Used by Contractor
vi. Project Length (miles)
vii. Original Contract Amount
viii. Total E&I Cost

Spreadsheet Calculations:

With all of the data now in the spreadsheet, a few calculations are needed before data can be placed in SPSS.

1. Create a new column and calculate the new value OCV/1000, which is the original contract value divided by 1000.
2. Create another column and calculate the E&I Cost/Day by taking the Total E&I cost and dividing by the total days used by the contractor.

OUTLIER ANALYSIS

There are four outlier parameters used to find atypical projects within the database: %E&I, $/Day, Original Contract Time and Projects with Extremely Late Finishes. The next steps will walk through the process of each outlier and how to determine atypical projects based on them.

%E&I

1. Convert all %E&I values to log using the LOG() function in the column next to %E&I. This ensures that the data will be a normal distribution.
2. Add eight blank rows above the database to store newly calculated values in these outlier parameter calculations.
3. In the rows above, find the average and standard deviation of this set of values using the AVERAGE() and STDEV.P() functions within Excel. Our plan is to keep 90% of the data, which can be done using a z-score of 1.645.
4. To find upper bound, take the calculated average and add the calculated standard deviation multiplied by 1.645 (Average+1.645*Standard Deviation). Place this value in an empty cell in the rows above the dataset.
5. To find the lower bound, take the calculated average and subtract the calculated standard deviation multiplied by 1.645 (Average-1.645*Standard Deviation). Place this value in an empty cell in the rows above the dataset.
6. Next to the column containing the log E&I values, create a column to determine if each value is an outlier.

7. The %E&I value is an outlier if it is smaller than the lower bound or larger than the upper bound, and can be determined using the IF() function: =IF(BA9>BB6,1,(IF(BA9<BB7,1,0))). In this formula, BA9 is the %E&I value in question, BB6 is the upper bound, and BB7 is the lower bound.*

*If the value is greater than the upper bound, a 1 will appear in the column. If it is not greater, it will then be compared to the lower bound, and if it is less, a 1 will also appear. If it is neither, a 0 will appear. All projects with a 1 should be removed from the database at the end of the outlier analysis using the four listed parameters, as they are outlier projects according to the database. Do not remove projects until the end all four outlier tests have been conducted.

$/Day

The second outlier parameter is $/Day. This outlier finds the amount of dollars placed per day for each project. Since larger contract projects typically take more time, this outlier parameter allows for contracts of all sizes to be compared.

1. To determine outliers using $/Day, first create a new column and calculate Contract $ Placed/Day, which is the original contract value divided by the original # of contract days.
2. Convert all $/Day values to log using the LOG() function in the column next to $/Day. This ensures that the data will be a normal distribution.
3. In the rows above, find the average and standard deviation of this set of values using the AVERAGE() and STDEV.P() functions within Excel. Our plan is to keep 90% of the data, which can be done using a z-score of 1.645.

4. To find upper bound, take the calculated average and add the calculated standard deviation multiplied by 1.645 (Average+1.645*Standard Deviation). Place this value in an empty cell in the rows above the dataset.
5. To find the lower bound, take the calculated average and subtract the calculated standard deviation multiplied by 1.645 (Average-1.645*Standard Deviation). Place this value in an empty cell in the rows above the dataset.
6. Next to the column containing the log $/Day values, create a column to determine if each value is an outlier.
7. The $/Day value is an outlier if it is smaller than the lower bound or larger than the upper bound, and can be determined using the IF() function: =IF(BD9>BE6,1,(IF(BD9<BE7,1,0))). In this formula, BD9 is the $/Day value in question, BE6 is the upper bound, and BE7 is the lower bound.*

*If the value is greater than the upper bound, a 1 will appear in the column. If it is not greater, it will then be compared to the lower bound, and if it is less, a 1 will also appear. If it is neither, a 0 will appear. All projects with a 1 should be removed from the database at the end of the outlier analysis using the four listed parameters, as they are outlier projects according to the database. Do not remove projects until the end all four outlier tests have been conducted.

Orig. Contract Time

The third outlier parameter to test is the original contract time amount (measured in days).

1. Convert all Original Number of Day values to log using the LOG() function in the column next to Orig. # of Days. This ensures that the data will be a normal distribution.

2. In the rows above, find the average and standard deviation of this set of values using the AVERAGE() and STDEV.P() functions within Excel. Our plan is to keep 90% of the data, which can be done using a z-score of 1.645.
3. To find upper bound, take the calculated average and add the calculated standard deviation multiplied by 1.645 (Average+1.645*Standard Deviation). Place this value in an empty cell in the rows above the dataset.
4. To find the lower bound, take the calculated average and subtract the calculated standard deviation multiplied by 1.645 (Average-1.645*Standard Deviation). Place this value in an empty cell in the rows above the dataset.
5. Next to the column containing the log Orig. # of Days values, create a column to determine if each value is an outlier. The Orig. # of Days value is an outlier if it is smaller than the lower bound or larger than the upper bound, and can be determined using the IF() function: =IF(A9>B6,1,(IF(A9<B7,1,0))). In this formula, A9 is the Orig. # of Days value in question, B6 is the upper bound, and B7 is the lower bound.*

*If the value is greater than the upper bound, a 1 will appear in the column. If it is not greater, it will then be compared to the lower bound, and if it is less, a 1 will also appear. If it is neither, a 0 will appear. All projects with a 1 should be removed from the database at the end of the outlier analysis using the four listed parameters, as they are outlier projects according to the database. Do not remove projects until the end all four outlier tests have been conducted.

Projects with Extremely Late Finishes:

The last outlier parameter that needs to be reviewed is extreme project lateness (80+ Days).

To determine if a project was completed early or late, subtract the number of days used from the total allowed time column.

- If the value is positive, the project was completed early.
- If the value is 0, the project was completed on time.
- If the value is negative, the project was completed late.

Using engineering judgement, it was determined that projects that are completed 80+ days late have a large impact on the model creation compared to projects completed 79 days or less late, so all projects completed 80 or more days late should be removed from the database as outliers.

Once all four outlier methodologies have been conducted to the project database, a copy of the datasheet should be made. On this new copy, all projects which tested as outliers for any of the four parameters tests may be removed from the sheet altogether. The next step is to place the data into SPSS and run a multiple regression analysis.

SPSS MULTIPLE REGRESSION

With all of the work completed in the Excel spreadsheet, it is time to open the SPSS Statistics program, start a new dataset, and copy over the data to SPSS Data Document to conduct analysis.

1. With a new Data Document open in SPSS, the following columns should be copied into the Data View from the spreadsheet without outlier projects:
    i. ProjectID
    ii. Orig. # of Days
    iii. Project Length

iv. OCV/1000

v. Daily E&I Cost.

2. Five columns of data should be moved in total. Only the data values should be copied over in this view. The headings of each variable will be changed after. Once the data is in place, switch over to the Variable View and add the following headings from top to bottom:

   i. PROJ_NAME

   ii. NO_DAYS

   iii. PROJ_LENGTH

   iv. OCV_THOU

   v. DAILY_EI

3. After variable names have been placed, ensure all variable types are Numeric, except for PROJ_NAME, which can be String.
4. With the variables correctly input into the sheet, go up to the Analyze tab, scroll down to Regression, and click on Linear. The Linear Regression window pops up.
5. In the Dependent slot at the top, place DAILY_EI there by selecting it in the left window and hitting the arrow next to the Dependent slot.
6. Move all remaining variables, except for PROJ_NAME, into the Independent(s) slot. Once finished, hit okay to run the regression.
7. The SPSS Output window will appear. Scroll to find the table marked 'Coefficients[a]'. This table contains all the information needed to continue the analysis and gather the coefficients for the daily LD equation.

In the ‘B’ column of the ‘Coefficients[a]’ table are the values listed which will make up the project-specific liquidated damage calculator equation. For future rate calculation, each significant coefficient will be multiplied by the corresponding variable for a specific project. These values will be added together, along with the “Constant” value to create a daily LD rate for construction projects.

APPENDIX G

ALDOT PROJECT DATABASE

Original No. Project / FA Project	Length of Days	Earthwork/ (miles)	2: 1000	3: Bases/1000	4: Surf/Pave/ 1000	5: Structures/ 1000	6: Incidentals/ 1000	9: Training & Lump 7: Traffic Control/1000	Sum / 1000	OCV/1000	Year Variable	Daily E&I Cost
IM-I020(317)	570	4.871	2163.21	1902.01	11123.99	3985.69	5982.68	1636.47	4.80	26798.85	6	$4,648
IM-NHF-I020(326)	765	5.378	3275.86	1985.83	12151.94	945.00	8379.61	1669.93	3.60	28411.76	8	$6,302
NHF-0001(512)	400	4.658	3448.00	0.00	389.31	4181.67	2915.08	19.21	7.20	10960.48	7	$1,640
NHF-0157(504)	260	12.759	1325.53	2414.52	6281.49	914.85	3077.72	429.77	2.40	14446.29	8	$4,044
IM-NHF-I020(340)	637	1.859	1502.99	0.00	8457.90	3356.12	2661.99	1025.00	1.41	17005.41	14	$1,739
IM-STPAAF-BRF-I020(333)	934	4.478	2697.17	2032.67	12039.77	14171.01	6261.57	2012.89	4.80	39219.88	13	$1,097
MGF-0001(516)	600	7.48	4474.64	0.00	1034.10	3224.47	3292.30	32.30	2.40	12060.22	8	$2,332
STPOA-9650(600)	300	2.272	2195.67	1807.89	4433.38	340.82	1643.84	420.28	1.80	10843.68	11	$7,617
NHF-HPP-0012(517)	300	4.122	2615.86	1064.16	1936.06	2891.35	2662.82	276.81	2.40	11449.46	14	$3,781
EOAPF-HWYPF-BRF-0008(529)	475	5.426	3768.81	1611.95	7250.12	6354.44	4627.96	1056.08	6.00	24675.37	13	$2,465
ACAPD-IM-NHF-BRF-I065(303)	1104	2.22	8227.69	2654.28	9018.35	34606.90	10309.10	7818.37	404.48	73039.16	10	$5,478
IM-ACNHF-I020(332)	739	3.655	2575.89	1563.03	9088.18	7909.13	6288.62	1729.30	3.60	29157.75	10	$2,751
STMAAF-I020(324)	1088	8.061	9584.64	3765.00	14589.66	12775.67	12098.42	2134.66	4.80	54952.86	12	$1,102
NHF-I059(317)	789	5.814	1617.54	3106.51	11954.20	733.41	5941.40	1063.88	1204.00	25620.95	10	$2,503
ACSTPAA-0181(500)	370	4.071	956.90	1136.70	5527.25	208.63	4161.39	706.60	2.40	12699.87	12	$6,213
ACNHF-I059(314)	306	4.183	2423.19	1384.59	4595.49	398.70	2160.19	692.29	3.60	11658.05	5	$3,210
IM-ACNHF-I065(353)	990	5.451	3205.98	5993.74	30587.49	19819.48	13990.80	4854.89	4.80	78457.18	11	$8,724
NHF-7571(600)	750	2.64	4361.76	881.06	2561.87	4598.77	2751.11	606.32	2.40	15763.29	7	$2,723
NHF-0067(501)	195	2.778	620.84	414.24	7178.46	1467.16	2050.52	1134.51	1.41	12867.14	15	$8,002
NHF-0008(530),BRF-0008(536)	500	5.629	4744.58	1049.28	7301.95	12415.01	5728.90	520.51	2004.80	33765.03	9	$5,472
NHF-0286(022)	340	1.144	993.73	228.51	1454.74	10094.00	2593.64	866.15	1.80	16232.57	10	$4,650
IM-NHF-I065(375)	846	4.613	9967.77	591.60	23983.38	13358.40	17534.46	11551.33	2603.71	79590.66	10	$5,814
IM-NHF-I020(339)	752	4.29	1561.82	3.03	18821.37	1081.40	6338.96	1220.00	3.39	29029.98	15	$312
STPAAF-EOAPF-BRF-I010(301)	897	3.831	1023.85	2025.34	11237.54	4803.17	4750.25	2551.19	3.60	26394.94	13	$3,563
ACNHF-0076(502)	315	2.129	1383.98	1359.53	3201.43	1324.90	2280.75	511.62	312.80	10375.00	9	$6,209
STMAAF-0009(509)	325	4.763	4328.01	1106.48	5889.24	753.99	2358.21	464.78	3.60	14904.31	12	$4,704
EB-0053(509)	330	4.602	3321.18	677.77	4409.45	2434.39	2534.94	504.29	1.80	13883.82	13	$5,331
IM-ACSTPAAF-0007(505)	400	1.516	1779.37	380.82	2271.94	3378.68	4796.72	707.07	2.40	13316.99	8	$726
IM-NHF-I020(320)	720	4.267	2314.77	1587.02	10024.01	2844.14	7138.10	1695.53	4.80	25608.37	7	$5,190
NHF-0056(500) BRF-0102(527)	674	1.763	2897.17	382.87	2683.77	3182.90	7235.81	1582.19	5.40	17970.11	7	$3,102
ACNHF-102(501)	857	7.809	3458.76	2141.20	2855.83	2145.74	4970.15	424.31	4.00	15999.99	5	$2,388
NHF-0012(544)	350	5.582	2155.27	1644.61	7072.86	368.17	3079.31	465.48	1.80	14787.50	15	$5,986
EBF-BRF-0006(516)	450	2.821	1172.89	2683.80	4112.63	3660.69	2156.89	291.90	2.66	14081.46	10	$4,883
NHF-0008(534)	250	5.057	1417.54	1103.60	5305.63	136.08	2127.53	592.59	433.80	11116.77	10	$3,787
NHF-IM-I065(308)	502	9.112	1428.06	1304.00	7504.03	4506.40	3285.99	901.15	3.60	18933.22	5	$2,961
NHF-I059(315)	401	5.13	2214.48	1854.81	6835.09	460.23	2564.26	902.50	4.80	14836.18	6	$1,935
NHF-I059(307)	445	5.33	0.00	0.00	0.00	0.00	0.00	0.00	18115.54	18115.54	5	$3,510
IM-NHF-I059(214)	388	5.056	2979.41	1682.08	5683.38	341.54	3564.42	1216.06	3.60	15470.48	6	$2,235
STPAAF-0113(500)	300	13.473	2958.03	4245.31	8662.65	1819.43	3798.83	1095.96	149.80	22730.01	10	$7,990
APD-0471(504)	623	4.421	1391.45	3903.26	7757.97	0.00	1581.89	62.05	4.80	14701.42	7	$1,391
APD-0471(510)& APD-0471(512)	704	7.588	1242.90	5258.90	12998.46	0.00	2745.13	92.64	4.20	22342.23	8	$1,943
NHF-0157(502)	500	7.084	1218.65	1383.82	5861.98	10.63	2265.19	440.72	3.60	11184.58	7	$1,150
NHF-0001(520)	300	4.8	1401.87	3021.46	4709.53	32.45	1072.48	207.32	1.80	10446.91	9	$4,265
STPOA-0025(518)	375	14.471	1658.48	3916.48	9277.19	294.45	2627.09	687.90	1.41	18463.00	15	$2,238
ACHPP-HPP-MCAA-MGF-0488(008)	400	1.401	852.88	52.63	210.45	14691.64	2161.54	82.24	34.80	18086.18	4	$3,752
BRF-0035(502)	325	0.277	292.51	0.00	0.00	10147.67	1320.36	27.39	2.40	11790.33	10	$3,091
BRF-310(17)	450	0.985	2852.44	89.65	384.01	15323.22	2516.47	230.53	4.80	21401.12	5	$2,707
ACBRF-0101(560)	550	1.461	1696.96	358.70	1996.41	5653.23	2144.13	500.50	3.60	12353.52	5	$4,416
BRF-0042(502)	780	1.021	1110.16	110.50	416.47	6711.20	1680.33	201.63	3.60	10233.89	7	$1,050
BRF-0017(505)	821	2.275	2875.19	499.42	1522.91	8207.86	3866.11	222.85	3.60	17197.95	8	$1,810
BRF-6403(201)	345	0.567	744.11	29.96	232.10	7547.68	1515.96	49.18	1.80	10120.79	8	$2,833
BR-I065(440)	250	6.079	0.00	0.00	0.00	12123.94	1692.15	282.82	2.24	14101.16	17	$3,572
NHF-I065(344)	613	0.576	456.24	29.71	68.13	9910.04	1890.26	748.69	142.40	13245.47	9	$3,962
ACHPP-124 (006)&(007)	300	0.481	258.05	0.00	0.00	18058.24	2168.54	0.00	1.20	20486.03	1	$3,931
APD-471(513)	550	0.406	1060.63	0.00	0.00	10808.48	1979.96	12.43	4.80	13866.30	6	$1,042
APD-471 (74)	500	0.168	349.50	0.00	0.00	12236.04	1487.85	3.41	34.80	14111.59	3	$3,274
APD-471(518)	800	0.27	362.25	0.00	0.00	10703.31	755.34	9.00	4.80	11834.70	5	$949
STPOAF-0013(544)	500	0.482	160.95	0.00	0.00	15064.61	2473.61	8.57	3.60	17711.34	12	$5,113
APD-471(506)	700	0.234	51.38	0.00	0.00	11818.11	1288.40	5.31	6.00	13169.20	6	$950
APD-0355(506)	340	7.859	1048.08	2652.29	7503.73	59.78	2028.31	606.28	1.80	13900.28	14	$5,765
STPOA-0275(502)	300	6.437	1757.17	2165.43	6809.13	20.02	706.56	416.60	1.80	11876.71	13	$6,110
APD-471(521)	360	5.669	1060.12	2321.87	7617.16	0.00	1796.04	351.96	4.80	13151.95	6	$1,716
ACSTPAAF-NCPD-0192(006)	385	2.756	11742.80	37.85	503.51	3739.68	6601.14	25.00	1575.60	24225.58	9	$797
MGF-393 (8)	400	7.084	7916.48	77.04	204.75	3182.47	3748.15	54.83	4.80	15188.51	4	$3,556
BR-0182(502)	235	0.378	0.00	608.55	131.61	355.74	7855.87	3092.14	125.80	12169.71	16	$1,487
IM-I010(319)	588	1.084	1987.99	653.01	2397.93	2354.56	2737.73	445.26	1.42	10577.90	16	$2,239
APD-471(522)	1095	2.512	16850.78	14.57	1032.22	9555.96	6357.15	56.79	3.60	33871.07	8	$3,942
APD-471(47)	720	4.287	8385.08	253.73	272.22	3414.45	3119.00	105.59	4.80	15554.88	5	$1,759
STPOA-0015(507) & IM-I085(318)	478	1.712	2281.28	1166.00	3120.35	4144.50	3416.81	1294.69	4.20	15427.83	7	$3,160
APD-DE-471(39)	360	5.555	3231.75	1430.51	3774.72	5384.11	2642.33	548.84	4.80	17017.06	2	$6,032
ACHPP-ACNHF-0080(007)	500	0.977	2005.68	364.44	768.20	14086.09	2805.58	362.92	4.80	20397.71	4	$3,897
ACSTPAAF-0124(900)	550	1.269	3375.12	1509.48	2928.17	7282.36	3682.62	2093.42	3.60	20874.77	8	$3,560
IM-NHF-I065(393)	281	2.341	1181.55	84.86	12037.61	274.33	4579.03	2931.34	27.45	21116.16	14	$6,465
APD-0471(503)	300	1.321	7561.57	0.00	131.15	832.70	3942.20	49.50	1.80	12518.92	11	$3,028
STPOA-0025(514)	385	7.751	6519.37	244.56	1510.67	3446.16	4732.67	215.50	2.40	16671.32	11	$3,914
ACSTPAA-0077(501)	270	3.977	3284.00	839.46	2526.94	924.69	2907.14	133.60	594.57	11210.40	9	$5,531
APD-471(46)	750	3.302	7493.35	177.24	93.96	2502.21	2710.25	176.77	6.00	13159.78	5	$1,882
NHF-0042(501)	400	7.965	7404.02	0.00	336.00	8317.30	3976.45	65.03	1002.23	21101.05	9	$9,577
STMOAF-0192(901)	390	2.821	11134.42	171.89	1001.10	6657.83	9791.32	613.33	4.80	29374.69	12	$3,924
ACSTPAA-0275(500)	300	6.406	6185.13	211.04	1532.90	4468.36	6438.79	130.82	898.60	19865.64	9	$9,766

HPP-0035(510)	1167	3.418	6410.64	2079.66	3394.08	42453.55	10354.85	1145.29	8.13	65846.20	14	$6,292
APD-471(45)	425	3.025	11480.15	205.41	332.46	5463.55	3609.74	63.04	4.80	21159.15	5	$4,592
IM-I020(322)	393	6.314	643.43	1371.66	4786.83	325.55	3447.65	950.63	3.60	11529.34	6	$3,041
ACSTPAA-1702(904)	978	6.734	4133.41	0.00	8042.38	17250.88	8496.63	546.58	4.48	38474.36	14	$5,194
STMAAF-0001(537)	550	1.557	1313.66	283.53	1546.29	9400.05	3177.14	1547.44	3.60	17271.71	12	$3,995
ST-049-039-001	300	1.715	1517.43	805.68	1472.88	4622.00	1446.31	397.81	0.00	10262.11	10	$3,516
MG-8570(600)	509	4.093	1991.52	1225.78	2808.96	1592.98	2265.88	421.41	4.00	10310.55	6	$1,952
STPAA-7571(601)	735	5.703	4041.10	1771.64	3424.05	2848.43	6346.14	376.62	2.40	18810.39	8	$3,652
NHF-286(21)	750	1.501	1660.67	395.80	1581.79	2277.27	4948.36	785.22	2.40	11651.50	6	$1,333
STPAA-8570(601)	360	1.61	955.76	427.84	2630.11	5726.21	2751.49	1838.42	2.40	14332.22	13	$5,249
STPOAF-1602(521)	465	1.452	6484.50	805.85	3177.52	5282.49	3054.05	772.01	2.40	19578.82	11	$4,771
NHF-0013(548)	540	0.697	3083.22	545.16	1743.44	3768.50	4754.45	1790.97	1.82	15687.57	11	$2,107
HPP-IM-STPOA-I085(311)	648	1.604	4710.73	1268.92	5633.31	2947.92	2371.19	1319.88	3.60	18255.55	13	$273
ACIM-IM-I010(327)	320	1.382	1892.40	882.86	2353.19	2718.30	2030.68	849.51	4.00	10730.94	5	$1,352
ACI-I065(329)	365	1.517	3209.28	0.00	3046.37	4790.46	3869.87	3957.16	4.80	18877.93	5	$5,649
IMD-IM-I065(326)	510	1.073	1521.62	455.50	3099.89	294.37	2237.75	2533.96	1.80	10144.89	8	$1,862
IM-I065(345)	400	12.086	261.40	7.19	14032.64	129.23	2768.54	504.99	13.70	17717.68	9	$3,319
ERF-STPAAF-8700(901)	550	10.661	0.00	0.00	0.00	0.00	1194.96	10446.55	72.49	11714.00	10	$1,413
IM-I059(365)	486	4.143	769.83	15.31	7719.26	274.65	6490.47	2521.09	1.25	17791.86	17	$8,891
NHF-0013(545)/EBF-STPAAF-0013(545)	400	0.311	329.53	0.00	0.00	11973.69	2475.61	10.19	1.41	14790.42	15	$4,612
STPOAF-8829(600)	320	1.903	1881.23	1017.65	3394.56	474.25	4513.70	312.07	1.41	11594.86	15	$6,004
APD-0471(508),APD-0471(509)	730	7.074	1237.28	5980.70	13382.78	0.00	3945.98	60.91	3.60	24611.24	8	$2,166
APD-0471(530)	338	10.587	19.37	0.00	9776.28	0.00	927.10	2691.86	1.20	13415.81	9	$2,551
IM-IMD-I020(325)	438	9.813	3520.45	0.00	22108.99	1660.69	7933.47	3331.42	2.82	38557.85	15	$6,914
ACIM-IM-I059(327)	332	7.895	4141.73	0.00	4604.65	0.00	3823.32	409.99	1.20	12980.89	8	$753
IM-I059(340)	416	7.268	462.02	3508.38	5432.91	6.50	2011.03	599.91	0.70	12021.46	10	$2,432
IM-I059(323)	592	19.163	67.79	0.00	8879.25	17.74	3328.24	553.15	0.70	12846.86	14	$1,328
IM-I059(336)	505	23.319	547.28	0.00	22209.49	0.00	1525.05	716.31	1.20	24999.33	15	$2,353
STMAAF-I059(342)	748	10.91	2283.71	4344.24	18565.66	2266.51	6761.84	3270.97	3.60	37496.53	12	$2,594
IM-I065(315)	365	13.035	143.80	0.00	9343.28	21.25	367.80	374.23	1.20	10251.56	8	$2,105
IM-I459(308)	352	5.404	96.47	0.00	8851.30	0.00	2128.89	348.31	1.41	11426.38	16	$1,066
IM-NHF-I020(327)	640	7.983	1771.64	412.49	11871.59	1325.69	2685.24	845.45	1.41	18913.50	14	$2,138
ACAPD-NHF-0355(503)	325	5.84	2426.17	3396.24	8519.57	342.93	3896.18	659.17	2.40	19242.66	14	$12,022
IM-I065(414)	603	12.304	1602.54	0.00	12369.08	1708.69	5156.14	466.11	1.20	21303.76	14	$2,967
IM-I010(324)	460	8.941	622.29	0.00	8133.18	497.46	2591.63	278.03	1.41	12124.00	15	$3,915
IM-I085(334)	492	14.736	506.75	6.00	11935.86	61.80	3770.03	546.36	1.20	16827.99	15	$2,839
IM-IMD-I010(328)	518	8.676	398.89	94.76	9959.42	946.17	2178.97	1101.95	1.41	14681.57	16	$2,055
IM-I059(331)	207	17.877	1003.16	262.90	9104.67	0.00	768.31	878.37	401.20	12418.61	10	$3,384
IM-I065(412)	553	10.268	1262.59	0.00	10613.27	1551.64	3315.88	317.71	1.42	17062.51	15	$3,004
APD-IM-0004(521)	206	7.875	388.37	0.00	13824.23	5.95	4032.01	946.48	0.83	19197.86	17	$4,428

APPENDIX H

PROJECT AND AGENCY LEVEL PERFORMANCE SPREADSHEETS

Project Level Performance

Dataset	Year	Project (Letting Date: 2008-2015)	Actual Daily E&I ($/Day)	ALDOT			Model: Time; Length; Cost			Model: Time; Length			Model: Length; Cost			Model: Time; Cost			Model: Time			Model: Length			Model: Cost		
				LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|
10.1	2008	STPOA-0025(514)	3914	3600	-8%	8%	3323	-15%	15%	2689	-31%	31%	2962	-24%	24%	3503	-11%	11%	3006	-23%	23%	2794	-29%	29%	3160	-19%	19%
10.1	2008	STPOAF-1602(521)	4771	3600	-25%	25%	4088	-14%	14%	3411	-29%	29%	3924	-18%	18%	3938	-17%	17%	3102	-35%	35%	3423	-28%	28%	3746	-21%	21%
10.1	2008	STPOA-9650(600)	7617	3600	-53%	53%	2488	-67%	67%	3133	-59%	59%	2150	-72%	72%	2352	-69%	69%	2903	-62%	62%	3341	-56%	56%	1985	-74%	74%
10.1	2008	APD-0471(503)	3028	3600	19%	19%	2952	-3%	3%	3228	7%	7%	2539	-16%	16%	2774	-8%	8%	2903	-4%	4%	3436	13%	13%	2323	-23%	23%
10.1	2009	NHF-0013(548)	2107	1800	-15%	15%	2896	37%	37%	3575	70%	70%	3203	52%	52%	2680	27%	27%	3193	52%	52%	3499	66%	66%	2962	41%	41%
10.1	2009	ACSTPAA-0181(500)	6213	3600	-42%	42%	2595	-58%	58%	3038	-51%	51%	2405	-61%	61%	2559	-59%	59%	2987	-52%	52%	3161	-49%	49%	2359	-62%	62%
10.1	2009	STMAAF-0001(537)	3995	3600	-10%	10%	3204	-20%	20%	3501	-12%	12%	3462	-13%	13%	3041	-24%	24%	3205	-20%	20%	3413	-15%	15%	3281	-18%	18%
10.1	2009	STPOAF-0013(544)	5113	3600	-30%	30%	3552	-31%	31%	3549	-31%	31%	3615	-29%	29%	3338	-35%	35%	3145	-38%	38%	3520	-31%	31%	3370	-34%	34%
10.1	2009	STMAAF-0009(509)	4704	3600	-23%	23%	3265	-31%	31%	2915	-38%	38%	2797	-41%	41%	3282	-30%	30%	2933	-38%	38%	3092	-34%	34%	2804	-40%	40%
10.2	2010	STMAAF-I059(342)	2594	1800	-31%	31%	6974	169%	169%	2806	8%	8%	6875	165%	165%	7396	185%	185%	3444	33%	33%	2478	-4%	4%	7359	184%	184%
10.2	2010	STPAA-8570(601)	5249	3600	-31%	31%	3727	-29%	29%	3449	-34%	34%	3140	-40%	40%	3371	-36%	36%	3268	-38%	38%	3313	-37%	37%	2962	-44%	44%
10.2	2010	STPOA-0275(502)	6110	3600	-41%	41%	3039	-50%	50%	3238	-47%	47%	2540	-58%	58%	3186	-48%	48%	3309	-46%	46%	3080	-50%	50%	2682	-56%	56%
10.2	2010	EOAPF-HWYPF-BRF-0008(529)	2465	3600	46%	46%	4692	90%	90%	3140	27%	27%	4108	67%	67%	4663	89%	89%	3190	29%	29%	3129	27%	27%	4143	68%	68%
10.2	2011	EB-0053(509)	5331	3600	-32%	32%	3463	-35%	35%	3312	-38%	38%	2894	-46%	46%	3408	-36%	36%	3289	-38%	38%	3169	-41%	41%	2911	-45%	45%
10.2	2011	STPAAF-EOAPF-BRF-I010(301)	3563	1800	-49%	49%	3326	-7%	7%	2859	-20%	20%	4413	24%	24%	3366	-6%	6%	2901	-19%	19%	3206	-10%	10%	4339	22%	22%
10.2	2011	APD-0355(506)	5765	3600	-38%	38%	3080	-47%	47%	3125	-46%	46%	2685	-53%	53%	3374	-41%	41%	3282	-43%	43%	3012	-48%	48%	2913	-49%	49%
10.2	2011	IM-NHF-I020(340)	1739	1800	4%	4%	2973	71%	71%	3194	84%	84%	3438	98%	98%	2777	60%	60%	3079	77%	77%	3301	90%	90%	3267	88%	88%
10.2	2011	IM-NHF-I020(327)	2138	1800	-16%	16%	2661	24%	24%	2857	34%	34%	3266	53%	53%	3084	44%	44%	3077	44%	44%	3006	41%	41%	3485	63%	63%
10.2	2011	IM-I065(414)	2967	1800	-39%	39%	2801	-6%	6%	2653	-11%	11%	3267	10%	10%	3621	22%	22%	3102	5%	5%	2797	-6%	6%	3758	27%	27%
10.3	2012	NHF-HPP-0012(517)	3781	3600	-5%	5%	3205	-15%	15%	3364	-11%	11%	2639	-30%	30%	3115	-18%	18%	3309	-12%	12%	3192	-16%	16%	2633	-30%	30%
10.3	2012	IM-I059(323)	1328	1800	36%	36%	601	-55%	55%	2288	72%	72%	1830	38%	38%	2253	70%	70%	3110	134%	134%	2466	86%	86%	2793	110%	110%
10.3	2012	IM-I010(324)	3915	1550	-60%	60%	2242	-43%	43%	3174	-19%	19%	2726	-30%	30%	2772	-29%	29%	3431	-12%	12%	3148	-20%	20%	3036	-22%	22%
10.3	2012	IM-I059(336)	2353	1550	-34%	34%	2922	24%	24%	2202	-6%	6%	2883	23%	23%	4879	107%	107%	3312	41%	41%	2426	3%	3%	4099	74%	74%
10.3	2012	STPOAF-8829(600)	6004	3100	-48%	48%	3856	-36%	36%	3969	-34%	34%	3151	-48%	48%	3558	-41%	41%	3800	-37%	37%	3502	-42%	42%	2993	-50%	50%
10.3	2012	NHF-0012(544)	5986	3100	-48%	48%	3885	-35%	35%	3670	-39%	39%	3182	-47%	47%	3961	-34%	34%	3721	-38%	38%	3317	-45%	45%	3256	-46%	46%
10.3	2013	NHF-0013(545)/EBF-STPAAF-0013(545)	4612	3100	-33%	33%	4131	-10%	10%	3846	-17%	17%	3535	-23%	23%	3646	-21%	21%	3589	-22%	22%	3582	-22%	22%	3257	-29%	29%
10.4	2014	IM-I065(412)	3004	1550	-48%	48%	2455	-18%	18%	2843	-5%	5%	3066	2%	2%	3101	3%	3%	3186	6%	6%	3081	3%	3%	3444	15%	15%
10.4	2014	IM-I085(334)	2839	1550	-45%	45%	2326	-18%	18%	2745	-3%	3%	2747	-3%	3%	3443	21%	21%	3347	18%	18%	2857	1%	1%	3425	21%	21%
10.4	2015	IM-IMD-I010(328)	2055	1550	-25%	25%	2391	16%	16%	3032	48%	48%	2966	44%	44%	2880	40%	40%	3278	60%	60%	3161	54%	54%	3248	58%	58%
10.4	2015	IM-I059(365)	8891	1550	-83%	83%	4009	-55%	55%	3780	-57%	57%	3815	-57%	57%	3913	-56%	56%	3742	-58%	58%	3772	-58%	58%	3760	-58%	58%
10.4	2015	BR-I065(440)	3572	3100	-13%	13%	4915	38%	38%	4454	25%	25%	3485	-2%	2%	5060	42%	42%	4595	29%	29%	3592	1%	1%	3674	3%	3%
10.4	2015	STPBHF-I020(349)	7089	3100	-56%	56%	6877	-3%	3%	5064	-29%	29%	4242	-40%	40%	5999	-15%	15%	4686	-34%	34%	4106	-42%	42%	3795	-46%	46%
		NHF-I059(376)	9155	3100	-66%	66%	7586	-17%	17%	4811	-47%	47%	4247	-54%	54%	6861	-25%	25%	4632	-49%	49%	3910	-57%	57%	3949	-57%	57%
		APDF-0471(533)	8145	3100	-62%	62%	4547	-44%	44%	3879	-52%	52%	2958	-64%	64%	5550	-32%	32%	4595	-44%	44%	3022	-63%	63%	3752	-54%	54%
		APDF-IMF-0004(530)	9826	3100	-68%	68%	5603	-43%	43%	4759	-52%	52%	3553	-64%	64%	5606	-43%	43%	4849	-51%	51%	3642	-63%	63%	3681	-63%	63%

Agency Level Performance-Late Projects

Late Projects (2008-2015)	Actual Daily E&I ($/Day)	No. of Late Days	Actual Total Damage ($)	ALDOT		Model: Time; Length; Cost		Model: Time; Length		Model: Length; Cost		Model: Time; Cost		Model: Time		Model: Length		Model: Cost	
				LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered
IM-I010(319)	$2,239	196	$438,844	$1,550	$303,800	$1,939	$380,044	$3,291	$645,036	$3,117	$610,932	$1,676	$328,496	$3,094	$606,424	$3,543	$694,428	$2,909	$570,164
STMOAF-0192(901)	$3,924	164	$643,536	$3,600	$590,400	$6,704	$1,099,456	$3,186	$522,504	$5,772	$946,608	$6,682	$1,095,848	$2,541	$416,724	$3,286	$538,904	$5,722	$938,408
IM-IMD-I020(325)	$6,914	11	$76,054	$1,550	$17,050	$7,569	$83,259	$3,182	$35,002	$4,962	$54,582	$7,820	$86,020	$3,489	$38,379	$3,104	$34,144	$5,219	$57,409
IM-I459(308)	$1,066	5	$5,330	$1,550	$7,750	$3,221	$16,105	$3,675	$18,375	$2,902	$14,510	$3,324	$16,620	$3,715	$18,575	$3,326	$16,630	$2,979	$14,895
ACAPD-NHF-0355(503)	$12,022	19	$228,418	$3,600	$68,400	$4,323	$82,137	$3,249	$61,731	$3,443	$65,417	$4,320	$82,080	$3,292	$62,548	$3,109	$59,071	$3,523	$66,937
APD-0471(503)	$3,028	20	$60,560	$3,600	$72,000	$2,952	$59,040	$3,228	$64,560	$2,539	$50,780	$2,774	$55,480	$2,903	$58,060	$3,436	$68,720	$2,323	$46,460
IM-IMD-I010(328)	$2,055	3	$6,165	$1,550	$4,650	$2,391	$7,173	$3,032	$9,096	$2,966	$8,898	$2,880	$8,640	$3,278	$9,834	$3,161	$9,483	$3,248	$9,744
NHF-0013(545)/EBF-STPAAF-0013(545)	$4,612	1	$4,612	$3,100	$3,100	$4,131	$4,131	$3,846	$3,846	$3,535	$3,535	$3,646	$3,646	$3,589	$3,589	$3,582	$3,582	$3,257	$3,257
STMAAF-0009(509)	$4,704	26	$122,304	$3,600	$93,600	$3,265	$84,890	$2,915	$75,790	$2,797	$72,722	$3,282	$85,332	$2,933	$76,258	$3,092	$80,392	$2,804	$72,904
IM-I065(412)	$3,004	23	$69,092	$1,550	$35,650	$2,455	$56,465	$2,843	$65,389	$3,066	$70,518	$3,101	$71,323	$3,186	$73,278	$3,081	$70,863	$3,444	$79,212
IM-NHF-I020(327)	$2,138	20	$42,760	$1,800	$36,000	$2,661	$53,220	$2,857	$57,140	$3,266	$65,320	$3,084	$61,680	$3,077	$61,540	$3,006	$60,120	$3,485	$69,700
IM-I065(414)	$2,967	13	$38,571	$1,800	$23,400	$2,801	$36,413	$2,653	$34,489	$3,267	$42,471	$3,621	$47,073	$3,102	$40,326	$2,797	$36,361	$3,758	$48,854
STPOA-0025(518)	$2,238	84	$187,992	$3,100	$260,400	$3,470	$291,480	$3,077	$258,468	$2,907	$244,188	$4,486	$376,824	$3,655	$307,020	$2,870	$241,080	$3,560	$299,040
STPBHF-I020(349)	$7,089	38	$269,382	$3,100	$117,800	$6,877	$261,326	$5,064	$192,432	$4,242	$161,196	$5,999	$227,962	$4,686	$178,068	$4,106	$156,028	$3,795	$144,210
APDF-IMF-0004(530)	$9,826	6	$58,956	$3,100	$18,600	$5,603	$33,618	$4,759	$28,554	$3,553	$21,318	$5,606	$33,636	$4,849	$29,094	$3,642	$21,852	$3,681	$22,086
		TOTAL	$2,252,576	TOTAL	$1,652,600	TOTAL	$2,548,757	TOTAL	$2,072,412	TOTAL	$2,432,995	TOTAL	$2,580,660	TOTAL	$1,979,717	TOTAL	$2,091,658	TOTAL	$2,443,280
				% Recovered	73%	% Recovered	113%	% Recovered	92%	% Recovered	108%	% Recovered	115%	% Recovered	88%	% Recovered	93%	% Recovered	108%

APPENDIX I

PROJECT AND AGENCY LEVEL PERFORMANCE SPREADSHEETS (%E&I)

Project Level Performance																							
Dataset	Year	Project (Letting Date: 2008-2015)	Actual Daily E&I ($/Day)	ALDOT			8.0% E&I			8.5% E&I			9.0% E&I			9.5% E&I			10.0% E&I		
				LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|	LD Rate	% Error	|% Error|
10.1	2008	STPOA-0025(514)	$ 3,914	$ 3,600	-8%	8%	$ 3,464	-11%	11%	$ 3,681	-6%	6%	$ 3,897	0%	0%	$ 4,114	5%	5%	$ 4,330	11%	11%
10.1	2008	STPOAF-1602(521)	$ 4,771	$ 3,600	-25%	25%	$ 3,368	-29%	29%	$ 3,579	-25%	25%	$ 3,789	-21%	21%	$ 4,000	-16%	16%	$ 4,210	-12%	12%
10.1	2008	STPOA-9650(600)	$ 7,617	$ 3,600	-53%	53%	$ 2,892	-62%	62%	$ 3,072	-60%	60%	$ 3,253	-57%	57%	$ 3,434	-55%	55%	$ 3,615	-53%	53%
10.1	2008	APD-0471(503)	$ 3,028	$ 3,600	19%	19%	$ 3,338	10%	10%	$ 3,547	17%	17%	$ 3,756	24%	24%	$ 3,964	31%	31%	$ 4,173	38%	38%
10.1	2008	NHF-0013(548)	$ 2,107	$ 1,800	-15%	15%	$ 2,324	10%	10%	$ 2,469	17%	17%	$ 2,615	24%	24%	$ 2,760	31%	31%	$ 2,905	38%	38%
10.1	2009	ACSTPAA-0181(500)	$ 6,213	$ 3,600	-42%	42%	$ 2,746	-56%	56%	$ 2,918	-53%	53%	$ 3,089	-50%	50%	$ 3,261	-48%	48%	$ 3,432	-45%	45%
10.1	2009	STMAAF-0001(537)	$ 3,995	$ 3,600	-10%	10%	$ 2,512	-37%	37%	$ 2,669	-33%	33%	$ 2,826	-29%	29%	$ 2,983	-25%	25%	$ 3,140	-21%	21%
10.1	2009	STPOAF-0013(544)	$ 5,113	$ 3,600	-30%	30%	$ 2,834	-45%	45%	$ 3,011	-41%	41%	$ 3,188	-38%	38%	$ 3,365	-34%	34%	$ 3,542	-31%	31%
10.1	2009	STMAAF-0009(509)	$ 4,704	$ 3,600	-23%	23%	$ 3,669	-22%	22%	$ 3,898	-17%	17%	$ 4,127	-12%	12%	$ 4,357	-7%	7%	$ 4,586	-3%	3%
10.1	2009	STMAAF-I059(342)	$ 2,594	$ 1,800	-31%	31%	$ 4,010	55%	55%	$ 4,261	64%	64%	$ 4,512	74%	74%	$ 4,762	84%	84%	$ 5,013	93%	93%
10.2	2010	STPAA-8570(601)	$ 5,249	$ 3,600	-31%	31%	$ 3,185	-39%	39%	$ 3,384	-36%	36%	$ 3,583	-32%	32%	$ 3,782	-28%	28%	$ 3,981	-24%	24%
10.2	2010	STPOA-0275(502)	$ 6,110	$ 3,600	-41%	41%	$ 3,167	-48%	48%	$ 3,365	-45%	45%	$ 3,563	-42%	42%	$ 3,761	-38%	38%	$ 3,959	-35%	35%
10.2	2010	EOAPF-HWYPF-BRF-0008(529)	$ 2,465	$ 3,600	46%	46%	$ 4,156	69%	69%	$ 4,416	79%	79%	$ 4,675	90%	90%	$ 4,935	100%	100%	$ 5,195	111%	111%
10.2	2010	EB-0053(509)	$ 5,331	$ 3,600	-32%	32%	$ 3,366	-37%	37%	$ 3,576	-33%	33%	$ 3,786	-29%	29%	$ 3,997	-25%	25%	$ 4,207	-21%	21%
10.2	2010	STPAAF-EOAPF-BRF-I010(301)	$ 3,563	$ 1,800	-49%	49%	$ 2,354	-34%	34%	$ 2,501	-30%	30%	$ 2,648	-26%	26%	$ 2,795	-22%	22%	$ 2,943	-17%	17%
10.2	2011	APD-0355(506)	$ 5,765	$ 3,600	-38%	38%	$ 3,271	-43%	43%	$ 3,475	-40%	40%	$ 3,679	-36%	36%	$ 3,884	-33%	33%	$ 4,088	-29%	29%
10.2	2011	IM-NHF-I020(340)	$ 1,739	$ 1,800	4%	4%	$ 2,136	23%	23%	$ 2,269	30%	30%	$ 2,403	38%	38%	$ 2,536	46%	46%	$ 2,670	54%	54%
10.2	2011	IM-NHF-I020(327)	$ 2,138	$ 1,800	-16%	16%	$ 2,364	11%	11%	$ 2,512	17%	17%	$ 2,660	24%	24%	$ 2,807	31%	31%	$ 2,955	38%	38%
10.2	2011	IM-I065(414)	$ 2,967	$ 1,800	-39%	39%	$ 2,826	-5%	5%	$ 3,003	1%	1%	$ 3,180	7%	7%	$ 3,356	13%	13%	$ 3,533	19%	19%
10.2	2011	NHF-HPP-0012(517)	$ 3,781	$ 3,600	-5%	5%	$ 3,053	-19%	19%	$ 3,244	-14%	14%	$ 3,435	-9%	9%	$ 3,626	-4%	4%	$ 3,816	1%	1%
10.2	2011	IM-I059(323)	$ 1,328	$ 1,800	36%	36%	$ 1,736	31%	31%	$ 1,845	39%	39%	$ 1,953	47%	47%	$ 2,062	55%	55%	$ 2,170	63%	63%
10.3	2012	IM-I010(324)	$ 3,915	$ 1,550	-60%	60%	$ 2,109	-46%	46%	$ 2,240	-43%	43%	$ 2,372	-39%	39%	$ 2,504	-36%	36%	$ 2,636	-33%	33%
10.3	2012	IM-I059(336)	$ 2,353	$ 1,550	-34%	34%	$ 3,960	68%	68%	$ 4,208	79%	79%	$ 4,455	89%	89%	$ 4,703	100%	100%	$ 4,950	110%	110%
10.3	2012	STPOAF-8829(600)	$ 6,004	$ 3,100	-48%	48%	$ 2,899	-52%	52%	$ 3,080	-49%	49%	$ 3,261	-46%	46%	$ 3,442	-43%	43%	$ 3,623	-40%	40%
10.3	2012	NHF-0012(544)	$ 5,986	$ 3,100	-48%	48%	$ 3,380	-44%	44%	$ 3,591	-40%	40%	$ 3,803	-36%	36%	$ 4,014	-33%	33%	$ 4,225	-29%	29%
10.3	2012	NHF-0013(545)/EBF-STPAAF-0013(545)	$ 4,612	$ 3,100	-33%	33%	$ 2,958	-36%	36%	$ 3,143	-32%	32%	$ 3,328	-28%	28%	$ 3,513	-24%	24%	$ 3,698	-20%	20%
10.3	2012	IM-I065(412)	$ 3,004	$ 1,550	-48%	48%	$ 2,468	-18%	18%	$ 2,623	-13%	13%	$ 2,777	-8%	8%	$ 2,931	-2%	2%	$ 3,085	3%	3%
10.3	2012	IM-I085(334)	$ 2,839	$ 1,550	-45%	45%	$ 2,736	-4%	4%	$ 2,907	2%	2%	$ 3,078	8%	8%	$ 3,249	14%	14%	$ 3,420	20%	20%
10.3	2013	IM-IMD-I010(328)	$ 2,055	$ 1,550	-25%	25%	$ 2,267	10%	10%	$ 2,409	17%	17%	$ 2,551	24%	24%	$ 2,693	31%	31%	$ 2,834	38%	38%
10.4	2014	IM-I059(365)	$ 8,891	$ 1,550	-83%	83%	$ 2,929	-67%	67%	$ 3,112	-65%	65%	$ 3,295	-63%	63%	$ 3,478	-61%	61%	$ 3,661	-59%	59%
10.4	2014	BR-I065(440)	$ 3,572	$ 3,100	-13%	13%	$ 4,512	26%	26%	$ 4,794	34%	34%	$ 5,076	42%	42%	$ 5,358	50%	50%	$ 5,640	58%	58%
10.4	2015	STPBHF-I020(349)	$ 7,089	$ 3,100	-56%	56%	$ 6,856	-3%	3%	$ 7,284	3%	3%	$ 7,713	9%	9%	$ 8,141	15%	15%	$ 8,570	21%	21%
10.4	2015	NHF-I059(376)	$ 9,155	$ 3,100	-66%	66%	$ 8,629	-6%	6%	$ 9,168	0%	0%	$ 9,707	6%	6%	$ 10,246	12%	12%	$ 10,786	18%	18%
10.4	2015	APDF-0471(533)	$ 8,145	$ 3,100	-62%	62%	$ 5,579	-31%	31%	$ 5,928	-27%	27%	$ 6,277	-23%	23%	$ 6,625	-19%	19%	$ 6,974	-14%	14%
10.4	2015	APDF-IMF-0004(530)	$ 9,826	$ 3,100	-68%	68%	$ 6,402	-35%	35%	$ 6,802	-31%	31%	$ 7,202	-27%	27%	$ 7,603	-23%	23%	$ 8,003	-19%	19%
10.4	2015	IM-I059(359)	$ 2,757	$ 3,100	12%	12%	$ 5,366	95%	95%	$ 5,701	107%	107%	$ 6,036	119%	119%	$ 6,372	131%	131%	$ 6,707	143%	143%
				Ave. Error	-29%	-	Ave. Error	-12%	-	Ave. Error	-6%	-	Ave. Error	-1%	-	Ave. Error	5%	-	Ave. Error	10%	-
		AVG	$4,575	SD	29%	-	SD	39%	-	SD	42%	-	SD	44%	-	SD	47%	-	SD	49%	-
				MAPE	-	36%	MAPE	-	34%	MAPE	-	34%	MAPE	-	35%	MAPE	-	37%	MAPE	-	38%

Agency Level Performance-Late Projects

Late Projects (2008-2015)	Actual Daily E&I ($/Day)	No. of Late Days	Actual Total Damage ($)	ALDOT		8.0% E&I		8.5% E&I		9.0% E&I		9.5% E&I		10.0% E&I	
				LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered	LD Rate	Total Damage Recovered
IM-I010(319)	$2,239	196	$438,844	$1,550	$303,800	$1,439	$282,077	$1,529	$299,707	$1,619	$317,337	$1,709	$334,967	$1,799	$352,597
STMOAF-0192(901)	$3,924	164	$643,536	$3,600	$590,400	$6,026	$988,195	$6,402	$1,049,957	$6,779	$1,111,719	$7,155	$1,173,481	$7,532	$1,235,243
IM-IMD-I020(325)	$6,914	11	$76,054	$1,550	$17,050	$7,043	$77,468	$7,483	$82,310	$7,923	$87,151	$8,363	$91,993	$8,803	$96,835
IM-I459(308)	$1,066	5	$5,330	$1,550	$7,750	$2,597	$12,985	$2,759	$13,796	$2,922	$14,608	$3,084	$15,419	$3,246	$16,231
ACAPD-NHF-0355(503)	$12,022	19	$228,418	$3,600	$68,400	$4,737	$89,996	$5,033	$95,621	$5,329	$101,246	$5,625	$106,871	$5,921	$112,496
APD-0471(503)	$3,028	20	$60,560	$3,600	$72,000	$3,338	$66,768	$3,547	$70,941	$3,756	$75,114	$3,964	$79,286	$4,173	$83,459
IM-IMD-I010(328)	$2,055	3	$6,165	$1,550	$4,650	$2,267	$6,801	$2,409	$7,227	$2,551	$7,653	$2,693	$8,079	$2,834	$8,502
NHF-0013(545)/EBF-STPAAF-0013(545)	$4,612	1	$4,612	$3,100	$3,100	$2,958	$2,958	$3,143	$3,143	$3,328	$3,328	$3,513	$3,513	$3,698	$3,698
STMAAF-0009(509)	$4,704	26	$122,304	$3,600	$93,600	$3,669	$95,394	$3,898	$101,348	$4,127	$107,302	$4,357	$113,282	$4,586	$119,236
IM-I065(412)	$3,004	23	$69,092	$1,550	$35,650	$2,468	$56,764	$2,623	$60,329	$2,777	$63,871	$2,931	$67,413	$3,085	$70,955
IM-NHF-I020(327)	$2,138	20	$42,760	$1,800	$36,000	$2,364	$47,280	$2,512	$50,240	$2,660	$53,200	$2,807	$56,140	$2,955	$59,100
IM-I065(414)	$2,967	13	$38,571	$1,800	$23,400	$2,826	$36,738	$3,003	$39,039	$3,180	$41,340	$3,356	$43,628	$3,533	$45,929
STPOA-0025(518)	$2,238	84	$187,992	$3,100	$260,400	$3,939	$330,876	$4,185	$351,540	$4,431	$372,204	$4,677	$392,868	$4,923	$413,532
STPBHF-I020(349)	$7,089	38	$269,382	$3,100	$117,800	$6,856	$260,528	$7,284	$276,792	$7,713	$293,094	$8,141	$309,358	$8,570	$325,660
APDF-IMF-0004(530)	$9,826	6	$58,956	$3,100	$18,600	$6,402	$38,412	$6,802	$40,812	$7,202	$43,212	$7,603	$45,618	$8,003	$48,018
		TOTAL	$2,252,576	TOTAL	$1,652,600	TOTAL	$2,393,239	TOTAL	$2,542,801	TOTAL	$2,692,378	TOTAL	$2,841,916	TOTAL	$2,991,490
				% Recovered	73%	% Recovered	106%	% Recovered	113%	% Recovered	120%	% Recovered	126%	% Recovered	133%