UNIVERSITY OF SOUTH CAROLINA

COST INDEXING AND UNIT PRICE ADJUSTMENTS FOR CONSTRUCTION MATERIALS

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16. Abstract

This project was focused on the assimilation of information regarding unit price adjustment clauses, or PACs, that are offered for construction materials at the state Departments of Transportation (DOTs). It is intended to provide the South Carolina Department of Transportation (SCDOT) with the current state of the practice and a better understanding of the financial and procedural benefits and risks associated with PACs. Asphalt and fuel are the most common and traditional materials for which PACs are accepted. This report evaluates the performance of SCDOT PACs for asphalt and fuel relative to its peers. This report also includes a PAC feasibility assessment for ten materials, other than asphalt and fuel, which are consumed in construction and maintenance operations. Steel was the singular material identified as a feasible option for PAC development; there are steel PACs available at 15 other state DOTs. Recommendations are developed for a PAC that covers reinforcing steel, but not structural steel.

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Executive Summary

This report describes the research conducted to evaluate the financial and procedural benefits and risks associated with unit price adjustment clauses (PACs), also known as cost escalation clauses, for construction materials. The goals were to provide the South Carolina Department of Transportation (SCDOT) with an assessment of its current PACs, which are accepted for asphalt and fuel, and to complete a feasibility study on the potential development of new clauses for other materials.

Given that the construction and maintenance of transportation infrastructure consumes significant quantities of materials, it is prudent for state Departments of Transportation (DOTs) to adopt mechanisms, like PACs, that mitigate the financial risks associated with the fluctuation of material costs during the period of a construction contract. Based on a comprehensive review of current practices at state DOTs, it is evident that PACs are the most common approach for risk mitigation. More than 90% (49 of 52) state DOTs provide PACs for at least one material, and more than 80% (41 of 49) of those state DOTs provide PACs for fuel or asphalt, or both. Far fewer state DOTs offer similar clauses for steel products (15) or portland cement concrete products (4). There appears to be some regional influences on the materials for which PACs are provided at each state DOT. PACs for steel, for example, tend to be concentrated in three distinct groups of states located within the northwestern, midwestern, and northeastern parts of the U.S.

Although PACs are common, the specifications contained within the clauses are variable and depend on the material. For a specific material, PACs can be invoked on the basis of minimum material quantities, minimum contract time periods, minimum contract amounts, or some combination of those requirements. There are two formulations to calculate price adjustment. An inclusive clause adjusts for the entire difference between the current price index and base price index, while an exclusive clause allows for a partial adjustment of the difference. While both are used, exclusive formulas are more common. All exclusive and most inclusive clauses require a trigger, as a percentage of the base price index, to initiate a price adjustment. The most common trigger is 5%, although there are triggers as high as 25%. The selection of a trigger has a significant influence on the amounts and frequencies of adjustments made on existing contracts. However, there are some inclusive clauses that do

not require a trigger. There is anecdotal evidence that the absence of a trigger can lower bid prices and increase bid competition. When there is a trigger required to initiate a price adjustment, contractors must account for that risk in the bid formulation, causing bid prices associated with those materials to be higher. Price adjustment caps can also be specified in PACs to protect against unlimited coverage from extreme shifts in material cost. While caps can be an effective risk sharing component of PACs, most state DOTs do not provide specifications for them. Those clauses that have caps range from 50% to 100% of the base price index.

Contractors and state DOTs both consider PACs to be favorable, according to responses gathered from a series of interviews and surveys. NCHRP Report 274 also indicates that such clauses are "moderately positive" and recommends PACs as an appropriate mechanism for certain construction materials, like asphalt and fuel. Other construction materials are not considered to be good candidates for price adjustment because there is a lack of reliable price indexes and/or materials are consumed in limited quantities. Steel meets both of these two criteria, but there is a mixed response on using PACs for steel. Most of the state DOTs with steel PACs are satisfied with their performance. However, some indicated that steel PACs have been underutilized or even removed from specifications. There are some complexities with making price adjustments for steel, given the large number of steel products that are manufactured, although that can be managed with the use of multiple price indexes. Some state DOTs have reported difficulties in monitoring transaction dates, such as mill shipping dates, for making proper price adjustments. NCHRP Report 274 does not recommend PACs for steel, although that assessment assumes that provisions for stockpiling steel are available. Recommendations are made in this report for SCDOT consideration of a PAC for reinforcing steel, but not structural steel.

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1 Introduction

1.1 Research Problem Statement

The construction and maintenance of our national transportation infrastructure consumes significant quantities of materials that include asphalt concrete, Portland cement concrete, steel, and the fuel required for such activities. The cost of these materials fluctuates during the period of a construction contract. Sometimes the cost changes are volatile. In the past decade, petroleum products (e.g. liquid asphalt binder and fuel) and reinforcing steel experienced considerable swings in cost over relatively short periods of time. For example, the cost indexes for asphalt binder and fuel have increased three- to four-fold since 2000, as shown in Figure 1.1.

In such a tumultuous economic environment, mechanisms that lessen the financial risk to contractors and state agencies are important. The most common mechanism that has been adopted at most state agencies is the implementation of unit price adjustment clauses. Some agencies refer to these provisions as cost escalation clauses, but given that material prices can increase or decrease during a project period, price adjustment clauses, or PACs, will be adopted and used throughout this report. This study is intended to assist the South Carolina Department of Transportation (SCDOT) with a better understanding of the benefits and risks involved with PACs for various construction materials.

1.2 Research Objectives and Scope of Work

The original research plan identified four main research objectives:

1. Identify the financial and procedural benefits and risks associated with cost indexing and payment adjustment allowances using PACs.
2. Determine best practices at state Departments of Transportation and align SCDOT with such practices, as appropriate.
3. Develop and document a decision worksheet for selecting bid lines items and determining appropriate adjustments such that SCDOT can adjust, expand, or contract cost indexes and unit price adjustments in the future.

4. Revise and update the existing Microsoft Excel application for calculating adjustments and provide documentation for its maintenance.

As part of Objective 2, this report evaluates the performance of SCDOT PACs for fuel and asphalt relative to its peers. As part of Objective 3, a decision tool was developed in Microsoft Excel that allows SCDOT to manipulate the attributes of PACs and evaluate their impacts on payment and/or return.

This study includes a PAC feasibility assessment for materials, other than fuel and asphalt, which are consumed in SCDOT construction and maintenance operations. These materials include Portland cement, coal fly ash, steel, aluminum, crushed stone (coarse aggregate), sand (fine aggregate), lumber, pavement markings, polymers, and landscaping products such as grass seed, fertilizers and lime. Based on outcomes of Objectives 1 and 2, steel was identified as a feasible material for PAC development, leading to one additional research objective:

5. Develop guidance and recommendations for a steel PAC.

1.3 Methodology

To complete Objectives 1 and 2, a combination of internet-based surveys, literature reviews, phone interviews and site visits were conducted. An online survey was developed and distributed to all state DOTs to identify and summarize current practices. The final survey and all responses can be found in Appendix A. The literature review focused on the chronological development of PACs and identifying trends and best practices. Numerous phone interviews were conducted as part of a follow-up plan to the survey. The research team also made a number of site visits to local contractors to obtain their opinions on current SCDOT PACs.

Objective 3 involved the development of a detailed set of worksheets that includes the equations and attributes related to PACs that are unique to each state DOT. The developed worksheets were generalized to create a tool that can be used to analyze the payment and/or return amounts for various PAC attributes, project parameters, and economic situations.

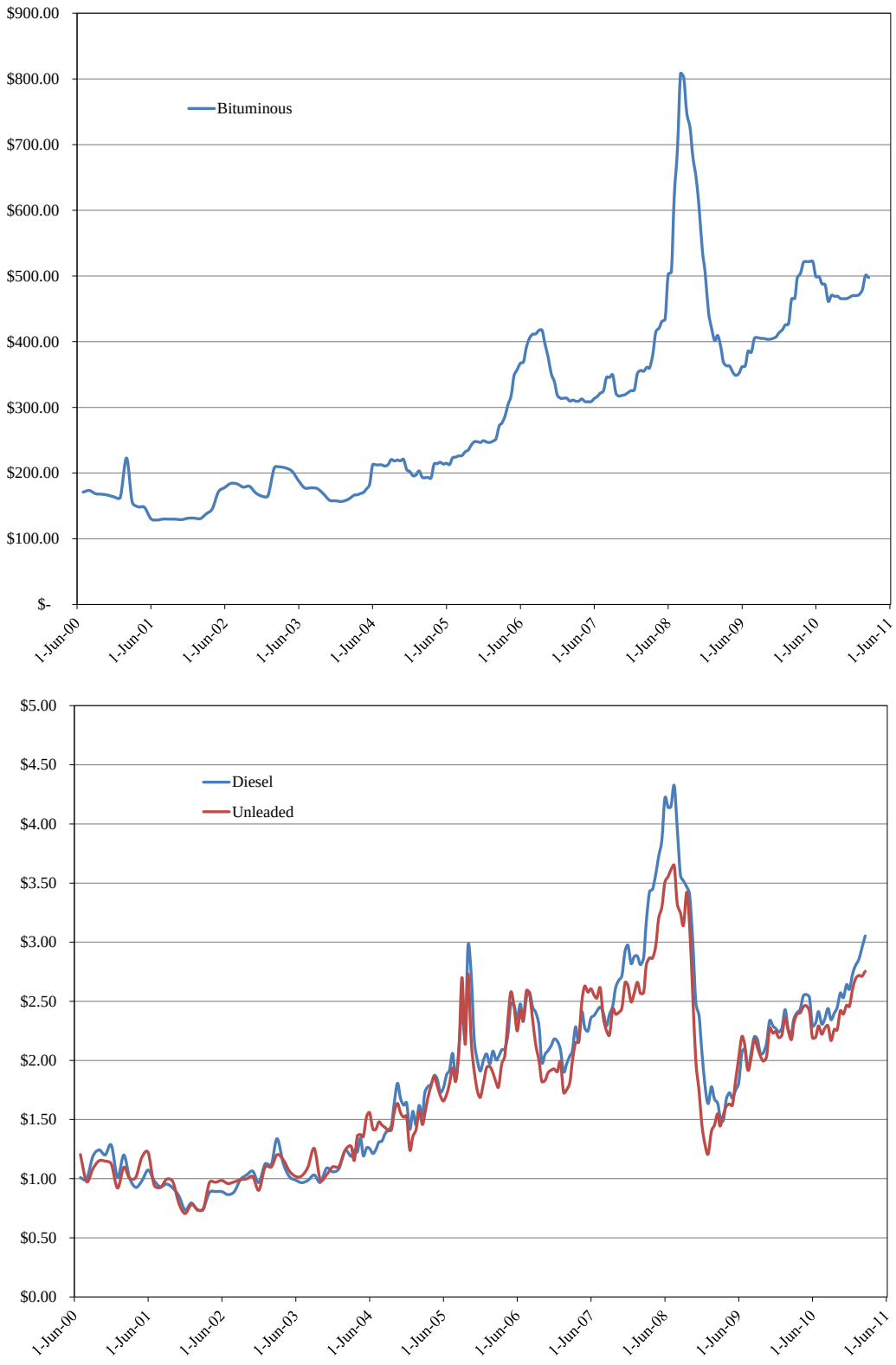

Figure 1.1 Monthly Cost Indexes for Asphalt Binder (Bituminous) and Fuel for Period of July 2000 to January 2009 (based on data from www.scdot.org/doing/monthlyindexes.asp).

The findings and developments from Objectives 2 and 3 helped to reinforce the financial and procedural benefits and risks associated with PACs for fuel and asphalt (Objective 1). The outcomes of all three of these research objectives allowed the team to analyze the performance of existing steel PACs and recommend criteria for implementation at SCDOT (Objective 5).

1.4 Report Organization

The remainder of this report is organized as follows. Chapter 2 provides the background and literature review related to PACs, followed by Chapter 3 which discusses the current state of practice by all DOTs, with particular focus on SCDOT. Chapter 4 presents the developed methodology and scenario analyses for fuel and asphalt. Chapter 5 reviews current practice related to steel and presents steel PAC recommendations that could be adopted by SCDOT. Lastly, Chapter 6 provides concluding remarks and recommendations.

2 BACKGROUND AND LITERATURE REVIEW

This chapter first provides background information on price adjustment clauses (PACs) [section 2.1], followed by a summary of recent studies related to PACs [section 2.2]. To illustrate the progress and trends of PACs, this information is presented in chronological order.

2.1 History of Price Adjustment

2.1.1 AASHTO "Suggestions and Guidelines for Combating Shortages and Minimizing the Effect of Price Uncertainties for Materials and Fuel in Construction" (1974)

AASHTO produced a document in 1974 entitled "Suggestions and guidelines for combating shortages and minimizing the effect of price uncertainties for materials and fuel in construction." This report appears to be the first to discuss price adjustment for construction materials. It suggested that shortages in materials can create problems with bid preparation for contractors, and that fixed quote pricing can be affected by these shortages. The possible consequences of material shortages are price speculation, delays of projects, and bid inflation. The report suggested several recommendations which are intended to relieve the problems caused by material shortage:

- Limiting the size and duration of jobs to ensure that a job may be completed within one season. If a job cannot be completed in one season, then phases could be considered to break a large job into smaller jobs.
- Projects should be designed and scheduled with "consideration to priority and available supply of materials." Alternative designs may be used to deal with short supply of materials.
- Policies for payment of stockpiling should also be considered as a means of handling material supply shortages. Time extension policies are another possible solution to project delays due to material supply limitations. In the event that material shortages cause delays, design changes could be used to allow timely completion of the project. In the event that prices become unpredictable or fixed quote pricing is not available to contractors, price adjustment should be considered.

- When considering price adjustment clauses, both availability and "cost of the materials or supplies should be unpredictable…in a reasonable geographic area." The mentioned geographic region could include several counties or could be statewide. The number of materials that price adjustment is allowed for should be kept at a minimum. The "need, effectiveness, and fairness" of price adjustment clauses should be "continually reevaluated." The clause should also be carefully worded so as to avoid confusion between the parties involved. Requirements and obligations should be clearly outlined within the price adjustment clause documentation. Price adjustments should only apply to raw material costs and should not include fabrication or handling of materials. This should be clearly stated in the price adjustment document. Opt in clauses should be avoided. A limit should be set on material cost change. Thirty five percent is suggested as a cap. Upon reaching the limit, the contracting agency should have the ability to approve or disapprove further construction with the material in question. The contracting agency could also approve the use of an alternate material or design. Price adjustment clauses should allow for increase or decrease in material costs. The upper limit on material cost should be stated in percentage form rather than in dollars and a lower limit should also be considered. The price of the material to be adjusted should be based on an index that "is not susceptible to manipulation by contractors and suppliers acting either singly or as a group." The index should be calculated on the same day each month. The details of this index should be included in the price adjustment documentation. The price adjustment clause should be induced by a percentage change in material cost. Five percent is suggested as a "trigger" value. The adjustment should be made on a monthly basis.

2.1.2 FHWA Technical Advisory T 5080.3 "Development and Use of Price Adjustment Contract Provisions" (1980)

In December of 1980, the Federal Highway Administration (FHWA) produced a technical advisory document entitled "Development and Use of Price Adjustment Contract Provisions." The purpose of this document was to outline procedures for price adjustment that would

minimize the effects of volatility in the cost of materials to be used for construction. When considering price adjustment provisions, the history of material costs compared to current costs of that material should demonstrate "unpredictable, uncontrollable shifts away from normal price trends over the longer term." The cause of these shifts should be assessed and determined if possible. In the event of such volatile prices, price quotes from material suppliers will not be available for the contract term. Price adjustment clauses should be included in special provisions rather than standard specifications to retain the ability to control which contracts the clauses are included in. The use of price adjustment clauses should be considered for each project and only used if necessary. This document also suggested that price adjustment procedures should be continually reevaluated. A cap on percentage price change is also considered important by FHWA; 25 to 100 percent is suggested as a reasonable value for the cap. As stated in the AASHTO publication, the index by which price adjustment is calculated should not be susceptible to corruption by contractors or suppliers. Possible price sources listed include the US Department of Labor, Bureau of Labor Statistics, Platt's Oilgram Price Service, Engineering News – Record, The Oil Daily, and The U.S. Oil Week. Trigger values of between 3 and 10 percent are suggested to avoid induction of the PAC by minor fluctuations in material costs. Monthly price adjustment is suggested in this document as well.

When fuel is the material being adjusted, further consideration is necessary. There are several methods outlined for dealing with fuel usage in construction. Fuel usage factors can be used to convert units of applicable work to gallons of fuel to ensure accurate price adjustment. The Transportation Research Board (TRB) published a paper in 1974 that provides details of fuel usage factors, entitled "Fuel Usage Factors for Highway Construction." For nonstructural work, fuel factors are given in gallons of fuel per unit of work. For structural work items, factors are given in gallons per $1,000 of work. Another method of calculating fuel usage is called the specified total fuel requirement method. In this method, as a specified percentage of work is completed, an average fuel usage percentage is applied to the work item to calculate the adjustment amount. Table 2.1 establishes the amount of fuel used during various stages of a project.

Table 2.1 Percentage of Fuel Use as a Function of Project Completion (FHWA 1980)

Percentage of Work Completed	Average Fuel Used (%)	Range of Values (%)
10	10	0 - 20
20	28	10 - 20
30	41	20 - 60
40	55	35 - 70
50	65	50 - 80
60	78	60 - 90
70	86	70 - 100
80	96	80 - 100
90	99	90 - 100
100	100	100

2.1.3 Technical Advisory T 5080.3 Attachment 1 "Fuel Usage Factors for Highway Construction" (1980)

The "Fuel Usage Factors for Highway Construction" document was provided as an attachment to the report published by FHWA in 1980. The fuel crisis at the time is what encouraged the Highway Equipment Committee of the TRB to develop this document. The committee formed a task force to develop fuel usage factors. The task force mailed questionnaires to the American Road Builders Association and the Associated General Contractors of America to gather data on fuel usage. The data that was gathered and analyzed by FHWA was provided by more than 400 contractors. The special notes section of the document outlined the construction items covered in the fuel usage factor chart. Table 2.2 and Table 2.3 present the fuel usage factors that were established through the study. Table 2.4 shows fuel usage factors as a percentage of total job cost.

Table 2.2 Fuel Usage Factors for Miscellaneous Construction (FHWA 1980)

Item of Work	Units	Fuel Usage Factors for Miscellaneous Construction					
		DIESEL			GASOLINE		
		Low	Avg.	High	Low	Avg	High
Excavation:	Gal/CY						
Earth		0.27	0.29	0.30	0.11	0.15	0.21
Rock		0.37	0.39	0.42	0.17	0.18	0.22
Other		0.33	0.35	0.38	0.15	0.16	0.18
Aggregates:	Gal/Ton						
Onsite Production		0.25	0.28	0.36	0.08	0.09	0.11
Aggregate Base							
0-10 Mi. Haul		0.24	0.27	0.33	0.22	0.24	0.28
10-20 Mi. Haul		0.35	0.42	0.54	0.27	0.39	0.49
Asphalt Concrete:	Gal/CY						
Production		1.75	2.43	3.50	0.07	0.14	0.18
Hauling							
0-10 Mi. Haul		0.28	0.33	0.34	0.35	0.34	0.53
10-20 Mi. Haul		0.30	0.49	0.56	0.35	0.58	0.89
Placement		0.06	0.14	0.20	0.08	0.14	0.22
Portland Cement Concrete Pavement:	Gal/CY						
Production		0.15	0.28	0.45	0.12	0.15	0.21
Hauling		0.33	0.48	0.67		0.52*	
Placement		0.13	0.22	0.31	0.14	0.23	0.38
Structures:	Gal/$1,000	10	19	25	10	22	35
Miscellaneous:	Gal/$1,000	10	19	30	10	19	30

*Estimated Figure due to Insufficient Data.

Table 2.3 Additional Fuel Usage Factors by States (FHWA 1980)

Items of Work	Units	Additional Fuel Usage Factors By States		
		Diesel	**Gasoline**	**Combined**
Clearing and Grubbing	Gal/CY	-	-	200
Earthwork:				
- Excavation	Gal/CY	-	-	0.25-0.30
- Borrow	Gal/CY	-	-	0.25
- Borrow	Gal/Ton	-	-	0.45
- Loose Riprap	Gal/CY	0.39	0.18	-
- Granular Backfill	Gal/CY	1	0.16	-
Aggregates:				
- Base Course	Gal/CY	0.82-0.88	0.55-0.57	1.3
- Base Course	Gal/Ton	0.55-0.63	0.09-0.40	0.65
- Stabilization (mixing)	Gal/SY	0.04-0.044	0.028-0.03	-
- Uncrushed Base	Gal/CY	-	-	0.45
- Uncrushed Base	Gal/Ton	-	-	0.25
Asphalt Concrete:				
- Pavement	Gal/Ton	2.57-2.90*	0.28-0.78	3.5
- Open-Graded	Gal/SY	0.07	0.02	-
- Pavement Widening	Gal/SY	0.86	0.24	-
*If natural gas is used for aggregate drying, deduct 2.00 gal/ton.				
Portland Cement Concrete Pavement:				
-Standard	Gal/SY	0.11	0.15	-
-9 inch	Gal/SY	0.25	0.038	-
-10 inch	Gal/SY	0.27	0.042	-
-Shoulders	Gal/SY	0.2	0.031	-
Miscellaneous:				
-Guard Rail	Gal/LF	-	-	0.23
-Concrete Barrier	Gal/LF	0.2	0.1	
-Lighting and Signing	Gal/$1000	-	-	15
-Fencing	Gal/$1000	-	-	53

Table 2.4 Fuel Factors as a Percentage of Total Cost by Type Construction (FHWA 1980)

Type of Construction	Fuel Cost Percentage
Grade and drain	13-15
Grade, Drain, and structures	9-10
Grade, drain, and pave	10-13
Grade, Drain pave, and structures	9-13
Surface and resurface - bituminous	9-15
Bituminous patching	11
Base and Sub base	10
Portland cement concrete pavement - rural	5
Portland cement concrete pavement - urban	10
Concrete pavement patching	9
Structures and approaches - rural	5-6
Structures and approaches - rural	3-6
Deck repair or minor widening	2
Electrical work	2
Landscaping	5
Pavement marking	1

2.1.4 FHWA Memorandum "Price Adjustment Contract Provisions" (1990)

In a memorandum dated August 21, 1990, the Associate Administrator for Engineering and Program Development for the FHWA stated that oil shortages are likely and price speculation could follow. It also stated that the use of PACs proved to be a reasonable way to relieve the risk to the contractors and place the risk associated with price inflation to the contracting agencies. The memo reiterated the relevance of the technical advisory from 1980 and added that PACs should be considered for projects in the development stage, but not projects that have already been let. If a project has been authorized but no bids have been received then it may be considered for price adjustment.

2.1.5 FHWA Memorandum "Price Adjustment of Existing Contracts" (1990)

A follow-up memorandum dated November 30, 1990 by the Executive Director of the FHWA advised that between August and mid-October, the price of oil rose from $20 per barrel to $40

per barrel. The FHWA evaluated material shortages through a survey indicated that suppliers of asphalt "were honoring their commitments to contractors for projects underway." Based on the results of this survey, the FHWA decided not to provide federal aid funds to contracts that were awarded without PACs. The director stated his support of PACs for future construction projects.

2.1.6 FHWA "Contract Administration Core Curriculum Participant's Manual and Reference Guide (2006)

The FHWA in 2006 produced a guidebook entitled "Contract Administration Core Curriculum Participant's Manual and Reference Guide." In this guidebook there is a section on commodity price adjustment clauses. This section referenced the Technical Advisory from 1980 and both memorandums from FHWA. The background section is extracted from the technical advisory and just reiterated that the information is still relevant. In providing guidance for when to use PACs, it suggested that the price trend of the material in question needs to be "extremely volatile," a fixed price quote should not be obtainable, and shortages may occur.

2.1.7 NCHRP 20-07/Task 274 "Price Indexing in Transportation Construction Contracts" (2011)

NCHRP 20-07 Task 274 is a project that is recently completed and is tasked with analyzing the current state of practice with regard to PACs. The project also aimed to "provide guidance for DOT staff making decisions about whether and how such clauses should be used." The final report provided a summary of PAC risk benefit analysis, materials to include, and methods and attributes to consider. The benefit of having a PAC includes positive effect on bid prices, number of bidders, market stability, and supply chain. The risks associated with implementing PAC are direct costs, start-up costs, administrative costs, and political barriers. The study found little evidence to support the concept of bids being retracted due to not having a PAC program. The materials recommended to have PAC are fuel and liquid asphalt. The study did not recommend having a PAC program for cement, steel (structural), steel (other), stone, and pipe. Regarding the methods and attributes to use to implement PAC, the study recommended the use of indexing for materials such as fuel and liquid asphalt. It recommended having a PAC

program for only projects that last longer than six months. Lastly, it did not recommend the use of trigger value, opt in/opt out, and project size.

2.1.8 NCHRP 10-81 Fuel Usage Factors in Highway and Bridge Construction (Active)

NCHRP project 10-81 is currently active and has been tasked with identifying construction activities that are major consumers of fuel, determining reasonable fuel usage factors for said activities, and revising any necessary fuel usage factors from FHWA Technical Advisory T5080.3. Factors will be adjusted for both "state-specific conditions and changes in construction costs, methods, and equipment." This project is scheduled to be completed in May of 2012.

2.2 Other Literature

2.2.1 "A Study of liquid Asphalt Price Indices Applications to Georgia Pavement Contracting" (Georgia Tech 2004)

This report combined quantitative data from GDOT, SC, NC, FL, TN, and AL and qualitative data from personal and phone interviews and a survey questionnaire sent to the 48 contiguous states. It was found that long term fixed price agreements were becoming more difficult for contractors to secure for liquid asphalt binder. If these agreements cannot be secured, contractors may include a contingent amount when bidding to reduce their risk. When this report was written, all five of the states that were analyzed had already begun allowing asphalt price adjustment clauses in their construction contracts. Each of the five states uses a price index to track the price of liquid asphalt. Each of the methods used are very similar, employing an average of the freight on board (FOB) terminal selling prices of asphalt to derive the index.

The first analysis looked at asphalt index data from each of the five states for four years spanning from January, 2000 to December, 2003. The second analysis looked at the indexed prices of liquid asphalt binder in the five states and the prices quoted to GDOT from November, 2001 to December, 2003. The third and final analysis compared All Super-pave and Super-pave 12.5mm between 2001 and 2003. The results of the analysis suggested that a price risk premium does not exist for the analyzed time period. A price risk premium is "the increase in price due to the probability that prices will rise over time in fixed bid long-term contracts."

A DOT employee from GDOT and each of the other five states was interviewed by phone. The questions included information about the index process and the knowledge attained from their experience with using the price index. Costs and benefits of the index process were also discussed. The results of the interviews are summarized below. These are the opinions of the people interviewed.

Benefits

- Gives smaller contractors an opportunity they might not otherwise have.
- Reduced contractor risk may lower bid prices, if they don't have to build risk into their bids. This is beneficial to the contractor and the DOT.
- May make bidding more competitive and may slow rising prices.
- It takes very little time to manage from an administrative perspective.
- May have less bidders without the adjustment, contractors who cannot afford to take the risk of rising prices might not bid without the adjustment clause.
- Although it has not been quantified, DOT may wind up paying less for materials.
- Overall, adjustment is a very simple process and it keeps either party from overpaying for material costs in a contract.
- May reduce legal fees due to litigation arising from severe price increases.
- Index is fair to both sides and protects both parties from catastrophic price change.
- Risk is mitigated for contractor and DOT.

Costs/Downsides

- Increases and decreases over the life of a project may average out to less than the trigger value. If this is the case, resources may be wasted on the process.
- Contractors may "bid the index" or not add a profit to the liquid asphalt. The profit is then added to the aggregate in the mix causing a bid unbalance on the aggregate.

- Since there is not much markup between the supplier and contractor on liquid asphalt, contractors may make their money from the mix instead of the liquid asphalt binder.
- If only local or state suppliers are used for the index, suppliers could artificially raise the price
- There is no way to tell if the contractors are paying material costs that are similar to the index prices.
- Progress estimates can be more complicated.
- Contingency amounts for contracts can be consumed by cost adjustments.
- Contracts must have a set aside contingency funding to be able to address indexed adjustments. These funds whether used or not, are tied to a contract (i.e., not available to other work) until closed.

After evaluation, it was determined that four out of the five states were satisfied with the indexing process for liquid asphalt binder. There was some concern that indexing may cost the state more than having a fixed bid system. There has not been a comprehensive evaluation of the indexing process and its potential to damage the asphalt binder market. In the state of Florida, submission of prices is voluntary so it is uncertain whether or not the price is legitimate. North Carolina is moving towards having no time or tonnage threshold for implementation of the adjustment in a contract. North Carolina only allows Super-pave and this may be the reason for this. Tennessee offered an example of the possible costs of the process: 100 projects/month x 30min/project x $50/hr./60 min/hr. x 12 months/yr. = $30,000/yr.

Other state interviews were performed. Mississippi has had an index for liquid asphalt binder since 1988. They would like to discontinue the price adjustment process because they do not believe it is worth the cost. The industry has rejected their attempts to discontinue it. Arkansas has considered an index but rejected it due to concerns that there may be too much work involved.

2.2.2 Financing Infrastructure: Fixed Price v. Price Index Contracts (Eger, 2008)

This paper compared Firm Fixed Price (FFP) and price indexing through both quantitative and qualitative analyses. It suggested that price indexing may lead to long term cost reduction. Liquid asphalt cement was analyzed in order to test this theory. Five states surrounding Georgia were using price indexing at the time of the study while Georgia was using FFP contracts. The five states that were compared were South Carolina, North Carolina, Florida, Alabama, and Tennessee. Each of these states uses a similar method of price indexing. Each of these states was interviewed by the team and four of five states reported that they were satisfied with their current indexing practice. Some of the states did however have some question as to the financial savings due to indexing, the costs associated with maintaining the index, and the effect that the index may or may not have on the market for liquid asphalt. None of the states had performed a cost-benefit analysis as of the writing of this paper.

The conclusion of the authors is that the price index system does not reduce the price of liquid asphalt cement. The authors contacted asphalt suppliers to discuss the matter and learned that the suppliers guarantee asphalt prices for as long as three years out, thereby placing the financial risk on the suppliers of asphalt.

2.2.3 Adjustments to Unit Priced Contracts (Howerton, 2000)

This brief article discussed unit priced contracts and adjustment clauses that they may contain. There was mention of contractors taking advantage of PACs and means for the contractor to remedy the situation should that occur. Trigger values were mentioned as well as the inclusion or exclusion of the price difference below the trigger value.

2.2.4 Asphalt Risk Management at WYDOT (Redd, 2009)

This paper identified, developed, and compared options for asphalt risk mitigation for the Wyoming Department of Transportation. It discussed short- and long-term dynamics in oil markets such as market speculation and a “perfect storm” in 2008, where OPEC had production cuts and supply disruptions. Potential strategy options are discussed such as teaming with neighboring states and stockpiling. Also included are contractors’ opinions.

2.2.5 Construction Project Cost Escalation Factors (Shane, 2009)

This study looked at 18 primary factors that affect cost escalation. Twenty states were interviewed to verify the validity of the factors to be investigated. The authors claimed that the incorporation of these factors into contract estimation can increase the accuracy of the estimates. Both internal and external factors were included in the study. Internal factors are considered to be those factors that are controllable by the agency and external factors are factors that are not controlled by the agency. While escalation of labor and material costs are considered to be factors, most of the factors are directly related to project scope and timing.

2.2.6 Fuel Price Adjustment Techniques: A Review of Industry Practice (Rutgers, 2004)

This paper examined the volatility of the prices of oil products. The author described the lack of ability to foresee or influence price changes that are influenced by global market changes. This uncertainty creates risk for both the transportation agency and contractors involved in the construction. The paper focused on fuel price indexing and adjustment options for construction contracts. A survey was sent out to transportation agencies, trade associations, private and nonprofit service providers and informants with knowledge in the field to determine current industry practices related to price indexing and adjusting.

2.2.7 Materials Risk Management - Beyond Escalation Clauses and Price Indexing (Redd, 2010)

The purpose of the study was to assess the effectiveness of escalation clauses in construction contracts. The Wyoming Department of Transportation completed a study in the spring of 2009 on Asphalt Risk Management. The study was done after three years of having an option in the WYDOT contract for an asphalt escalation clause. Both the contractors and WYDOT did favor the escalation clause, but it was also found that the contractors still faced some risk. The possibility of the escalation clause having a long term negative effect on the asphalt market is also covered in the study.

3 Price Adjustment Clauses

3.1 General Framework for Price Adjustment Clauses

Based on a review of price adjustment clauses (PACs) at a number of different state DOTs for different construction materials, there are three common elements that are defined here as qualifications, price adjustment calculations, and caps. Not all PACs are structured in this manner; however, this is recommended as a general framework for guidance in the revision of current PACs or the development of new ones.

3.1.1 Qualification

PACs for a specified construction material often must meet some minimum contract requirement(s) to be applicable. In some cases, there might be an option (opt in/out) clause for PACs. The most common requirements invoke minimum material quantities, minimum contract sums, and/or minimum contract duration. PACs can have one or more of these requirements for the same material. Each one is described in the following sections.

3.1.1.1 Minimum Quantity

Minimum quantity specifies the minimum amount of a material that must be used on a contract to allow price adjustment. Units must be specified for the weight, volume, or other metric of each material.

3.1.1.2 Minimum Sum

A minimum sum can be specified for the entire contract or for the particular item or items associated with each material.

3.1.1.3 Minimum Duration

Minimum contract duration can be specified in days, months, or years. PACs can contain both short term and long term clauses for the same material. In this case, short term and long term clauses can be differentiated through specification of other minimum qualifications (material quantity and/or contract sum) and/or price adjustment calculations.

3.1.2 Price Adjustment Calculations

Price adjustments are calculated for material quantities purchased in an invoice period, which generally occur on a monthly basis. The formulas and variables used to calculate an adjustment are described in the following sections.

3.1.2.1 Common Formulas

There are two unique equations used for calculating price adjustment. Equation 3.1 shows the general expression for an inclusive price adjustment. In an inclusive price adjustment clause, the entire difference between the current price and base price is paid. A trigger value can be specified to invoke the calculation. If there is no trigger, then the entire difference is paid regardless of price change. The price adjustment at the end of the invoice period, PA, is given as

$$PA = (CP - BP) * Q * R \tag{3.1}$$

where

BP ≡ base price, which is the price of the material at the time of the contract ($/quantity),

CP ≡ current price, which is the price of the material at the end of the invoice period ($/quantity),

Q ≡ quantity of the material consumed during the invoice period, in appropriate quantity units for that material, and

R ≡ price adjustment reduction factor.

When the current price is greater than the base price, the price adjustment is a positive dollar amount, which represents an increased payment to the contractor. When the current price is less than the base price, the price adjustment is a negative dollar amount, which represents a decreased payment to the contractor.

Equation 3.2 represents an exclusive price adjustment formula. In an exclusive price adjustment clause, a partial difference between the current price and base price is paid. A trigger value is

required to invoke the calculation. The price adjustment at the end of the invoice period, PA, is given as

$$PA = (CP - ((1 \pm T) * BP)) * Q \qquad (3.2)$$

where T ≡ trigger value, which is the percent change from base price (expressed in decimal form in Equation 3.2) required to invoke a price adjustment. If the trigger value is not reached, then no adjustment is made. If the trigger value is reached, the adjustment amount corresponds to the price change that exceeds the trigger value.

3.1.2.2 Trigger Values

Trigger values represent thresholds of price change required to invoke price adjustment clauses. Trigger values can be expressed as either a percent change from a base price or a monetary change from a base price. If a percent change is specified, then the monetary change corresponding to that percent change fluctuates as a function of the base price. If a monetary change is specified, then the percent change corresponding to that monetary change fluctuates as a function of the base price. A trigger value expressed as a monetary change must indicate the price change per unit of material.

3.1.2.3 Base Price

The material price per unit is provided through a supplier(s) either at the national or local level and is used to set the base price. The base price is set at the time of the contract and is included in the contract paperwork.

3.1.2.4 Current Price

The current material price per unit is monitored throughout the contract duration. The current price should be acquired and reported on the same date(s) of each month, whether it is reported monthly or semi-monthly.

3.1.2.5 Quantity

There can be two separate quantities specified in PACs: 1) the quantity of material, Q, for price adjustment calculations and 2) the quantity of material per work item. The quantity units depend on the construction material and product. For example, if the price index for asphalt is based on tons of liquid asphalt binder, then Q for price adjustment calculations must be in the same units. However, the work item might be specified in tons of hot mix asphalt (HMA). Fuel is another example. Fuel usage factors convert the quantity of material per work item, such as cubic yards of excavation, into gallons of fuel consumed for the calculation of fuel price adjustment.

3.1.2.6 Payment Reduction Factor

The payment reduction factor, R, is a value less than 1 that decreases a price adjustment. When specified, it creates a quasi-exclusive clause. It provides a means to share the risk when prices change, especially when the price change is dramatic. The use of a payment reduction factor appears to be limited.

3.1.3 Price Adjustment Caps

A cap can be specified to limit the price adjustment to a maximum acceptable amount. Like the payment reduction factor, it provides a means to share the risk when prices change, especially when the price change is dramatic. Caps can be expressed as a percent change from a base price, a monetary change from a base price, or as a monetary sum. If the current price exceeds the corresponding cap, then a partial difference between the current price and base price is paid. No adjustment is made for the amount that exceeds the cap.

3.2 Review of PACs in South Carolina

The South Carolina Department of Transportation (SCDOT) currently has PACs for asphalt and fuel. The documents are shown in Appendix B.

The asphalt PAC allows price adjustment for asphalt binder PG 64-22 and PG 76-22. There are no stated minimum qualifications in the PAC documentation; however it was reported to the investigators that a minimum quantity of 40 tons of liquid asphalt binder is required. A price

adjustment is invoked at a trigger value of 5% and the payment is calculated using an inclusive formula like the one shown in Equation 3.1. There are no explicit caps stated in the asphalt PAC documentation.

The index for asphalt binder is maintained by obtaining quotes from asphalt suppliers on the 1st and 17th day of each month. The index can be found on the SCDOT website at www.scdot.org/doing/monthlyindexes.asp. The worksheet, shown in Figure 3.1, contains historical prices since July 1, 2000 and it acts as a calculator to determine if a price adjustment is invoked for a given invoice period. The worksheet identifies the eligible work items and the asphalt binder quantities that are consumed for each work item. The base index is set for each project contract prior to the letting of the contract. Adjustments are calculated by multiplying the factor by the change in the asphalt binder index. The amount is a per unit amount and must be added to the estimate as a line item adjustment.

The fuel PAC allows price adjustment for both diesel and gasoline. The minimum contract duration for fuel price adjustment is six months, which is measured from the letting date to the calculated contract completion date. The six month contract time was reduced from 12 months in 2005. Minimum quantities are a function of the work line item. According to an internal memorandum dated November 16, 2005, the minimum quantities for fuel price adjustment are as follows: 25,000 cubic yards of excavation or embankment in place; 5,000 cubic yards of sand-clay base course; 10,000 and 15,000 square yards of graded aggregate base course, for 6 in. and 8 in. uniform courses, respectively; 20,000 square yards of concrete pavement; 5,000 tons of HMA; 5,000 linear feet of reinforced concrete pipe; and 400 cubic yards of structural concrete. Per this memorandum, fuel adjustments for graded aggregate base course, reinforced concrete pipe, and structural concrete were added in 2005. The fuel usage factors, reported in gallons of diesel or unleaded gasoline per unit, are also a function of the work line item, as shown in Figure 3.1. Like asphalt, there is no adjustment cap stated in the fuel PAC documentation.

Table 3.1 SCDOT Asphalt and Fuel Adjustment Worksheet

WORKSHEET FOR DETERMINING FUEL AND ASPHALT BINDER INDEX ADJUSTMENTS

HOW TO USE: Select Base Index Date (cell B8) and Current Index Date (cell H8).
Spreadsheet uses stored index data to calculate and present index adjustments for eligible items of work.
Adjustments to be applied in accordance with contract provisions.

Select Base Indexes			
Date	Asphalt Binder	Diesel	Unleaded
1-Jun-10	$ 499.20	$ 2.2924	$ 2.1919

Select Current Indexes			
Date	Asphalt Binder	Diesel	Unleaded
17-Feb-11	$ 497.56	$ 3.0534	$ 2.7545

Items of Work Eligible for Fuel Adjustments *	Unit	Gallons Per Unit		Monetary Adjustment per Unit		
		Diesel	Unleaded	Diesel	Unleaded	Combined
Excavation (Unclassified, Borrow, etc.)	CY	0.29	0.15	$ 0.20	$ 0.07	$ 0.27
Embankment in Place	CY	0.29	0.15	$ 0.20	$ 0.07	$ 0.27
Sand Clay Base Course 6" Uniform	SY	0.05	0.02	$ 0.03	$ 0.01	$ 0.04
Sand Clay Base Course 8" Uniform	SY	0.06	0.03	$ 0.04	$ 0.01	$ 0.05
Graded Aggregate Base Course 6" Uniform	SY	0.10	0.06	$ 0.07	$ 0.03	$ 0.10
Graded Aggregate Base Course 8" Uniform	SY	0.13	0.06	$ 0.09	$ 0.03	$ 0.12
Graded Aggregate Base Course 10" Uniform	SY	0.16	0.10	$ 0.11	$ 0.04	$ 0.15
Hot Mix Asphalt (Base, Binder, Surface Courses)	TON	2.90	0.71	$ 1.99	$ 0.31	$ 2.30
Full Depth Patching - 4" (Fuel)	SY	0.64	0.16	$ 0.44	$ 0.07	$ 0.51
Full Depth Patching - 6" (Fuel)	SY	0.96	0.23	$ 0.66	$ 0.10	$ 0.76
Full Depth Patching - 8" (Fuel)	SY	1.28	0.31	$ 0.88	$ 0.14	$ 1.02
Full Depth Patching - 10" (Fuel)	SY	1.60	0.39	$ 1.10	$ 0.17	$ 1.27
Full Depth Patching - 12" (Fuel)	SY	1.91	0.47	$ 1.31	$ 0.21	$ 1.52
Portland Cement Concrete Pavements	SY	0.25	0.20	$ 0.17	$ 0.09	$ 0.26
Structural Concrete	CY	1.00	0.20	$ 0.69	$ 0.09	$ 0.78
Reinforced Concrete Pipe (24" or less)	LF	0.50	0.15	$ 0.34	$ 0.07	$ 0.41
Reinforced Concrete Pipe (greater than 24")	LF	0.75	0.15	$ 0.52	$ 0.07	$ 0.59

* Eligible for index adjustment when specified in contract.

Items of Work Eligible for A.C. Binder Adjustments *	Unit	AC Binder Tons per Unit	Monetary Adjustment per Unit (for AC Binder)
Liquid Asphalt Binder (PG64-22)	TON	1.0000	$0.00
Liquid Asphalt Binder (PG76-22)	TON	1.0000	$0.00
Full Depth Patching - 4" (AC Binder)	SY	0.0110	$0.00
Full Depth Patching - 6" (AC Binder)	SY	0.0165	$0.00
Full Depth Patching - 8" (AC Binder)	SY	0.0220	$0.00
Full Depth Patching - 10" (AC Binder)	SY	0.0275	$0.00
Full Depth Patching - 12" (AC Binder)	SY	0.0330	$0.00
Asph Surf Trmt - Single Treatment (0.28 gals/sy mod. emulsion)	SY	0.0008	$0.00
Asph Surf Trmt - Double Treatment - Type 1 (0.82 gals/sy mod. emulsion)	SY	0.0023	$0.00
Asph Surf Trmt - Double Treatment - Type 2 (0.97 gals/sy mod. emulsion)	SY	0.0027	$0.00
Asph Surf Trmt - Double Treatment - Type 3 (0.55 gals/sy mod. emulsion)	SY	0.0015	$0.00
Asph Surf Trmt - Double Treatment - Type 4 (0.46 gals/sy mod. emulsion)	SY	0.0013	$0.00
Asph Surf Trmt - Double Treatment - Type 5 (0.48 gals/sy mod. emulsion)	SY	0.0013	$0.00
Asph Surf Trmt - Triple Treatment-Type 1 (0.85 gal/sy emulsion)	SY	0.0024	$0.00
Asph Surf Trmt - Triple Treatment-Type 2 (0.71 gal/sy emulsion)	SY	0.0020	$0.00
Asph Surf Trmt - Triple Treatment-Type 4 (0.82 gal/sy emulsion)	SY	0.0023	$0.00
Microsurfacing, Type II	SY	0.0007	$0.00
Microsurfacing, Type II - Leveling	TON	0.0800	$0.00
Emulsion for High Performance Chip Seal (Macrosurfacing)	Gal	0.0028	$0.00
Preventative Maintenance Surface Treatment (80 # per SY @ 6.5% AC)	SY	0.0026	$0.00

* Eligible for index adjustment when specified in contract.

The six month minimum time period requirement is evident when using the SCDOT fuel worksheet. If the time between the base index and current index is less than six months, the unit adjustment for each line item will be zero, regardless of how volatile the index is during that period. If the minimum qualifications are met, a price adjustment is invoked at a trigger value of

10% and the payment is calculated using an inclusive formula. The index can be found on the SCDOT website at www.scdot.org/doing/monthlyindexes.asp.

Table 3.1 captures a screenshot when the base index was set to June 1, 2010 and the current index was set to February 17, 2011. In this example, there are fuel payments indicated for the work items because the time period exceeds six months and the increases in fuel prices exceeded the trigger. The price increases in diesel and unleaded gasoline are 33% and 26%, respectively, and are much higher than the required 10% trigger. For this same period, however, there are no adjustments for asphalt because the asphalt binder price index did not change significantly (< 1% price change).

3.3 State of the Practice on PACs for Construction Materials

A thorough review of current price adjustment practices at state DOTs was conducted. To this end, a survey was prepared and distributed in December 2009 to the 52 state DOTs; 14 responses were received. This information was combined with survey results compiled from the AASHTO Subcommittee on Highway Construction, which completed an updated survey in the fall 2009. In addition, more than 75 PAC documents were retrieved from state DOT websites. When PAC documents could not be located, each DOT in question was contacted directly through email and/or telephone to acquire the documents or pertinent information if documents were unavailable. In some cases, DOTs were contacted to confirm information listed in their PACs. At least 15 DOTs were contacted directly. All of the information was compiled and cross-checked to produce a state-of-the-practice summary.

This comprehensive review of PACs at the state DOTs, including Washington D.C. and Puerto Rico, shows that 49 of the 52 agencies provide PACs for at least one of these four materials: asphalt, fuel, cement, and steel. The three state DOTs that do not invoke PACs are Arkansas, Michigan, and Texas. Details on the clauses are presented in the following sections.

3.3.1 Asphalt and Fuel

Figure 3.1 illustrates the distribution of states that allow PACs for each of these four materials. Asphalt and fuel are the most common materials with PACs. The 49 state DOTs with PACs include fuel or asphalt. In fact, 33 state DOTs provide PACs for both.

The distribution map suggests that there are some regional influences on which materials are accepted for price adjustments. There is a small group of state DOTs (Arkansas, New Mexico, Oklahoma, and Texas) in the southwestern U.S. that do not allow fuel price adjustments. Alaska and Hawaii DOTs also do not allow fuel price adjustments, but both of them have asphalt PACs. Most of the state DOTs that do not allow asphalt price adjustments are grouped in the upper Midwestern U.S. (Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, South Dakota, and Wisconsin). However, each of these state DOTs allows for fuel adjustment. State DOTs in the southeast region tend to have PACs for both fuel and asphalt, but not for other materials.

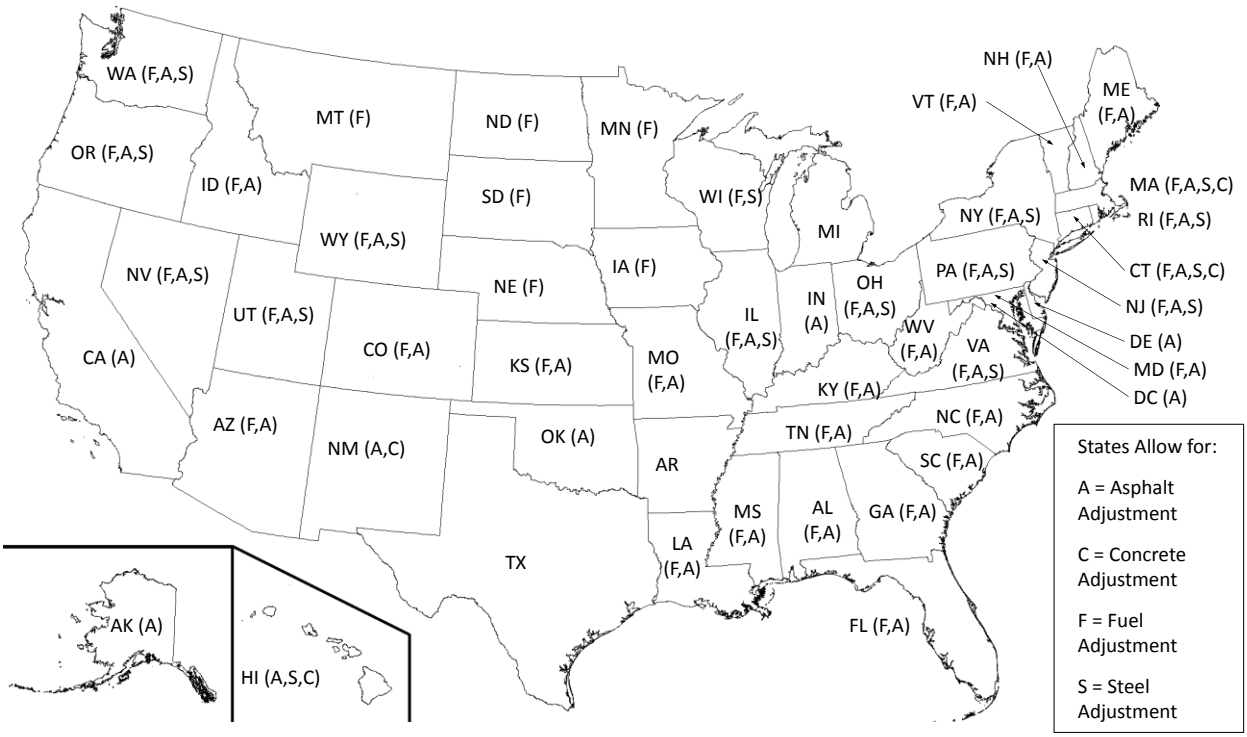

Figure 3.1 Distribution of Current PACs at State DOTs

3.3.1.1 Minimum Requirements

Generally, there are minimum requirements to invoke PACs for asphalt and fuel. Based on a review of PAC documentation, minimum quantities are specified for asphalt, but not a minimum contract time period or cost. For fuel, minimum quantities or costs for associated work items are assigned, but not minimum contract time periods.

Table 3.2 lists the minimum quantities required to invoke PACs for asphalt. There is a wide range from 100 tons to 10,000 tons of HMA, although nine of the 12 state DOTs listed here require 2,000 tons or less. These are minimum values as listed in the PAC documentation for each state. This is not a comprehensive list, however, because some DOTs may not list minimum values in their PAC documentation.

Tables 3.3 and 3.4 provide some examples of minimum requirements for fuel at six different state DOTs. It is evident that there is considerable variation in work items and minimum requirements. For example, earthwork or excavation requires minimum quantities that range from 10,000 CY to 50,000 CY at five of the six DOTs. However, Utah DOT specifies a minimum of $100,000 for earthwork.

Table 3.2 Minimum Quantities Required for Asphalt Price Adjustment

DOT	Minimum HMA (tons)
Alaska	500
DC (> 1 Year)	10,000
Florida	5,000
Illinois	1,200
Indiana	2,000
Kansas	2,000
Kentucky	3,000
Maine	500
Massachusetts	100
Missouri	1,000
Nevada	500
Pennsylvania	100

Table 3.3 Minimum Quantities and Costs Required for Fuel Price Adjustment (Illinois, Ohio, and Louisiana DOTs)

State DOT Work Items	Minimum
Illinois	
Earthwork items	25,000 CY
Aggregate or HMA base course, pavement and shoulder items	5,000 tons
PCC base course, pavement and shoulder items	7500 SY
Structure items	$250,000
Ohio	
Earthwork	30,000 CY
Aggregate Base	2,500 CY
Granular Backfill	2,000 CY
Flexible bases and pavements	1,200 CY
Rigid bases and pavements	1,200 CY
Structural concrete	350 CY
Louisiana	
General Excavation	10,000 CY
Drainage Excavation	10,000 CY
Embankment	10,000 CY
Non-plastic Embankment	10,000 CY
Borrow (Vehicular Measurement)	10,000 CY
Class I Base Course	3,000 CY
Class I Base Course (" Thick)	50,000 SY
Class II Base Course	3,000 CY
Class II Base Course (" Thick)	50,000 SY
In-Place Cement Stabilized Base Course	50,000 SY
Lime Treatment (Type B)	50,000 SY
Lime Treatment (Type C)	50,000 SY
Lime Treatment (Type D)	50,000 SY
Subgrade Layer (" Thick)	50,000 SY
In-Place Cement Treated Base Course	50,000 SY
Aggregate Surface Course (Net Section)	3,000 CY
Aggregate Surface Course (Adjusted Vehicular Measurement)	3,000 CY
Super-pave Asphaltic Concrete	1000 ton
Super-pave Asphaltic Concrete	500 CY
Super-pave Asphaltic Concrete (" Thick)	10,000 SY
Asphaltic Concrete (SMA)	1000 ton
Pavement Widening	3,000 SY
Portland Cement Concrete Pavement "	15,000 SY

Table 3.4 Minimum Quantities and Costs Required for Fuel Price Adjustment (Pennsylvania, Kentucky, and Utah DOTs)

State DOT Work Items	Minimum
Pennsylvania	
Earthwork	50,000 cu yd
Subbase and Aggregate Base courses	5,000 tons
Flexible Bases, Pavements, Pavement Patching, and Shoulders	5,000 tons
Rigid Bases, Pavements, Pavement Patching, and Shoulders	10,000 SY
Structures	$1,000,000
Milling	10,000 cu yd
Kentucky	
Roadway Excavation	10,000 CY
Embankment-in-Place	10,000 CY
Borrow Excavation	10,000 CY
DGA Base or Crushed Stone Base	5,000 tons
Gravel Base, Type III	5,000 tons
Stabilized Aggregate Base	5,000 tons
Drainage Blanket, Treated or Untreated	5,000 tons
Crushed Sandstone Base (Cement Treated)	5,000 tons
Hot-Mixed Asphalt Mixtures for Pavements or Shoulders	3,000 tons
PCC Pavement, Base, or Shoulders	2,000 SY
Utah	
Roadway Excavation, Borrow, Granular Borrow, Top Soil	$100,000
Under-drain Granular Backfill	$100,000
Untreated Base Course	$100,000
Hot Mix Asphalt	$100,000
Open Graded Surface Course	$100,000
Stone Matrix Asphalt (SMA)	$100,000
Roto-milling Profile Roto-milling In-Place Cold Recycled Asphaltic Base Recycled Surface	$100,000
Chip Seal Coat	$100,000
Portland Cement Concrete Pavement Lean Concrete Base Course	$100,000
Riprap	$100,000
Bridges	$500,000
36 in and larger pipe culvert	$200,000

3.3.1.2 Price Adjustment Formulas

In the PAC documentation, each state DOT presents their own formulas using different variables or definition of variables. These expressions are not necessarily identical to those shown in Equations 3.1 and 3.2. After manipulation and analysis, it was determined whether or not formulas were inclusive or exclusive. Not all formulas were obtained for state DOTs with asphalt and fuel PACs.

Of the 41 state DOTs with asphalt PACs, 18 use exclusive formulas and eight use inclusive formulas. Washington, D.C. and Ohio DOTs both have two separate PACs for asphalt. One is used for contracts completed within one year and the other is for multi-year contracts. Of the 41 state DOTs with fuel PACs, 22 use exclusive formulas and 10 use inclusive formulas. In total, the ratio of exclusive to inclusive formulas is about 5:2.

3.3.1.3 Trigger Value

Figures 3.2 and 3.3 show the distribution of trigger values that are used for fuel and asphalt PACs. There are 52 agencies represented in Figure 3.2 (fuel) and 54 agencies in Figure 3.3 (asphalt). Washington D.C. and Ohio are identified twice in Figure 3.3 because each DOT uses two separate asphalt PACs with different trigger values. A short term clause is used for projects completed within one year and a long term clause is used for projects spanning more than one construction season. In both cases, the single year PAC has a higher trigger value. There are several states where the price adjustment formulas could not be located and those are designated as unknown (U).

The most common trigger for asphalt price adjustment is 5%. Sixteen of 41 state DOTs, or 39%, that have asphalt PACs use it. No trigger value is also common for asphalt PACs. Thirteen state DOTs, or 32%, require no trigger to invoke a price adjustment. Triggers of 10% and 15% are less common. Several state DOTs use a cost trigger of either $5/ton or $10/ton.

Like asphalt, the most common trigger for fuel price adjustment is 5%. Fourteen of 41 state DOTs, or 34%, that have fuel PACs use it. No trigger value is also common for fuel PACs. Nine states, or 22%, require no trigger to invoke a price adjustment. Triggers of 10% and 15%

are somewhat less common; the highest trigger is 25% (Oregon DOT). Like asphalt, a few state DOTs use a cost trigger ranging from $0.10/gallon to $0.25/gallon. New York DOT is the only one that specifies cost triggers for both asphalt and fuel.

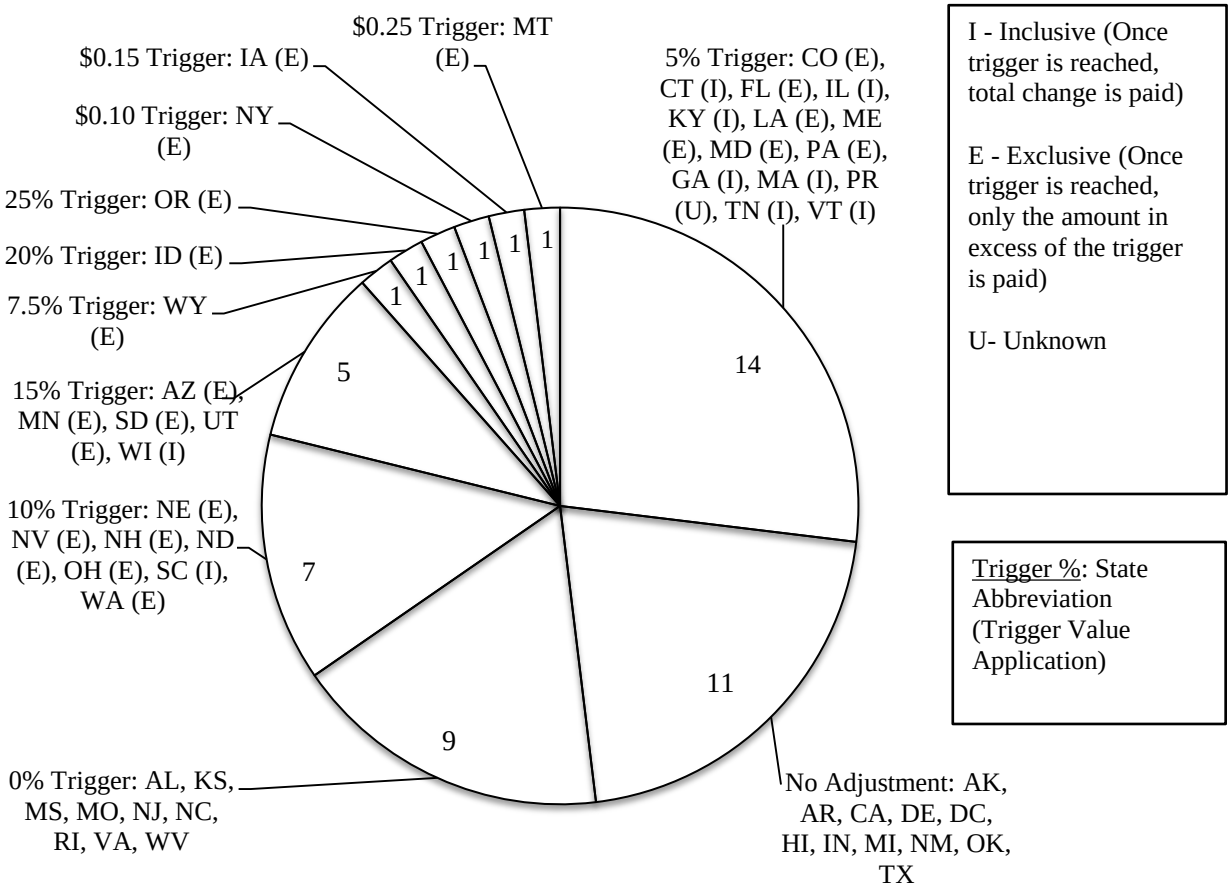

Figure 3.2 Distribution of Trigger Values and Modifiers for Fuel PACs

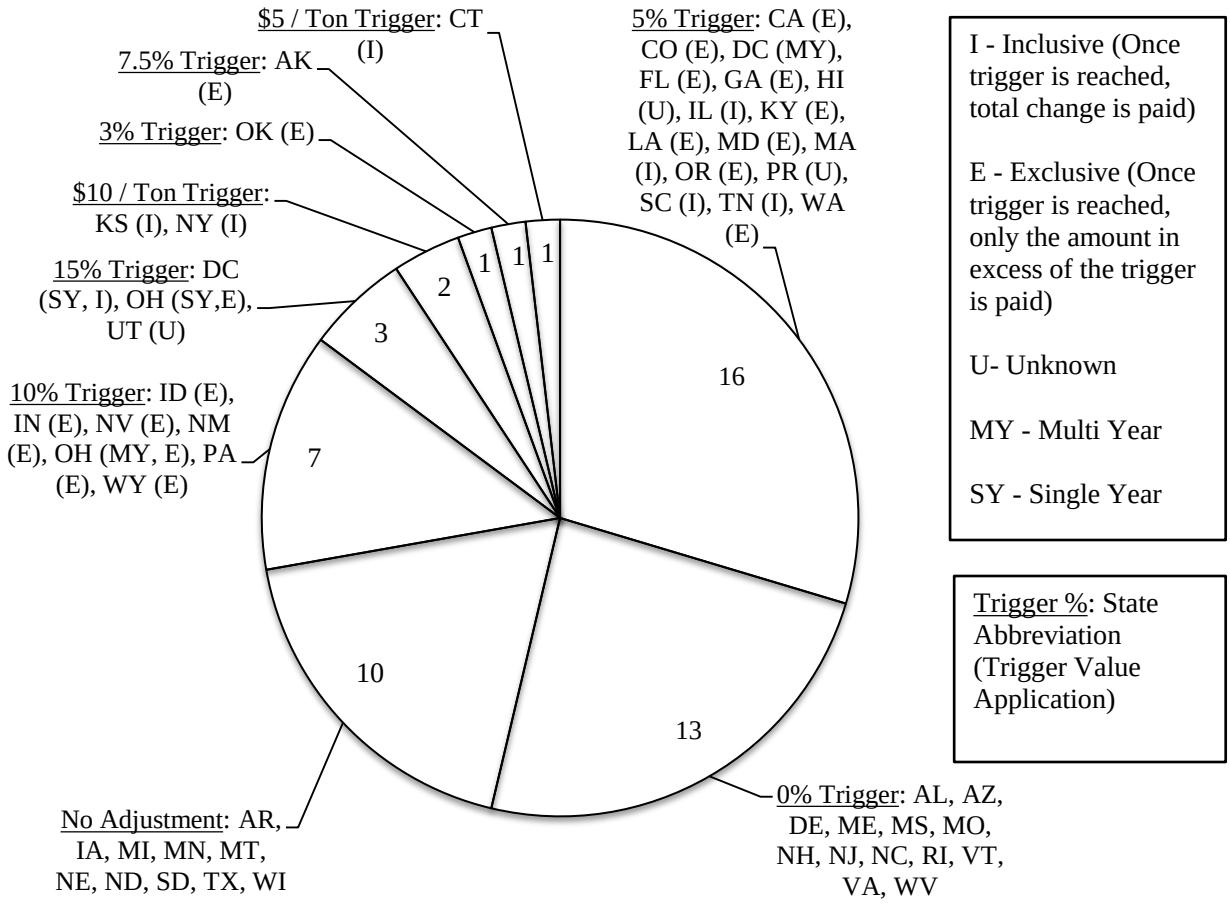

Figure 3.3 Distribution of Trigger Values and Modifiers for Asphalt PACs

3.3.1.4 Price Index Sources

Tables 3.4 and 3.5 show the asphalt and fuel price sources currently used for indexes. Of the national sources available, Asphalt Weekly Monitor is the most common source of asphalt price indexes; it has been adopted at 15 state DOTs. Asphalt Weekly Monitor is published by Poten & Partners and provides the most comprehensive coverage of asphalt prices in the United States and Canada. It lists prices and market developments for regions and specific locations throughout the nation on a weekly basis. It is also the most expensive source, but the high number of DOTs using it suggests that Asphalt Weekly Monitor is an accurate and reliable index for PACs. Given the high subscription cost, it is not surprising that most of the other DOTs obtain cost information for asphalt through local suppliers. It is noted that state DOTs in the

southeastern region, including South Carolina, utilize local suppliers rather than Asphalt Weekly Monitor or another national source.

However, the use of local suppliers for price indexing is much more common for asphalt than it is for fuel. Of the four state DOTs that use local suppliers for fuel price sources, three are in the southeastern U.S. (Florida, North Carolina, and South Carolina). Oil Price Information Service (OPIS) is the most prevalent fuel price source among national sources, followed with Platts and the United States Energy Information Administration (USEIA). OPIS provides daily price information for fuel at more than 360 locations, and the annual cost is much less than Platts. However, the subscription cost is charged per location (city), such that the annual cost can become expensive if multiple cities are incorporated into the calculation for a fuel index. For example, the annual cost for four cities would exceed $2,000. USEIA provides a free, alternative source that monitors weekly fuel prices in different regions of the country, as well as in specific states and major cities.

The BLS PPI (Bureau of Labor Statistics Producer Price Index) and ENR (Engineering New-Record) are two national sources that are underutilized. Illinois and Wyoming DOTs each use one of these sources for asphalt prices, as shown in Table 3.5, and none use the BLS PPI for fuel sources (ENR does not monitor fuel prices). Cost is not a factor, since the BLS PPI is free and ENR is the least expensive option compared to the other national sources. Both sources provide monthly price updates, which is much less frequent than the other sources that offer daily or weekly updates. Monthly updates do not capture the expected price fluctuations of asphalt and fuel and, therefore, are not necessarily representative of the costs incurred for the purchase of those materials in a given month.

Table 3.5 Asphalt Price Sources Used for Indexes at US DOTs

Sources	States	Fee	Frequency	Products
Asphalt Weekly Monitor	AZ, CT, ID, IN, KS, ME, MA, MO, NM, OH, OK, OR, UT, WA, WY	$3,595/yr	Weekly	PG 64-28, 64-22, 67-22, 58-28, 76-10, 64-10, 64-16, 70-10
ENR (Engineering News-Record)	IL	$82/yr	Monthly	PG58, Cutback MC800, Emulsion, Rapid Set, Slow Set
BLS PPI (Bureau of Labor Statistics Producer Price Index)	WY	Free	Monthly	Asphalt (no details, just listed as asphalt)
Local Suppliers	CA, DC, DE, FL, KY, LA, MS, NJ, NC, PA, RI, SC, TN, WV, WY	N/A	Depends on arrangement between DOT and suppliers	

Table 3.6 Fuel Price Sources Used for Indexes at US DOTs

Sources	State DOTs	Fee	Frequency
OPIS (Oil Price Information Service)	AZ, CO, CT, DE, ID, KY, MN, NV, OR, PA, SD, WV, WI, WY	$127.50 per quarter per city	Daily
Platts	AL, IL, LA, MS, MO, MT, NE	$5,495/yr	Daily
USEIA (U.S. Energy Information Administration)	ME, MD, VT, VA, WA	Free	Weekly
Local Suppliers	FL, NC, RI, SC	N/A	Depends on arrangement between DOT and suppliers

3.3.1.5 Price Adjustment Caps

Several state DOTs list maximum allowable price changes for fuel and/or asphalt price adjustment, as shown in Table 3.7. These caps were stated in the PAC documentation for each DOT. The most common cap is 50% but can be as high as 100%. Four state DOTs (Virginia,

Nevada, New Jersey, and Idaho) reserve the right to cancel the contract if the cap is reached. Utah and Virginia DOTs reserve the right to renegotiate the contract. Wisconsin DOT allows the project to proceed, but will not make any price adjustment above the cap.

It is interesting to note that only Nevada and New Jersey DOTs have identical calculation methods and caps for both asphalt and fuel. Nevada DOT has an exclusive clause with a 10% trigger and 75% cap, which means that it will reimburse the contractor an amount up to 65% of the base price for asphalt and fuel. New Jersey DOT has an inclusive clause without a trigger but a 50% cap, which means that it will reimburse an amount associated with any price increase that does not exceed 50%. In other words, smaller price changes are compensated but larger price changes are not. Idaho DOT has the most restrictive compensation for asphalt, since its reimbursement is limited to an amount up to 40% of the base price. Utah DOT is even more restrictive for fuel; its compensation is limited to an amount up to 35% of the base price.

Table 3.7 Asphalt and Fuel Price Adjustment Caps

State DOT	Price Adjustment Calculation Method and Trigger		Maximum Allowable Price Change	
	Asphalt	Fuel	Asphalt	Fuel
California	Exclusive, 5%	-	50%	None
Georgia	Exclusive, 5%	-	50%	None
Idaho	Exclusive, 10%	-	50%	None
Nevada	Exclusive, 10%	Exclusive, 10%	75%	75%
New Jersey	Inclusive, 0%	Inclusive, 0%	50%	50%
Ohio	-	Exclusive, 10%	None	50%
Utah	-	Exclusive, 15%	None	50%
Virginia	-	Inclusive, 0%	None	100%

3.3.2 Steel and Cement

Fewer state DOTs offer PACs for steel (15) or concrete (4) than for asphalt and fuel. Connecticut and Massachusetts DOTs are the only two that invoke PACs for all four materials. As shown in Figure 3.1, steel PACs are available in three distinct groups of states: the upper

western/northwestern U.S. (e.g. Washington and Wyoming DOTs), the Midwestern U.S. (e.g. Ohio and Wisconsin DOTs), and the northeastern U.S. (e.g. Massachusetts and Pennsylvania DOTs). A more detailed discussion of steel PACs is presented in Chapter 5.

Price adjustment for Portland cement and concrete materials is limited. Massachusetts DOT allows a price adjustment for projects using more than 100 cubic yards of Portland cement concrete. Its PAC uses a 5% trigger and an inclusive clause. Connecticut DOT uses a 5% trigger and an exclusive clause. New Mexico DOT uses a 10% trigger and an inclusive clause. Finally, Hawaii DOT uses a 5% trigger, but no details could be found on the price adjustment formula.

4 Evaluation of Price Adjustment Clauses

4.1 Risk Benefit Analysis of PACs

4.1.1 South Carolina Contractors' Perceptions of PACs

Two contractors were interviewed (REA Contracting and United Contractors) and five contractors were surveyed (Banks Construction, HRI Bridge Company, Sanitary Plumbing Contractors, Sloan Construction, and US Group). The purpose of these interviews and surveys was to understand the contractors' perception of and experience with price adjustment clauses. Table 4.1 summarizes the services that each contractor provides for SCDOT. The results from the surveys can be found in Appendix C. The work that these contractors perform covers a range of project types, project sizes, and material types. Project work includes interstate rehabilitation, road widening, bridge construction and bridge deck repair. Projects range from $10,000 to $70 million in cost and materials include asphalt, concrete, and steel.

Table 4.2 summarizes the responses regarding the benefits and risks associated with price adjustment clauses. Based on the responses, there is substantial evidence that contractors are in favor of price adjustment clauses. The major findings are as follows:

- Price adjustment lowers the financial risks associated with volatile construction materials. It was recognized that PACs protect the contractor in the event of rising prices, but that the clauses also protect SCDOT in the event of falling prices. This mechanism of sharing the financial risks in construction contracts was viewed favorably. There was support to continue the use of PACs for asphalt and fuel and to explore PACs for other construction materials.
- When there is a trigger value required to invoke price adjustment, contractors must take that risk into account in the bid formulation, causing bid prices associated with those materials to be higher. PACs without a trigger would be preferred. If there is no trigger, then the contractor will be reimbursed for any change in material cost. This effectively mitigates the risk with prices rising above the bid price.
- PACs tend to hold the bid price down slightly, but not considerably.

- Contractors are not always able to anticipate rapid market variations that result in large price increases in products that are not covered with PACs, like steel products. It was suggested that a steel PAC should be considered for development.
- In most cases, stockpiling construction materials is often not reasonable or cost effective, and so it is not a valuable addition or alternative to PACs.
- When questioned about market based risk management options, the contractors expressed concerns about vendor support for such services.

Table 4.1 Services Provided by Surveyed Contractors

Contractor	What kind of work do you do for SCDOT?	What construction materials are consumed in your work for SCDOT?	What materials are most volatile?
Rea	Interstate rehab is majority of their work SCDOT is 80% of jobs	Rock, binder, fuel. Sub-out: guardrails, striping, grass, road signs, rumble strips	
United Contractors	Everything from road widening to bridge construction SCDOT is 90+% of jobs	Asphalt, steel, concrete, paint, etc.	asphalt, overhead signs and structures
Banks Construction	Highway-heavy construction	Stone, pipe, sand, asphalt cement, etc.	asphalt
Sanitary Plumbing Contractors	Concrete Culverts, retaining walls, specialty concrete	Rebar, concrete, precast panel	rebar, fuel
US Group	General contracting on highway and bridge construction contracts. Earthwork, storm drainage, concrete work, erosion control.	Mainly pipe (RCP & HDPE), concrete, and all erosion control products.	concrete, steel, asphalt
Eastern Bridge (HRI Bridge)	Bridges of most types. Steel, concrete pile and drilled shaft supported concrete foundations. Concrete superstructures. Bridge demolition and deck repair, concrete retaining walls and mechanically stabilized earth walls. Up to 100 tons rebar, up to 150 tons structural steel.	Concrete, reinforcing steel, structural steel girders, precast concrete, bridge expansion joints, timber, pipe, steel pipe pile, metal bridge rail, coatings/paint, geo=fabrics, processed stone/rip rap.	fuel, concrete, steel, asphalt
Sloan Construction	Heavy Highway Range of Quantities Consumed in work for DOT: 0-300,000 tons aggregates; 0-10,000 CY concrete; 0-1,000,000 lbs. reinforcing	Liquid asphalt, aggregates, cement, girders(steel or concrete), expansion materials, reinforcing steel, drainage items	cement and steel

Table 4.2 Contractor Responses Regarding PAC Benefits and Risks

Contractor	What have your experiences been with SCDOT projects that allow price adjustments?	What are the risks associated with allowing price adjustments for materials?	Are the impacts of price adjustments different for small versus large contractors?	Building, buying, or leasing storage for contingency supplies of asphalt volumes.	Market-based risk management options provided by vendors equipped to do so.
Rea					
United Contractors	Positive	Trigger value imposes risk.	Yes	Binder is difficult to store.	
Banks Construction	Very favorable	Agency comes out ahead by taking the risk vs. shifting it to the contractor.	Yes	Not reasonable or cost effective in most cases.	Vendors will not provide the service.
Sanitary Plumbing Contractors	SCDOT publishes a list of items that will be adjusted.	None			
US Group	Normally good.	No risks associated with SCDOT covered items.	Impact is a function of cash flow and working capital	Restricted by cash flow concerns	Possible option, but restricted to very small number of vendors.
Eastern Bridge Company (HRI Bridge Company)	Tend to hold the price down slightly, as escalation additions may be lower.	Formulas can allow inadequate or incorrect adjustment.	Dollar magnitude may be different due to quantities.	Not viable all the time due to money that is tied up with stock piles.	Payment for materials on hand helps
Sloan Construction	Good and fair	Risk is mitigated for owner and contractor	No, both are protected	Cost of this is overwhelming	Vendors are always concerned with profit

4.1.2 Wyoming DOT (WYDOT) Experiences

Redd and Hibbard (2009) performed an initial investigation of alternatives to traditional asphalt price adjustment clauses for WYDOT, which use an exclusive PAC with a 10% trigger. Their index is based on regional average prices. It was determined that contractors support asphalt PACs; however the contractors recognize that there are still risks associated with material costs related to "asphalt price volatility (and material prices that contractors were charged that were over the CPI)." This can occur when there are increases in asphalt price after the current index is set but before the asphalt is purchased. Alternatively, the supplier may invoice the contractor for the previous month's index while the price is falling, thereby causing the contractor to pay more for the asphalt than the current DOT index price.

Risks are exacerbated in cases of extreme and rapid volatility in material prices, like what occurred during 2008. According to the SCDOT worksheet, the asphalt index price started at $351/ton in January 2008 and ended at $504/ton in December 2008. However, the most significant increase occurred over a two month period from June to August, when the price rose from $502/ton to $807/ton. Wyoming experienced similar dramatic changes in its asphalt index prices, especially during the asphalt paving season, which is much shorter than in South Carolina. Contractors interviewed by WYDOT described the following circumstances during their 2008 asphalt paving season, when asphalt rose from $500/ton to $800/ton in about eight weeks (Redd and Hibbard 2009):

- There were some problems with suppliers honoring contracts for price and volume; WYDOT does not allow PACs for fixed price contracts. If a supplier does not perform on a fixed price contract, the contractor is not covered by either protection plan.
- Among the eight contractors surveyed, there was approximately $1 million in impact. Delays were reported at $20,000 per day due to limited supplies. There were also increased hauling costs from alternate suppliers because of limited local supplies.
- Invoice timing created discrepancies between what the contractor is charged and what he/she is reimbursed for. For example, if the supplier invoices based on a previous month's prices, there can be a difference between the supplier invoice and the DOT reimbursement.

- WYDOT specifies an exclusive clause with a 10% trigger, which means that there is no adjustment paid for the first 10% price increase. Contractors were concerned that the 10% trigger was too high.

The study also questions whether price adjustment may have some long term negative effects on the asphalt market with regard to price competition (Redd 2010). DOTs have assumed more risk associated with price increases and should consider additional measures to reduce the high direct costs that result from price increases.

According to Redd and Hibbard (2009), there are several risk mitigation approaches that could be implemented as options to support price adjustment clauses, such as:

- storage for contingency supplies of materials;
- collaborating with other states;
- market-based risk management options;
- purchasing hedges on commodities related to the material in the PAC;
- considering long term market behaviors; or
- any combination of the above options.

Storage of liquid asphalt binder is more complicated than stockpiling of non-hazardous materials and therefore is not practical on a large scale. The WYDOT report suggests that an alternative to in-state storage involves "collaborating with surrounding states to reconcile specifications in order to pool supply requirements, garner joint supply, coordinate deliveries, etc." (Redd and Hibbard 2009). Market-based risk management options are possible with vendors capable of providing such options, but as noted in the survey of South Carolina contractors, the number of vendors would be quite limited and render this a non-viable approach.

In a technical brief, Redd (2010) describes how WYDOT might hedge against rising costs of asphalt using either futures contracts or call options with the New York Mercantile Exchange (NYMEX). A futures contract allows one to purchase an asset, such as oil, at the present time for a specified futures price at a specified future date. If one believes that the futures price of oil is less than what the actual price will be at that time, then a futures contract provides a means of

insurance against rising oil costs. In that case, a futures contract can be sold prior to the delivery date to collect on the oil price increase. If it does not reach the futures price, then there is a financial loss from the futures contract. Call options can have less risk than futures contracts in that the buyer has the "right, but not the obligation" to purchase oil, for example, at a futures price. However, call options require payment of a premium that is added to the futures price. For more details on futures contracts and call options, refer to the brief provided in Appendix D.

Redd (2010) illustrates how the purchase of call options compares to cost escalation payments made by WYDOT for asphalt in 2008. In one scenario, hedging against rising costs through a call option for crude oil (equivalent to 20,000 tons of asphalt) might have cost $600,000; whereas, the actual cost escalation payments for that amount of asphalt was at least $3,000,000. However, Redd (2010) clearly indicates that hedging requires more research, especially to determine the most appropriate oil-based commodity to hedge against. There are three such NYMEX commodities: heating oil, crude oil, and gasoline. Crude oil seems to be a reasonable option, although he recognizes that none provide a perfect hedge against asphalt price fluctuations. In addition to hedging asphalt with oil and/or gasoline on the NYMEX, steel could be hedged since it is traded on the London Metal Exchange and Chicago Mercantile Exchange.

With further research, these approaches might be able to provide a true market-based alternative for state agencies and, in effect, act as insurance policies against rising materials costs. Yet the public perception is more likely to be viewed as speculative on the part of state agencies, making it difficult to pursue hedging as a viable option. According to Redd (personal communication), WYDOT decided that the volatility of asphalt prices was not significant enough to consider hedging.

In summary, WYDOT stakeholders decided not to evaluate the first four risk mitigation options as listed above; rather, the group agreed to investigate the fifth option of considering long-range market behaviors of asphalt and concrete to help guide long-term paving strategies. To this end, Redd (personal communication) is developing a market analysis method for WYDOT and expects to make this available to other DOTs. He also maintains that price adjustment policies may have long-term negative effects on the construction materials market.

4.1.3 State DOT Survey on PACs

A survey was distributed to 52 state DOTs and 14 responses were received; the survey instrument and the complete response summaries are shown in Appendix A. As part of this survey, state DOTs were asked if there was allowance for state agencies to purchase options on, or stockpile, any construction materials. State DOTs were also asked if those options or stockpiled materials are available for use on contracts. It was also asked whether state agencies allowed contractors to purchase options or stockpile materials in advance of construction.

Table 4.3 shows the results to these particular survey questions. Six of the 14 state DOTs that responded allow the contractor to stockpile materials. One state DOT stockpiles and another is considering stockpiling for the contractor's benefit. Another state considered stockpiling liquid asphalt binder and found that the cost of tanks for storage was too high.

4.1.4 NCHRP Report 274

NCHRP Report 274 recommends price adjustment clauses as an appropriate mechanism for certain construction materials. Based on a weighting of the financial risks and benefits associated with price adjustment clauses, the findings suggest that such clauses are "moderately positive."

According to this report, the four benefits associated with price adjustment clauses are (NCHRP 2011):

- bid prices ("strongly positive");
- market stability ("strongly positive");
- number of bidders ("moderately positive"); and
- supply chain ("moderately positive").

The two most significant benefits are the positive impacts on controlling bid prices and market stability. While it is difficult to prove that PAC programs lower bid prices, there is "anecdotal and economic evidence" that supports it (NCHRP 2011). This observation is consistent with what was reported from the South Carolina contractor interviews. Without PACs, the

uncertainty of future material costs will translate into a higher bid price. With PACs, the magnitude of the trigger value to invoke price adjustment will likely influence the bid price. For example, the Rhode Island DOT (RIDOT) recently eliminated the 5% trigger value for asphalt. While a change has not been quantified, there is anecdotal evidence of a reduction in bid prices and an increase in bidding competition (based on personal communication with RIDOT representative). The latter observation also supports the "moderately positive" benefit of an increased number of bidders.

Table 4.3 State Responses to Survey Questions on Options and Stockpiles

State DOT	Does your state agency purchase options on or stockpile any materials at favorable prices and make those options or stockpiled materials available for use on contracts?	Does your state agency allow contractors to purchase options on or stockpile any materials at favorable prices in advance of construction?
AL	No, ALDOT has had discussions regarding asphalt, but initial cost was a deterrent.	
AK	No	No
IA	No	Yes, contractors may stockpile materials at their own expense. After contract award, reimbursements may be made for stockpiled materials not yet incorporated into work.
IN	No	No
KS	No	No
MD	No	Yes, the acquisition of materials with a long lead time may proceed upon notice of low bid but prior to award.
ME	No, but under consideration.	
MO	No	Yes, the engineer may include the value of any non-perishable material that will be incorporated in the work.
MT	Yes, we have optioned sources on a limited number of projects in the last few years and are exploring possible expansion of this practice.	Yes, any material that the contractor chooses. The vast majority of our contracts are contractor optioned sources so any aggregate, borrow, etc. can be procured ahead of the contract.
OR	No	Yes, we have a provision to pay advancement for materials on hand for most materials, if certain conditions are met.
TX	No	Yes
WA	No	N/A
WV	No	Yes, for aggregates, steel, electrical items, fencing, and guardrail.
WY	No, but under consideration.	

The other significant benefit is market stability. According to the NCHRP national survey, owners and contractors responded that market stability is a "large benefit" of PAC programs.

The four risk factors associated with price adjustment are (NCHRP 2011):

- direct costs ("negative");
- startup costs ("slightly negative");
- administrative costs ("slightly negative"); and
- political barriers ("slightly negative").

Direct costs were identified as the single largest financial risk associated with PACs. When material prices rise, the direct costs of price adjustment payments will exceed all administrative and other costs of the PAC program. While higher trigger values may reduce administrative duties related to price adjustment and therefore lower administrative costs, lower trigger values may reduce bid prices, as discussed earlier. As illustrated in Section 4.1.2, when a material like asphalt experiences a period of extreme price volatility, the direct costs can be abnormally high, especially for large projects where considerable material quantities are invoiced in a given period.

To illustrate the magnitude of direct costs, NCHRP (2011) lists the annual price adjustment payments and returns for 19 DOTs, including SCDOT, over a four year period. In 2006, 2007, and 2008, the total amount of payment far exceeds the returns due to each DOT. In 2009, the returns far exceed the payments. For example, in 2006, SCDOT distributed $38,299,465 in payments and received only $1,402,596 in returns. In 2009, however, SCDOT made $5,050,402 in payments but received $23,829,665 in returns. During that four year period, the SCDOT cumulative net payment was more than $44 million, or an annual average of $11 million. However, it is clear that the actual net payment for a given year deviates considerably from the average of $11 million, and this uncertainty creates a higher risk for SCDOT. Without price adjustment clauses, however, it is possible that bid prices would have been much higher in order to reduce risks to the contractor associated with material price increase.

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4.2 Selection of New PACs for Construction Materials

4.2.1 Materials under Consideration for SCDOT

As described in Chapter 3, SCDOT maintains active PACs for asphalt and fuel. In this investigation, 10 other construction materials were identified for consideration of price adjustment clauses. Those materials are described below.

4.2.1.1 Portland Cement

Portland cement is the binding agent used in all concrete structures (refer to Section 701 in SCDOT Standard Specifications for Highway Construction). It is also used in a broad range of other cement-based construction products, including, but not limited to: flowable fill, cement modified sub base and recycled base, cement stabilized earth base and aggregate base, Portland cement concrete pavement and patching, drilled shafts, pre-stressed concrete pilings, concrete pipe, concrete block, panels for mechanically stabilized earth walls (MSEW) and others. Portland cement is one of three materials that constitute the ENR MCI; the SCDOT Composite Index does not explicitly account for Portland cement, but it does include structural concrete as one of its weighted elements.

4.2.1.2 Coal Fly Ash

Pozzolanic and/or cementitious materials like coal fly ash, silica fume, and granulated blast furnace slag (i.e. slag cement) are often used as admixtures in Portland cement concrete products. For example, fly ash is often a high-volume component in the production of flowable fill, high performance concrete, and self-consolidating concrete. SCDOT Class 6500 and Class 10000 structural concrete calls for both fly ash and silica fume in the mixture design.

4.2.1.3 Steel

Steel can be classified into three categories: reinforcing steel, structural steel, and fastening steel (refer to Sections 703 and 709 in SCDOT Standard Specifications for Highway Construction, respectively). Reinforced concrete is used in numerous applications; structural steel is used extensively in bridge construction. Steel products are also used in a broad range of other

construction activities including driven piles, sign supports and sign structures, bridge railings and guardrails, and fences. Structural steel is one of three materials that constitute the ENR MCI; ENR also tracks the cost of reinforcing steel on a monthly basis. The SCDOT Composite Index uses reinforcing steel as one of its weighted elements, but not structural steel.

4.2.1.4 Aluminum

Aluminum or aluminum composites are used for products such as construction and work zone signs, flat sheet sign blanks and multiple panel signs, bridge railing, and corrugated pipe. ENR tracks the cost of aluminum sheeting on a monthly basis.

4.2.1.5 Crushed Stone (Coarse Aggregate)

Crushed stone and gravel serve as coarse aggregate sources for numerous construction applications, including, but not limited to: soil-aggregate sub base, graded aggregate base, cement stabilized aggregate base, hot mix asphalt (HMA) and cold mix asphalt pavement courses, open graded friction course, aggregate under drains, rip rap, and almost all Portland cement concrete products. Most of the components (e.g. aggregate base course and structural concrete) in the SCDOT Composite Index include construction items that use coarse aggregate. Coarse aggregate is not included in the ENR MCI; however, ENR tracks the cost of crushed stone and gravel on a monthly basis.

4.2.1.6 Sand (Fine Aggregate)

Sand serves as fine aggregate for Portland cement concrete and masonry products. It is also utilized in a number of the same construction applications as coarse aggregate, and it is an ingredient in several components that constitute the SCDOT Composite Index. Fine aggregate is not included in the ENR MCI; however, ENR tracks the cost of crushed sand and masonry sand on a monthly basis.

4.2.1.7 Lumber

Wood products for use in highway construction are detailed in Section 706 of the SCDOT Standard Specifications for Highway Construction. These include structural lumber, dimension

lumber, timbers, posts and braces, and timber piles. Lumber (2 x 4) is one of three materials that constitute the ENR MCI; the SCDOT Composite Index does not account for lumber. ENR tracks the cost of other dimension lumber products including 2 x 6, 4 x 6, 2 x 8, and 2 x 10 on a monthly basis.

4.2.1.8 Pavement Markings

Pavement markings can be temporary or permanent and consist of three general material types: fast drying waterborne paints, epoxies, and thermoplastics (refer to Sections 609, 625, 626, and 627 in SCDOT Standard Specifications for Highway Construction). Glass beads are added for retro-reflectance.

4.2.1.9 Polymers

Polymers can include polymer modifiers for asphalt, HDPE pipe, and extensible reinforcement (geo-synthetics) in MSEW construction, in addition to a few other products. It is recognized that each one of these examples represents a unique product and that the costs are not necessarily associated.

4.2.1.10 Grass Seed, Fertilizers, and Lime

At least nine different seeds (refer to Section 810 in SCDOT Standard Specifications for Highway Construction) are specified for SCDOT use. Commercial fertilizers, such as 10-10-10 mixed fertilizer, and lime are used for seeding, sodding, plants, and trees.

4.2.2 Factors Affecting PAC Selection

There are six factors that affect whether or not price adjustment should be considered for a given material (NCHRP 2011). Those factors are:

- Index availability;
- Index validity;
- Material measurement method;
- Material price change impact;

- Ability of the contractor to control the price of the material; and
- Program administration costs.

NCHRP (2011) gives suggestions as to which materials to include and which materials to exclude from PACs. The study assumes that there are provisions to pay for stockpiling. If stockpiling is not a provision, the recommendations might change.

For the purpose of evaluating construction materials for SCDOT PACs, three of these factors were selected: index availability, index validity, and the impact of changes in material price. Table 4.4 summarizes the results for asphalt and fuel, which have PACs, as a means for comparison to six other construction materials shown in Table 4.5: steel, aluminum, lumber, Portland cement, coarse aggregate and fine aggregate. As expected, this assessment demonstrates that asphalt and fuel are good candidates for price adjustment. First, there are several published and reliable sources for price indexes of both materials, and those sources provide price information for numerous locations. Second, the impact of a price change in either asphalt or fuel, or both, on project cost can be significant.

Steel and aluminum have multiple indexes that are easily accessible and updated regularly. Correlations between local prices and published prices for steel and aluminum might need to be developed and monitored to ensure that the index is accurate. This is particularly important for steel, given that there are different steel types and products that might be under consideration. However, steel is consumed in much larger quantities and in a broader range of construction projects than aluminum. Thus the impact of a steel price change can be high, and steel might be a reasonable candidate for price adjustment. This analysis is consistent with the fact that there are 15 state DOTs with steel PACs, but none with aluminum PACs. NCHRP Report 274 does not suggest steel as a material that is suited for PACs because the number of shapes and grades make it difficult to make a direct connection between an index and actual steel costs. Additionally, steel can be measured by weight or length, further complicating the process.

Published indexes for lumber are also available in a number of local markets. Like aluminum, lumber is not used in sufficient quantities for most construction projects and the price of lumber is not volatile. Lumber is therefore not a good candidate for PACs.

Published indexes can be found for Portland cement but might not reflect local market prices, since there can be local conditions that cause price variations among local and regional markets. However, Portland cement is consumed in a broad range of concrete products, and its cost can be somewhat volatile, especially during times when supplies are limited and demand is high. A Portland cement PAC can be used to help offset cost fluctuations, but it requires the development of a reliable and valid local index. It should be noted that price adjustment for Portland cement and/or Portland cement concrete products is currently allowed in four state DOTs. NCHRP report 274 points out that correlation of indexes for cement price and the actual cost of concrete is indirect because cement is used in the making of concrete. Also noted is that increasing cement cost can have an adverse effect on concrete prices. Additionally, it is impractical to stockpile concrete (NCHRP 2011).

Coarse and fine aggregate prices are driven strongly by local markets, and so published indexes are not available. Aggregate source proximity is the main factor that determines the local price of stone and sand. In markets where natural stone and sand are readily available, like in South Carolina, prices are lower; whereas, regions where natural resources are limited and products must be shipped have higher material costs and hauling costs. Even though aggregate is consumed in a broad range of products, it is not a reasonable candidate for PACs because of the lack of available indexes.

Table 4.5 does not include four of the 10 materials under consideration because there is a lack of available and valid indexes. Without them, PACs for coal fly ash, pavement markings, polymers, and agricultural products would not be suitable, even though the impact of material shortage can cause rapid price increases. For example, in the summer of 2010, the U.S. experienced a shortage of raw materials used in the manufacture of pavement markings. The shortage resulted from several occurrences throughout the manufacturing process. According to ATSSA (2010), the materials that were in limited supply included Acrylic Resin, Rosin Esters, Liquid Epoxy Resin and Titanium Dioxide. These materials are also used in other products, further complicating the shortage. Gum rosin, or pine sap, is used to produce the resins used in making thermoplastics. China has historically been a large exporter of gum rosin. The harvest of gum rosin was limited in 2009 while China had increased road construction, therefore

reducing the amount of export. In addition to those two factors, a manufacturer of rosin esters shut down one of its manufacturing plants. The combination of these three things was devastating to the global supply of resins and rosin esters. The price of pavement markings increased rapidly across the U.S. and, in some cases, materials could not be purchased and markings could not be placed, halting pavement construction. While this same set of circumstances is unlikely to occur again unexpectedly, it demonstrates the need for cost control measures and alternative practices.

Table 4.4 Factors Affecting Whether or Not PACs Should be Considered for Asphalt and Fuel

Material	Index Availability	Index Validity	Effect of Price Change
Asphalt	Indices are readily available from any number of national sources. The most common include Asphalt Weekly Monitor and Engineering News Record (ENR)	The available indices are valid for many locations nationwide. Asphalt Weekly Monitor provided price information for specific binder types for many markets.	An increase in asphalt binder price can have a tremendous effect on the budget of a paving job. Binder The price of asphalt binder is also more volatile than any other ingredient in HMA.
Fuel	Indices are available from any number of national sources. The most common include Oil Price Information Service (OPIS) and Platts Oilgram	The available indices are valid for many locations nationwide. OPIS provides cost information for hundreds of locations.	Because fuel is used in so many construction activities, the change in cost of fuel can affect a project in many different areas of the budget. The change in fuel cost can have a great effect on project costs.

Table 4.5 Factors Affecting Whether or Not PACs Should be Considered for Other Materials

Material	Index Availability	Index Validity	Effect of Price Change
Steel	Indices for steel are available. The steel index, American metal market, and ENR provide steel price information. The Bureau of Labor Statistics also provides cost information for steel.	Correlation of local steel prices and steel indexes are less direct than for other materials. Steel is available in many different types and grades. Most indexes do not cover every shape.	Steel price can have a great effect on bridge construction and other construction activities where steel is a major component of design
Aluminum	Indices for aluminum are available. London Metal Market and American Metal Market provide cost information for aluminum.	Indices available are for billet aluminum, costs may not apply to local market availability.	Aluminum is typically not a large portion of the material used on a construction project and therefore should not have a great effect on total project cost.
Lumber	ENR, Chicago mercantile exchange, and forest to market all provide lumber price information.	Lumber price may vary from market to market. Indices may or may not apply. ENR provides prices for 20 cities nationwide and an average based on those cities.	Lumber is typically not used in large enough quantities to have a great effect on project budget.
Portland Cement	Indices for cement are much less common than fuel and asphalt. The Bureau of Labor Statistics (BLS) and ENR do provide cost information for Portland Cement.	Because there are fewer indices available for cement, an index will not be valid in every market. The price of Portland cement can vary based on local market conditions.	Depending on the project, cement costs can have an effect on total project costs. Historically, cement costs have not been as volatile as petroleum based products.
Crushed Stone (Coarse Aggregate)	Local markets drive the costs of crushed stone and therefore there are typically not indexes for stone.	Not Available	Crushed stone may have a large effect on jobs with considerable amount of concrete or crushed stone as sub base for paving.
Sand (Fine Aggregate)	Local markets drive the costs of sand and therefore there are typically not indexes for sand.	Not Available	The price of sand may have an effect on jobs that call for large quantities.

4.3 Scenario Analyses

The following subsections compare SCDOT price adjustments for asphalt and fuel to those at other state DOTs. Comparisons are made based on theoretical scenarios with increasing asphalt and fuel prices, not actual data. For the purposes of a controlled comparison, the base price and current prices are assumed to be the same for all calculation methods, meaning that the prices would be identical in each state.

In these scenario analyses, the SCDOT price adjustments are shown to be continuous in a manner similar to other DOTs. Once a trigger is reached, an adjustment is calculated based on the current price to the nearest cent. For example, if the trigger is 5% and the price index shows an 8% increase for one month and a 12% increase for the next month, then the price adjustments are calculated based on 8% and 12%, respectively. SCDOT price adjustments, however, are based on 5% increments rather than a continuous function. In the prior example, SCDOT would make adjustments of 5% for the first month and 10% for the second month. The adjustment worksheet described in section 3.2 reflects this calculation method; in other words, the adjustment amount remains the same for index increases between 5 and 10%, 10 and 15%, and so on. An illustration of continuous and incremental calculation methods are shown in Figure 4.1. According to SCDOT, the incremental calculation method was not an intentional means of risk sharing, although it serves that purpose. Rather, the incremental calculations were intended to help make the adjustment process more simplified and manageable.

4.3.1 Asphalt

Figure 4.2 and Figure 4.3 illustrate the change in asphalt price adjustment as a function of current asphalt binder price. The base price for asphalt binder was set at $500/ton and was increased to $600/ton. The HMA quantity was fixed at 20,000 tons, which exceeds the minimum requirements for all states with minimums (as shown in Table 3.2). In its formula, Arizona DOT specifies a constant 5% asphalt binder. For compatibility, this value was applied to states with formulas that allow variable asphalt binder content. The resulting asphalt binder quantity is 1,000 tons. For the purpose of this example, the job in question is a 2 inch overlay paving job,

with ideal weather conditions. There is an uninterrupted supply of asphalt provided, and it is not unreasonable to assume that this job can be completed in one month.

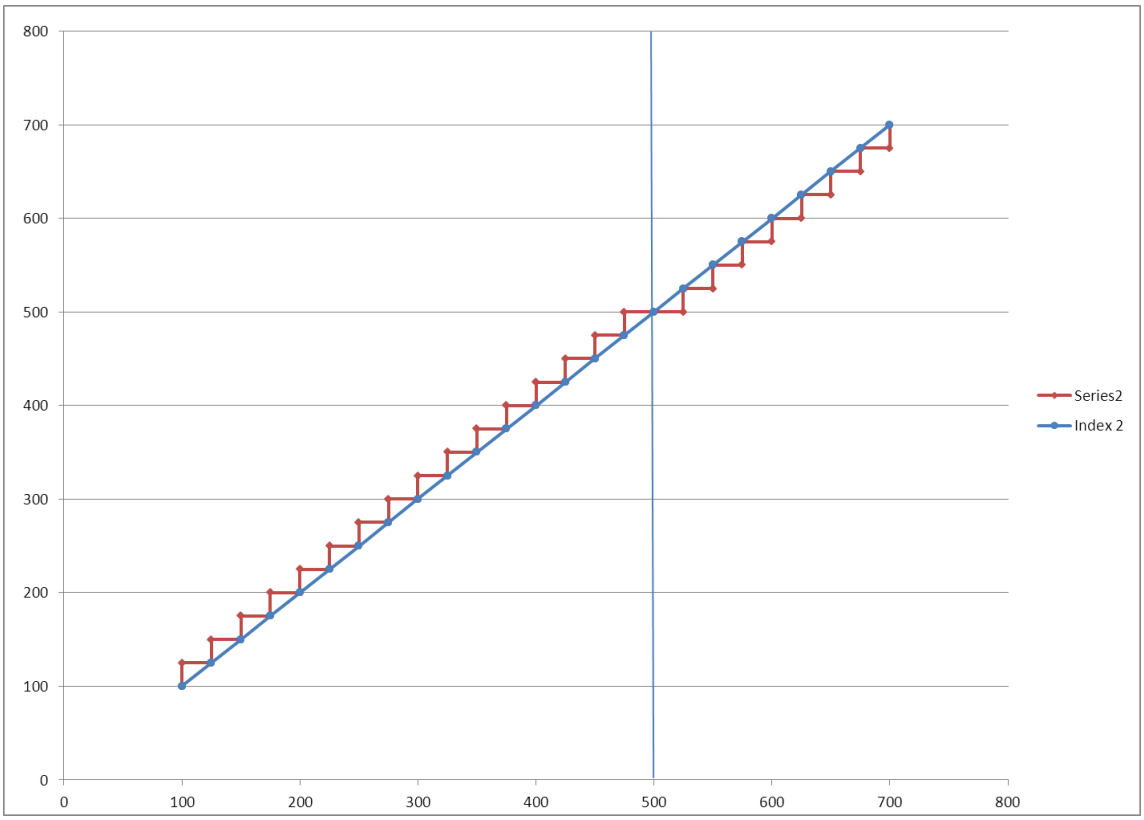

Figure 4.1 Illustration of Continuous and Incremental Price Adjustment Calculations

Figure 4.2 compares South Carolina DOT with the national trends for asphalt price adjustment. Inclusive and exclusive clauses are represented here with a range of trigger values. Because it uses an inclusive clause, South Carolina DOT has the highest price adjustment for asphalt when compared to state DOTs with exclusive clauses. It should be noted that 12 state DOTs have no trigger, so there are price adjustments for any change in asphalt binder price, assuming that other applicable conditions (e.g. minimum quantities) are met. State DOTs with triggers are identified with a step function at the asphalt binder price that corresponds to its trigger value. In Figure 4.2, most price adjustment clauses are invoked at or prior to a current price of $525/ton. The maximum trigger value is 15% (Ohio DOT), which means that adjustments are not invoked until the price exceeds $575/ton. As a result, there are no price adjustments at Ohio DOT when price adjustment for the other states ranges from $12,500 to $50,000 at a current price of $550/ton,

which corresponds to a 10% price change. When the current price is $575/ton, because Ohio DOT uses an exclusive clause, there is still no price adjustment when the range of other price adjustments is from $25,000 to $75,000.

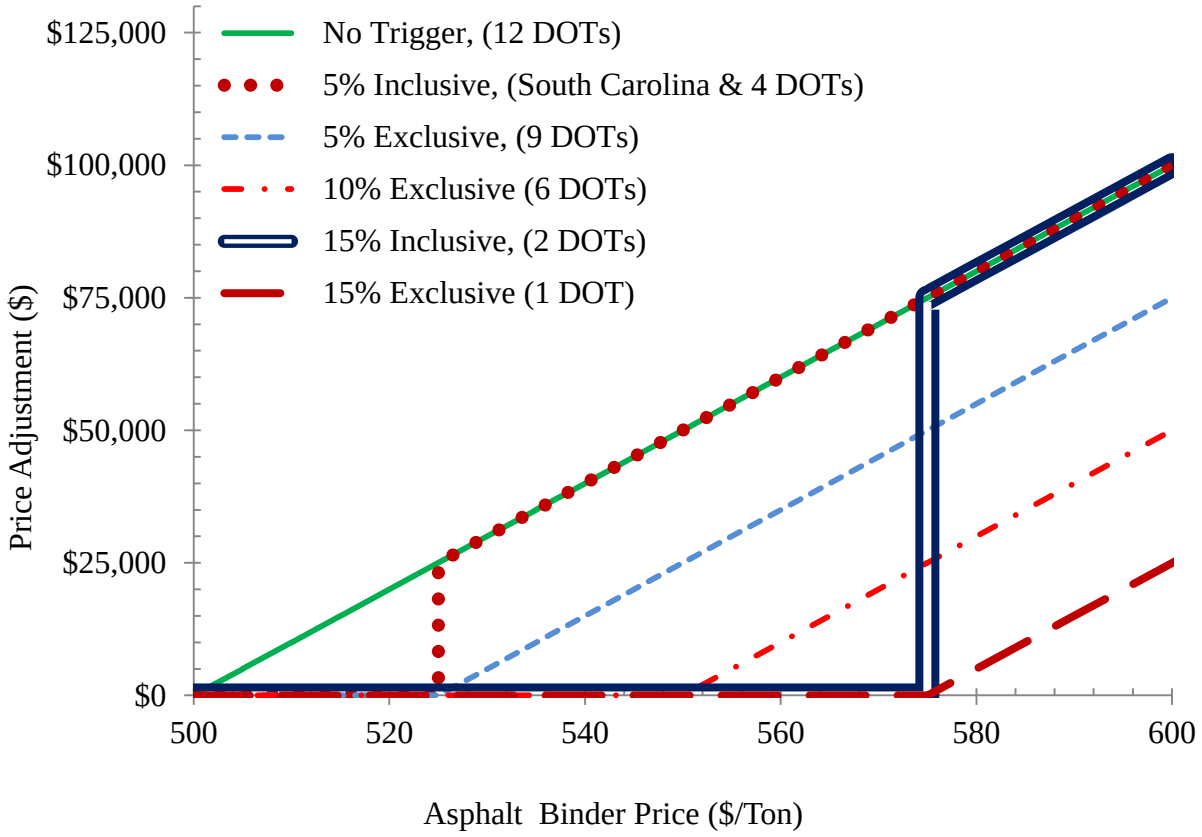

Figure 4.2 National Comparison of Price Adjustment vs. Asphalt Binder Price

Figure 4.3 compares South Carolina DOT with other state DOTs in the southeast. The states include Alabama, Florida, Georgia, North Carolina, Tennessee, and Virginia. Both inclusive and exclusive clauses are represented as well as no trigger and 5% trigger. When a current price of $525/ton is reached, all of the clauses are invoked and the difference between the minimum and maximum price adjustments is $25,000. This difference remains constant as the current price rises above 15% of the base price.

Figure 4.4 compares asphalt price adjustment as a function of small-to-medium HMA quantities up to 20,000 tons. In this comparison, the price change in asphalt binder was set at 20% to

exceed all of the trigger values. Given a hypothetical base price of $500/ton for asphalt binder, the current price is assumed to be $600/ton. The inclusive and exclusive clauses have differing slopes in this analysis; an inclusive clause yields a steeper slope and thus a larger adjustment rate per ton of HMA.

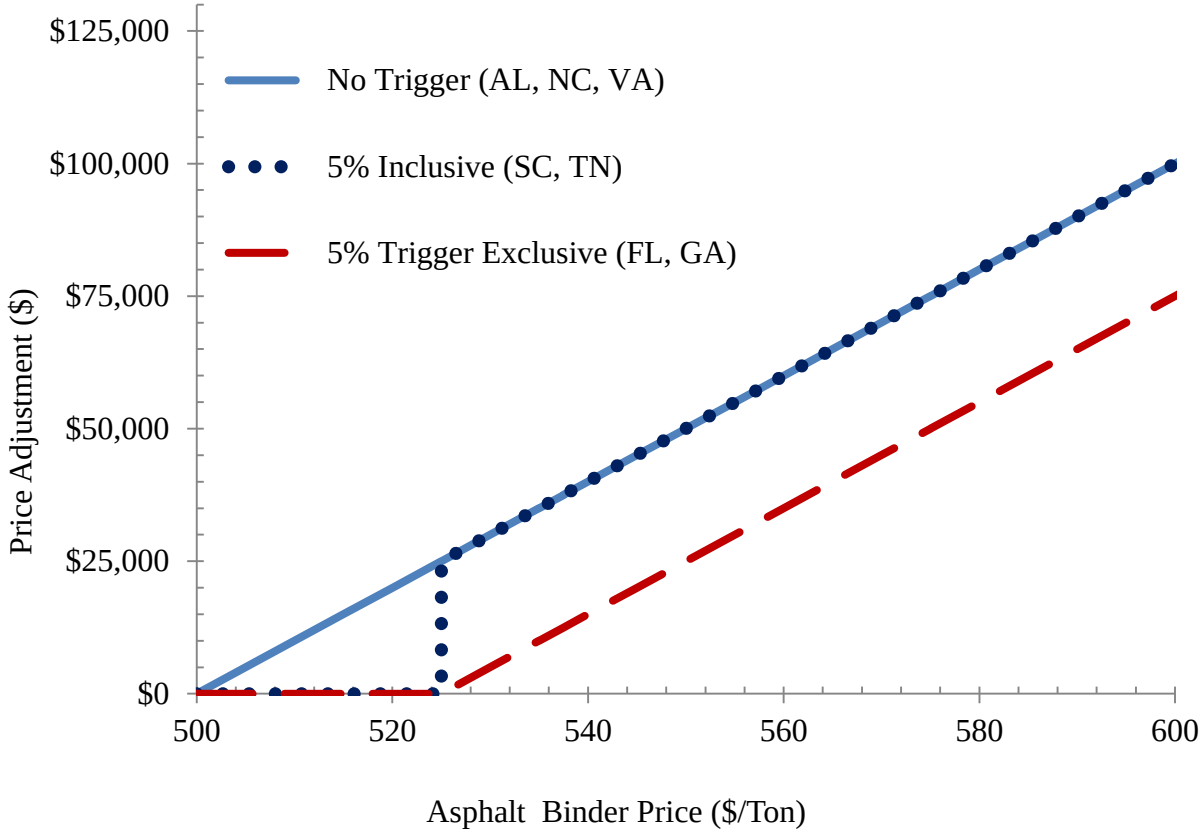

Figure 4.3 Southeastern Regional Comparison of Price Adjustment vs. Asphalt Binder Price

South Carolina has a 40 ton minimum for asphalt binder, and assuming 5% binder this would represent 800 tons HMA. Florida requires a minimum of 5,000 tons HMA for asphalt price adjustment. These are compared to 14 states that do not have minimums stated in their PAC documentation. For a 5,000 ton HMA project, the minimum and maximum price adjustments would be $0 and $25,000, respectively. South Carolina and the 14 other states would make payments of $25,000 in this case, but Florida would not have a price adjustment.

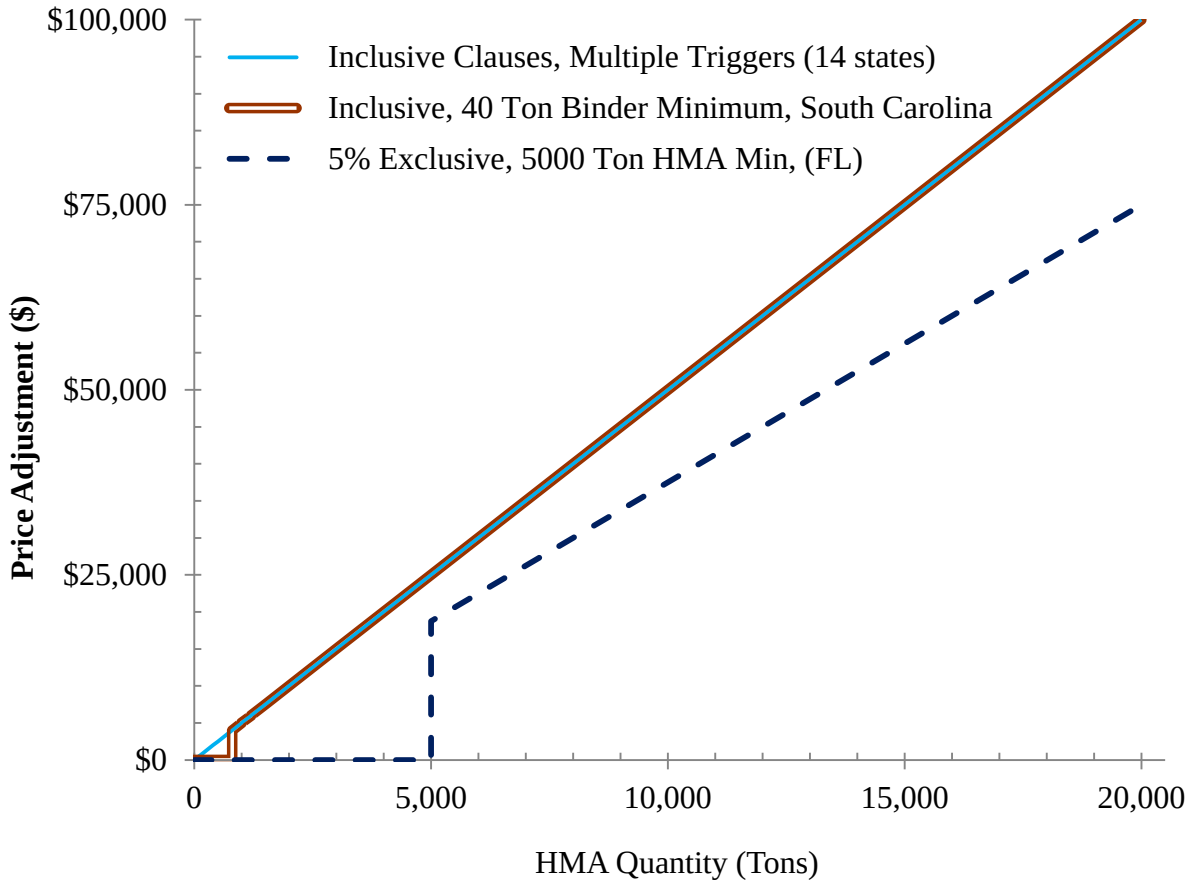

Figure 4.4 Price Adjustment vs. HMA Quantity

For a 20,000 ton project, the minimum and maximum price adjustments would be $75,000 and $100,000, respectively. The difference is $25,000, which equates to 33% of the minimum adjustment. Since the price adjustments increase at different rates for inclusive and exclusive clauses as HMA quantities increase, the difference in magnitude of adjustment becomes substantial. If a much larger project of 200,000 tons of HMA is assumed, the minimum and maximum price adjustments would be $750,000 and $1,000,000. Table 4.6 shows several scenarios for projects ranging from 5,000 tons to 200,000 tons of HMA. The percentage difference remains the same between the two examples, but a $250,000 difference has more potential impact on the contract budget. In contrast, when the HMA quantity is fixed and the price changes, the amount remains the same but the percentage difference of the price adjustments falls as the price change increases.

Table 4.6 Price Adjustments for Different HMA Quantities

Adjustment Method, with 5% Trigger	Price Adjustments				
	HMA, tons				
	5,000	25,000	50,000	100,000	200,000
Inclusive	$25,000	$125,000	$250,000	$500,000	$1,000,000
Exclusive	$18,750	$93,750	$187,500	$375,000	$750,000

4.3.2 Fuel

Figures 4.5, 4.6, and 4.7 compare fuel price adjustment versus change in fuel price. For the purpose of this analysis, only the states with fuel usage factors for excavation, hot mix asphalt (HMA), and Portland cement concrete pavement (PCCP) for diesel fuel were considered. The quantity of excavation was set to 40,000 cubic yards, (HMA) was set at 20,000 tons, and PCCP was set to 20,000 square yards. The base price was set at $2.50/gallon and was increased to $3.75/gallon. This is not an unreasonable scenario given the rise in fuel prices in the 2008 construction season in South Carolina. In this scenario, the price adjustment represents a hypothetical increase in payment to the contractor. In order to compare these fuel usage factors, all adjustments were calculated using a 5% inclusive PAC, which is what South Carolina uses for Fuel. In all three figure, the minimum, maximum, and South Carolina's fuel usage factors are shown along with how many other states use these factors.

The minimum and maximum price adjustments for excavation at a 50% increase in fuel price ($3.75/gallon) would be $3,000 and $25,000, respectively. The difference is $22,000, which represents a 700% increase in adjustment based on the minimum payment of $3,000. Figure 4.6 and 4.7 also show similar trends. Given the same 50% increase in fuel price ($3.75/gallon), the minimum and maximum price adjustments would be $22,500 and $87,500, respectively for HMA, and $2,750 and $24,500, respectively for PCCP. In this case, the differences represent 280% and 790% increases, respectively, based on the minimum payments for each work item.

South Carolina falls in between the minimum and maximum values for all three work items considered. The fuel usage factors that South Carolina uses, however, do fall towards the high end of those in place at other DOTs.

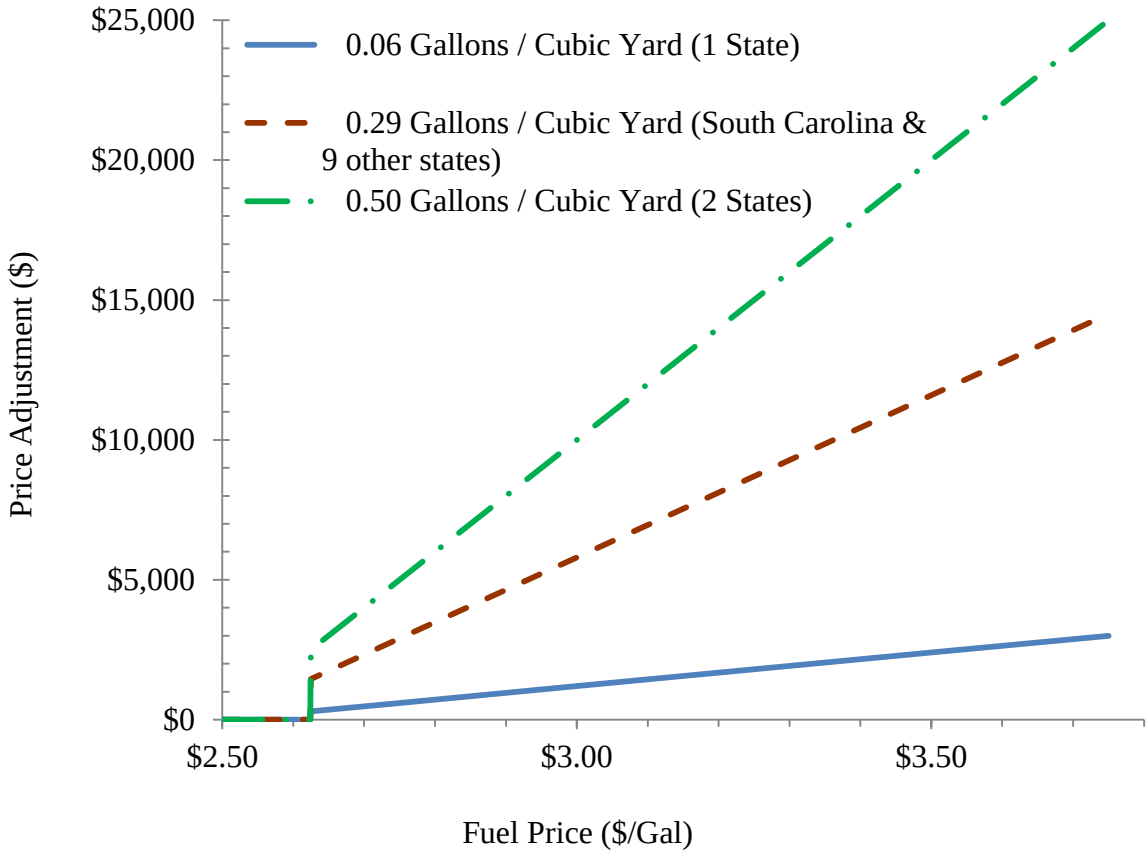

Figure 4.5 Price Adjustment vs. Fuel Price for Excavation

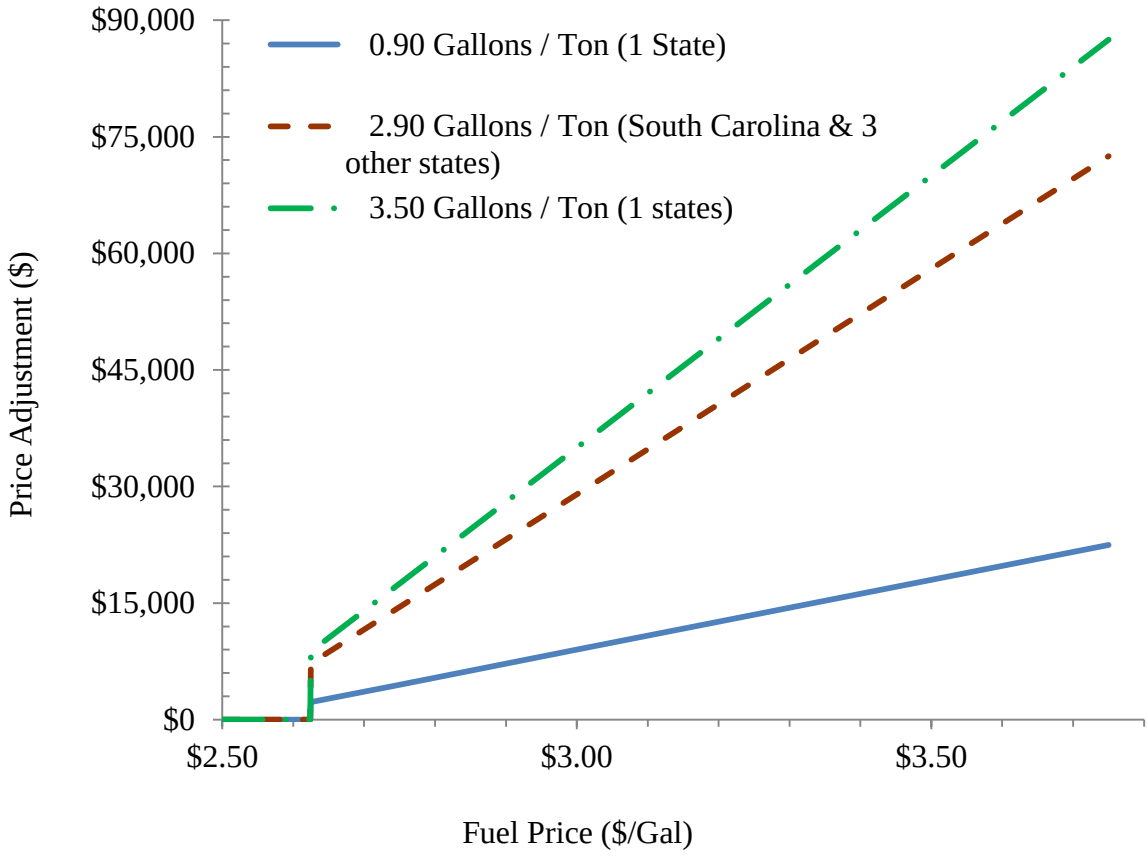

Figure 4.6 Price Adjustment vs. Fuel Price for HMA

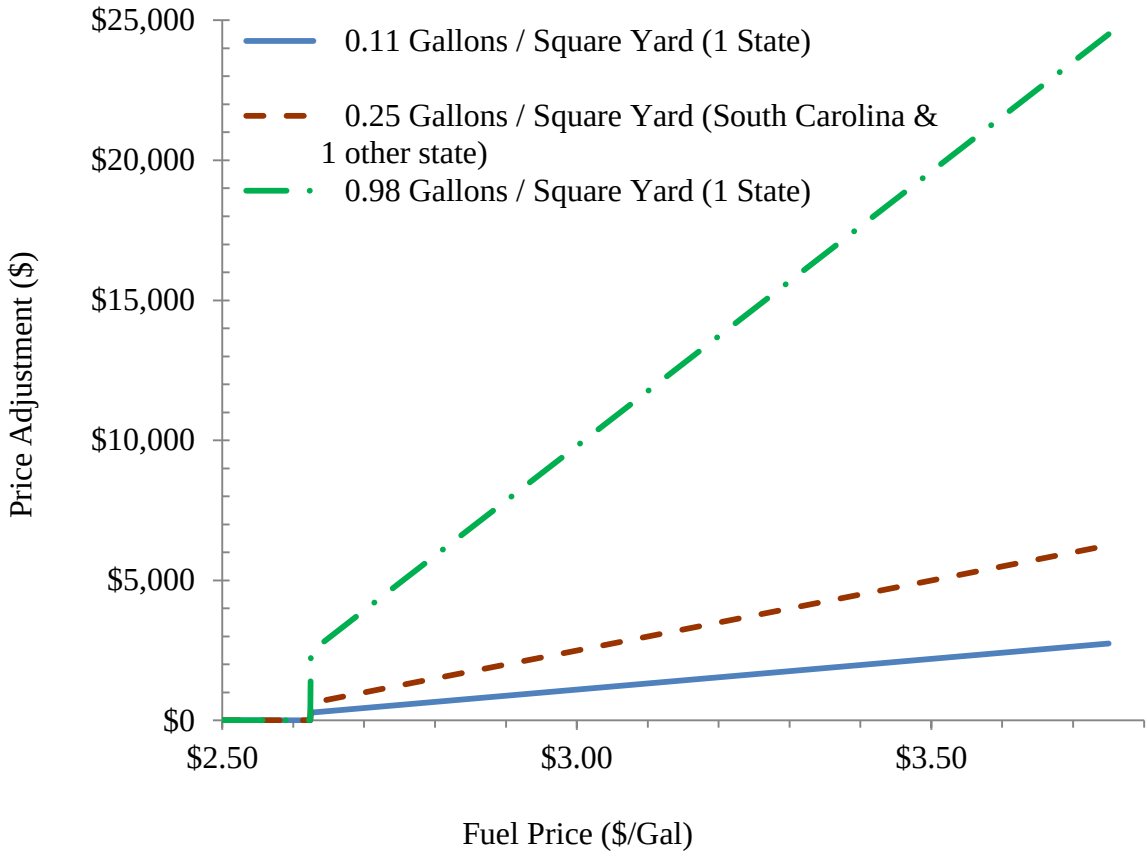

Figure 4.7 Price Adjustment vs. Fuel Price for Portland Cement Concrete Pavement

5 Steel Price Adjustment Clauses

5.1 Current Practice

There are 15 state DOTs that have current PACs for steel. Steel PAC documents for 13 state DOTs were acquired and evaluated; the investigators were unable to obtain published documentation for New Jersey and Rhode Island. Based on a review of steel PACs, six have minimum qualifications as shown in Table 5.1. New Jersey DOT is the only one that specifies a minimum quantity of steel; their clause is intended for very large projects and the minimum quantity is set at 500 tons (personal communication with New Jersey DOT representative). Both New York DOT and Illinois DOT specify a minimum cost of steel. New York DOT requires a $1,000 minimum and Illinois DOT specifies a $10,000 minimum for what is classified as "other" steel items. These materials include "dowel bars, tie bars, mesh reinforcement, guardrail, steel traffic signal and light poles, towers and mast arms, metal railings (excluding wire fence), and frames and grates." These items are eligible for price adjustment when "the pay item they are used in has a contract value of $10,000 or greater." This minimum cost requirement does not apply to metal piling, structural steel, or reinforcing steel; however these three materials are eligible for price adjustment. Connecticut, Ohio and Washington DOTs specify minimum time requirements. Connecticut DOT requires a minimum of two years, Ohio DOT requires a minimum of one year, and Washington DOT requires that a project must last 200 working days to be eligible for steel price adjustment.

Structural and reinforcing steel are eligible items in most, but not all, of these PACs. Connecticut DOT allows price adjustment for reinforcing steel but not structural steel; Wisconsin and Ohio DOTs allow price adjustment for structural steel but not reinforcing steel. The other state DOTs with steel PACs have provisions for both structural and reinforcing steel. About half of the steel PACs include other items, such as sheet piling, guard railing, traffic signage, frames, and grates.

Price adjustments for steel are most often calculated using an exclusive formula with trigger values ranging from 5% to 15%, as shown in Table 5.1. Eleven of the 15 state DOTs use exclusive formulas and two use inclusive formulas. Formulas for the remaining two were not

determined because the study team was unable to obtain their PAC documents. Trigger values for exclusive clauses are 5% and 10%. Trigger values for the two inclusive clauses are 5%. New Jersey DOT is the only state that specifies a trigger value of 15%. However, it is unknown whether the formula is exclusive or inclusive, which will have a significant impact on the price adjustment.

Table 5.1 shows that exclusive formulas are common for steel, which is consistent with the most common practices for fuel and asphalt price adjustment calculations. However, the ratio of exclusive to inclusive formulas is much higher for steel. The exclusive: inclusive ratio for steel PACs is 11:2, compared to about 5:2 for both fuel and asphalt PACs. Trigger values of 5% and 10% for steel are also similar to the most common practices for fuel and asphalt. Both of these specifications help to reduce direct costs to DOTs. There are no steel PACs with zero trigger values, which is the most significant difference from fuel and asphalt PACs, where inclusive formulas with no trigger requirements are somewhat common.

New York DOT includes a condition that states "adjustments, either positive or negative, will be made when the accumulated amount for a price adjustment contract pay item exceeds $5,000." Wisconsin DOT will allow partial payments of price adjustment when the amount due "exceeds $10,000 or at the end of each construction season."

Five state DOTs cap the price adjustment for steel. Four of the five state DOTs set a maximum percent increase in material cost at 50% (Ohio, Virginia, and Wisconsin DOTs) and 75% (Nevada DOT). This means that once the current price exceeds the cap, the price adjustment reimbursement is limited to that maximum allowable percentage for that invoice period. Utah DOT specifies a maximum dollar amount of $500,000, meaning that price adjustment reimbursements cannot exceed $500,000 for the entire contract. While caps are less common for fuel and asphalt adjustment, when they are specified, 50% seems to be the most common. This assessment of caps is based on information presented in the steel PAC documentation, and it is possible that cap specifications are provided in other related DOT documents.

Table 5.1 Summary of Steel PACs

State DOT	Eligible Materials			Minimum Qualifications	Adjustment Formula	Trigger	Adjustment Cap
	Structural	Reinforcing	Other				
CT	No	Yes	No	2 Years	Exclusive	5%	N/A
IL	Yes	Yes	Yes	$10,000	Inclusive	5%	N/A
MA	Yes	Yes	Yes	N/A	Inclusive	5%	N/A
NJ	Yes	Yes	No	500 Tons	Unknown	15%	N/A
NV	Yes	Yes	Yes	N/A	Exclusive	10%	75%
NY	Yes	Yes	No	$1,000	Exclusive	5%	N/A
OH	Yes	No	No	1 Year	Exclusive	10%	50%
OR	Yes	Yes	Yes	N/A	Exclusive	10%	N/A
PA	Yes	Yes	No	N/A	Exclusive	5%	N/A
RI	Yes	Yes	No	N/A	Unknown	10%	N/A
UT	Yes	Yes	Yes	N/A	Exclusive	5%	$500,000
VA	Yes	Yes	Yes	N/A	Exclusive	10%	50%
WA	Yes	Yes	Yes	200 Working Days	Exclusive	10%	N/A
WI	Yes	No	No	N/A	Exclusive	5%	50%
WY	Yes	Yes	Yes	N/A	Exclusive	10%	N/A

Table 5.2 State-by-State Details of Products and Price Indexes for Steel PACs

State DOT	Steel Products	Price Index Source	Notes
Connecticut	**reinforcing steel (deformed steel bars, deformed steel bars - epoxy coated, deformed steel bars - weldable)**	ENR, reinforcing bars (Grade 60, #4) and reinforcing bars (epoxy) for Boston	
Illinois	structural steel, **reinforcing steel**, steel metal piling (excluding temporary sheet piling), **dowel bars**, **tie bars**, mesh reinforcement, guardrail, steel traffic signal and light poles, towers and mast arms, metal railings (excluding wire fence), and frames and grates	ENR, materials cost index for steel	no adjustment made for changes in the cost of manufacturing, fabrication , shipping, storage, etc.
Massachusetts	rolled shapes, plate steel, sheet piling, pipe piles, steel castings, steel forgings, guardrail, and **unfabricated reinforcing steel bars**	PPI	adjustments will not include the costs of shop drawing preparation, handling, fabrication, coatings, transportation, storage, installation, profit, overhead, fuel surcharges, or other such charges not related to the cost of the unfabricated structural or reinforcing steel itself
New Jersey	structural steel, **steel reinforcement**, steel piling, guide rail, steel conduit and other miscellaneous steel bid items	PPI	**items such as precast culverts that contain steel reinforcement are not eligible for consideration**
Nevada	**reinforcing steel**, structural steel, overhead sign structures, steel piling, steel poles for luminaries and traffic signals, **dowel bars and tie bars for concrete pavement**, and beam elements and metal posts for guardrail	ENR, average of the 20-City Average for "Grade 60, #4 Reinforcing Bars" and "Hot-Rolled Carbon Steel Plate"	no other steel materials are covered by this provision
New York	structural steel, **reinforcing steel**	PPI	
Ohio	steel H piling, stay in place steel casing (piling and caissons)	average of three producers for levels UF 1,2,3 and AMM for levels 4,5,6	nuts, bolts, rebar chairs, connecting bands and other miscellaneous hardware items shall not be included; no other steel products shall be considered; adjustments will only be made for fluctuations in the cost of steel as shipped from the producing mill; no adjustment will be made for changes in the cost of manufacturing, fabrication, shipping, storage, etc.

Oregon	structural and **reinforcing steel**, steel studs, sheet piling, guardrail, ductile iron pipe and other steel products used for the construction, reconstruction or major renovation of a road or highway	PPI, using non-seasonally adjusted indexes only	
Pennsylvania	structural steel, **reinforcing steel**	PPI	
Rhode Island	structural steel, **reinforcing steel**	PPI	
Utah	steel girders including structural bolts, metal attachments, and structural steel in sign supports, **concrete reinforcing rebar**, steel pipe piling, steel H-piling	Girders – The Steel Index, USA, domestic, prime carbon steel plate, structural quality ASTM A36 or equivalent Piling – CRU Monitor, steel finished products, pipe piling **Rebar – ENR, Denver (Grade 60, #4)**	
Virginia	structural steel (rolled beams, plate girders, diaphragms, plate bearings, etc.), **reinforcing steel (plain and epoxy coated)**, overhead sign structures, guardrail, posts, standard sign or lighting supports, railing, encasement pipe, H-piles (end bearing or friction), **steel strand (used for pre-tensioned or post-tensioned finished elements)**, and sheet piles	PPI	
Washington	structural steel, **reinforcing steel**, soldier piles, permanent steel casings for vertical shafts, horizontal borings, and concrete piling	ENR, materials cost index for steel	
Wisconsin	structural steel carbon, structural steel HS	AMM, average of shredded auto scrap and No. 1 heavy melt prices	no adjustment made for work for any products after the authorized time for completion
Wyoming	**reinforcing steel**, pedestrian rail, box beam guardrail, bridge rail, structural steel, overhead sign structures, and **reinforcing steel (coated)**	PPI	**adjustments made for reinforcing steel in approach slabs and drilled shafts**

A state-by-state listing of the steel products eligible for price adjustment are shown in Table 5.2. There is a wide range on the number and type of steel products that are called out in the documentation. For example, state DOTs in New York, Pennsylvania, and Rhode Island identify structural steel and reinforcing steel as eligible products, without further details. Other states are more specific about eligible items. Virginia DOT qualifies structural steel as "rolled beams, plate girders, diaphragms, plate bearings, etc.," and Utah DOT specifies that "steel girders, including structural bolts" and "structural steel in sign supports" are allowable. Connecticut DOT qualifies reinforcing steel as deformed bars, deformed bars with epoxy coating, and weldable deformed bars. Steel piling products (such as H-piles, pipe piles, sheet piles, and steel casings) are also identified frequently, with nine DOTs listing at least one piling product.

Table 5.2 also identifies the published price index source(s) that each DOT uses to maintain a steel index. It should be noted that none of the 15 state DOTs with steel PACs utilize local suppliers as a means for determining a steel index. Table 5.3 summarizes the price index sources and presents them in rank order of adoption for steel indexes. The two most common sources are the Producer Price Index (PPI), published by the U.S. Bureau of Labor Statistics, and the Engineering News Record (ENR).

Table 5.3 Price Index Sources Adopted for Steel PACs

Price Index Source	Rank (No. DOTs)	Geographical Coverage of Index	Publication Frequency	Annual Cost
Producer Price Index (PPI)	1 (8)	National	Monthly	Free
Engineering News Record (ENR)	2 (5)	Major Cities (20) National (average of 20 cities)	Monthly	$82
American Metal Market (AMM)	3 (2)	National	Daily (except Sun, Mon)	*unknown*
The Steel Index	4 (1)	National	Weekly	$990
CRU Monitor	4 (1)	National	Weekly	*unknown*

PPI publishes a commodity index for metals and metal products and, within that, an index for iron and steel products that is further subdivided into a considerable number of process-specific and product-specific indexes. New Jersey, Pennsylvania, and Wyoming DOTs use the semi-finished steel products index; New York DOT uses the shredded carbon scrap steel index; and Rhode Island DOT uses the index for hot rolled bars, plates and structural shapes.

ENR publishes steel prices per cwt. for 20 cities nationwide for standard structural shapes, reinforcing bars (coated and uncoated), hot rolled carbon steel plate, and steel piling. ENR also publishes a national average of these 20 cities as well as a material cost index that tracks the combined cost of Portland cement, 2 x 4 lumber and structural steel. For its steel index, the Connecticut DOT uses reinforcing bar pricing for Boston, Massachusetts. Nevada DOT calculates an average of the 20-city average steel pricing for reinforcing bar and hot rolled carbon steel plate. Illinois and Washington DOTs use the materials cost index.

The American Metal Market (AMM) provides a daily index, except Sunday and Monday, for steel, nonferrous, and scrap metal markets. Ohio and Wisconsin DOTs are the two that use AMM to index steel prices for structural steel (since these two state DOTs do not allow price adjustment for reinforcing steel or other steel products). Utah DOT maintains three different steel indexes from three different sources, as shown in Table 5.2. The Steel Index provides weekly steel prices based on actual transaction data from 400 companies. CRU Monitor provides weekly prices for semi-finished and finished carbon steel products.

5.2 Current Developments

5.2.1 Changes in Steel PACs

According to the 2009 AASHTO Price Adjustment Survey (AASHTO 2009), several states have made changes to steel PACs. Florida DOT used a steel PAC from March until December of 2004. It reports that the industry has requested reintroduction of steel PACs to contracts; however, at the time that the survey was conducted, Florida DOT was not considering the request. Vermont DOT developed a steel PAC, but it is not used because it is not supported by the Associated General Contractors of America. Although listed as one of the 15 state DOTs with steel PACs, New Jersey DOT has allowed steel price adjustment for very few projects and does not include it in their standard specifications or special provisions.

5.2.2 Reinforcing Steel in PACs

As shown in Tables 5.1 and 5.2, reinforcing steel is included as an eligible item for price adjustment in all but two of the states with steel PACs. In an effort to compile additional information on the acceptance and performance of price adjustments for reinforcing steel, a brief survey was prepared and distributed to the state DOTs. The survey questions are as follows:

Q1. What, if any, were the driving reasons for the decision to include (or not to include) *steel reinforcement* in price adjustment for steel?
Q2. Does your price adjustment clause also cover *steel reinforcement* in precast elements?
Q3. How long has your price adjustment clause for *steel reinforcement* been in place, and has it functioned well from the perspective of the DOT and contractors?
Q4. Are you satisfied with the price index used for *steel reinforcement*? If not, what changes, if any, have been considered?

Six of the 15 DOTs responded and the results are presented in Table 5.4. Five of the six respondents were identified previously as state DOTs that allow price adjustments for reinforcing steel. Ohio DOT was the sole respondent that does not allow reinforcing steel. Their response indicates that reinforcing steel was included in the initial development of a steel clause, but has since been removed because of limited benefit to both parties and complications in tracking mill shipping dates. Rhode Island DOT indicated that their steel clause is not active, but there is a specification for it. However, it no longer considers reinforcing steel, just structural steel for large projects.

Collectively, there is limited information provided on the reasons for including reinforcing steel in their PACs. In two cases, it was the result of a legislative mandate (in Massachusetts and Oregon). In general, it appears that the motivation was to develop a clause to accommodate rising prices for all steel products, including reinforcing steel. Reinforcement in precast concrete elements is not eligible for price adjustment. Ohio DOT noted that reinforcement in precast concrete would have been eligible in its initial steel clause, if the mill shipping date occurred after the project letting date.

Table 5.4 Survey Responses on Reinforcing Steel in PACs

State DOT	What were driving reasons to include *reinforcement* in steel clause?	Does steel clause cover *reinforcement* in precast elements?	Has steel clause functioned well for *reinforcement*?	Are you satisfied with price index for *reinforcement*?
Illinois Mike F. Renner, Acting Bureau Chief, Construction	The volatility of steel prices several years ago.	No.	Steel clause was adopted in April 2004. Yes it functions well, although contractors occasionally complain.	Yes.
Massachusetts William A. Moore, Asst. State Construction Engineer	A state law was passed in 2008 requiring it. Steel clause was adopted in Dec 2008.	No, only plain, unfabricated bars.	The original version of our clause did not function well, because it required the submittal of certified, paid mill invoices to determine period prices, and, for a variety of reasons, it was difficult to obtain compliance, plus invoice-based processes violate FHWA policy. A revised clause went into effect in May 2011 that uses PPI to determine period prices. So far, this seems to be working much better.	Yes.
Ohio Gary L. Middleton, Construction Administration	It was at the request of the Ohio Contractors Association due to market volatility, but has since been removed from the clause due to limited benefit to either contracting party. It was difficult to administer with respect to identifying the material via heat numbers to determine the mill ship date and the ensuing chain of custody. The clause also contained a provision that stated "*No steel price adjustments will be made for any products manufactured from steel having a mill shipping date prior to the letting date*," which disallowed the clause for stock items such as reinforcing steel.	It would have initially been included for precast elements provided the mill ship date was after the letting date.	Steel clause has been in place since mid-2004. It has undergone multiple changes in an attempt to capture the market conditions in an independent index. It has reflected market conditions over time with mixed results at best until the development of the current clause, dated 4/15/2011, that uses mill pricing data which seems to reflect current market conditions.	Satisfied with the general provisions of the current clause for major steel items.
Oregon Jeff Gower, State Construction and Materials Engineer	ODOT adopted a policy to pay steel escalation several years ago when the price of steel shot up quickly. The contracting community took a proposal to the legislature and passed a bill requiring	It typically would not include reinforcement in precast materials.	It has been in our standard specifications since 2008. It functions ok, but there are a lot of assumptions built in that are not extremely accurate. It is optional to the contractor at bid time … most times for	We use a single index for all steel products. It is slow to become final and creates problems in finalizing

	ODOT to develop a method to pay escalation on steel products.		reinforcement they choose not to participate.	escalation payments.
Rhode Island Mark Felag, Managing Engineer, Materials	We do not have an active clause for steel. There was a specification developed but it was pulled from a couple of big projects. We did use it for rebar on one project.	No response.	We will review its use on a project by project basis for larger projects for structural steel.	Rebar used to be tracked by the PPI but it does not anymore. This is one reason why we do not use it for rebar.
Washington Dan Gasche, Construction Administration Specialist	The sudden upsurge in steel prices, including reinforcing steel.	Our provision covers reinforcing steel in non-proprietary walls and reinforcing steel and structural steel in pedestrian and vehicular bridge substructures and superstructures, soldier piles, steel casings for shafts and horizontal boring, and casings for concrete pilings.	This provision has been in force about three years and appears to be working well.	We have been satisfied with the ENR price index.

5.3 Scenario Analyses

A scenario analysis was performed to illustrate and compare the performance of each steel PAC for a given set of conditions. In this example, the steel quantity was set to 100 tons and the base steel price was set at $50 per hundredweight (cwt.). The contracted cost of the steel would be 100 tons x 20 cwt. /ton x $50/cwt. = $100,000. The current steel price (upon invoice) is varied as high as $125/cwt., which represents a 150% price increase.

Figures 5.1 and 5.2 compare steel price adjustment as a function of increasing steel price. Figure 5.1 shows the effect on payment when steel price increases 50% from $50/cwt. to $75/cwt. The minimum adjustment is $40,000 when the current price reaches $75/cwt. This adjustment occurs with the exclusive clauses that require a 10% trigger. The maximum adjustment is $50,000 and it occurs with both of the inclusive clauses, since the 50% increase far exceeds the 5% trigger. In this scenario the total payment for 100 tons of steel ranges from $140,000 to $150,000. The difference is $10,000, which represents an increased payment of about 7% when using an inclusive clause instead of an exclusive clause with a 10% trigger. Without a PAC, the payment would remain at the contracted cost of $100,000, meaning that the contractor would have to absorb the $40,000 to $50,000 that would otherwise be reimbursed.

Figure 5.2 compares steel price adjustment as a function of increasing steel price up to $125/cwt. At that price, the minimum adjustment is still $40,000 because Ohio and Virginia DOTs implement 50% caps, meaning that the reimbursement is for the same amount whether the current price rises to $75/cwt. or $125/cwt. The other two state DOTs with caps, Wisconsin and Nevada, would pay an adjustment of $45,000 and $65,000, respectively, at a steel price of $125/cwt. The maximum adjustment is $150,000 and occurs with both of the inclusive clauses. For a 150% increase in steel price, then, the difference in price adjustment is $110,000, depending on the PAC. In this scenario, the total payment for 100 tons of steel ranges from $140,000 to $250,000. Clearly, the impact is a function of the difference between the capped steel price and the actual steel price at invoice. However, without a PAC, the payment would remain at the contracted cost of $100,000.

It should be noted that Wyoming DOT uses a unique formula for price adjustment. It is an exclusive formula with a 10% trigger and a reduction factor of 0.90 (see Equation 2.1). The

reduction factor influences the slope of the price adjustment line, which can be observed in Figure 5.1. At smaller price increases, this formula behaves more like an inclusive formula. At higher price increases, the effect of exclusion becomes more pronounced. For example, at a steel price of $125/cwt., the adjustment is $135,000 and is smaller than all of the PACs without caps, as shown in Figure 5.2.

Similar to asphalt and fuel, the steel quantity has a significant impact on the difference in steel price adjustments. Figure 5.3 compares steel price adjustment with increasing steel quantities up to 500 tons. The price increase was set to 20% of the base price to exceed the triggers required to invoke all of the clauses. New York and Illinois DOTs require $1,000 and $10,000 minimum payments, respectively. In this scenario, a minimum of 50 tons of steel would need to be invoiced to Illinois DOT to meet the minimum adjustment payment of $10,000. Figure 5.3 shows the differences in price adjustment for a specific steel quantity are a function of the trigger values and whether the calculation is inclusive or exclusive. For example, a 20% price change on a 500 ton steel project yields a minimum adjustment of $50,000 and a maximum adjustment of $100,000. There is a difference of $50,000, which is equivalent to a 100% difference from the minimum adjustment.

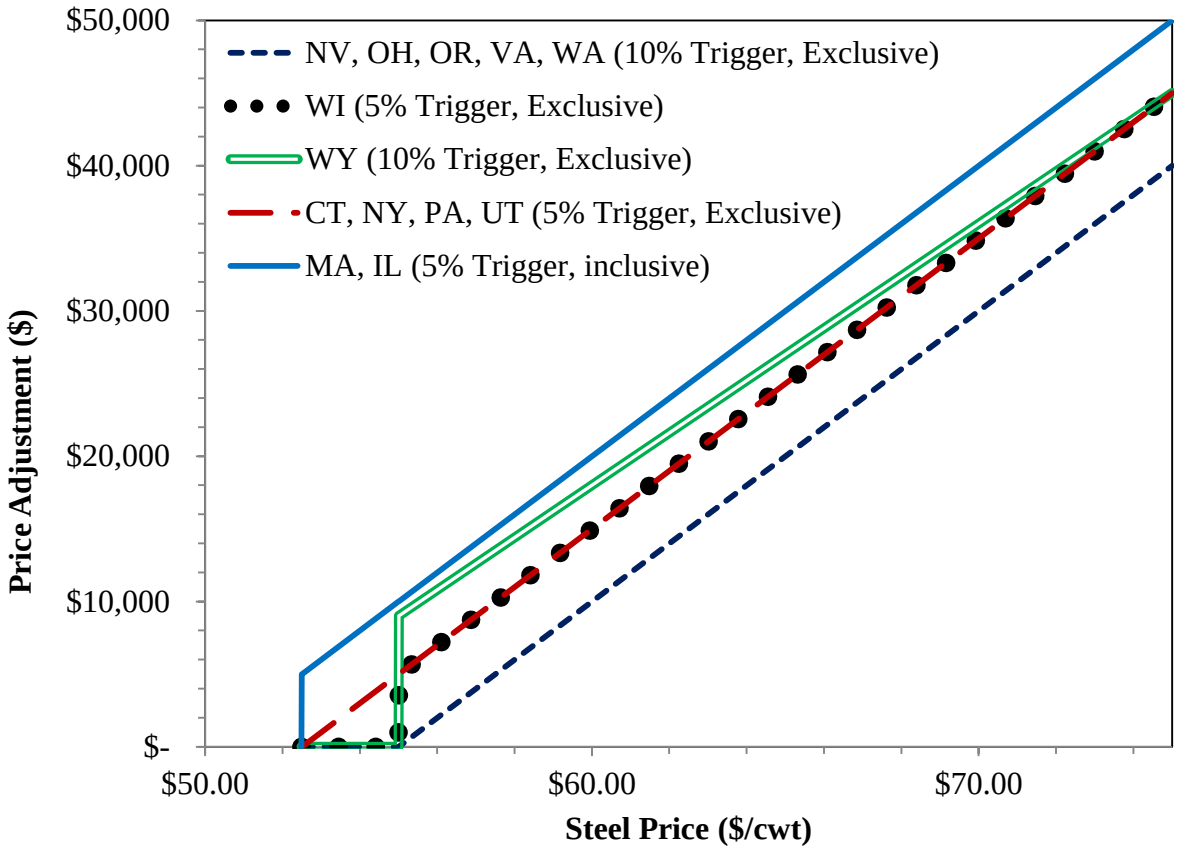

Figure 5.1 Price Adjustment vs. Steel Price for a 50% Price Increase

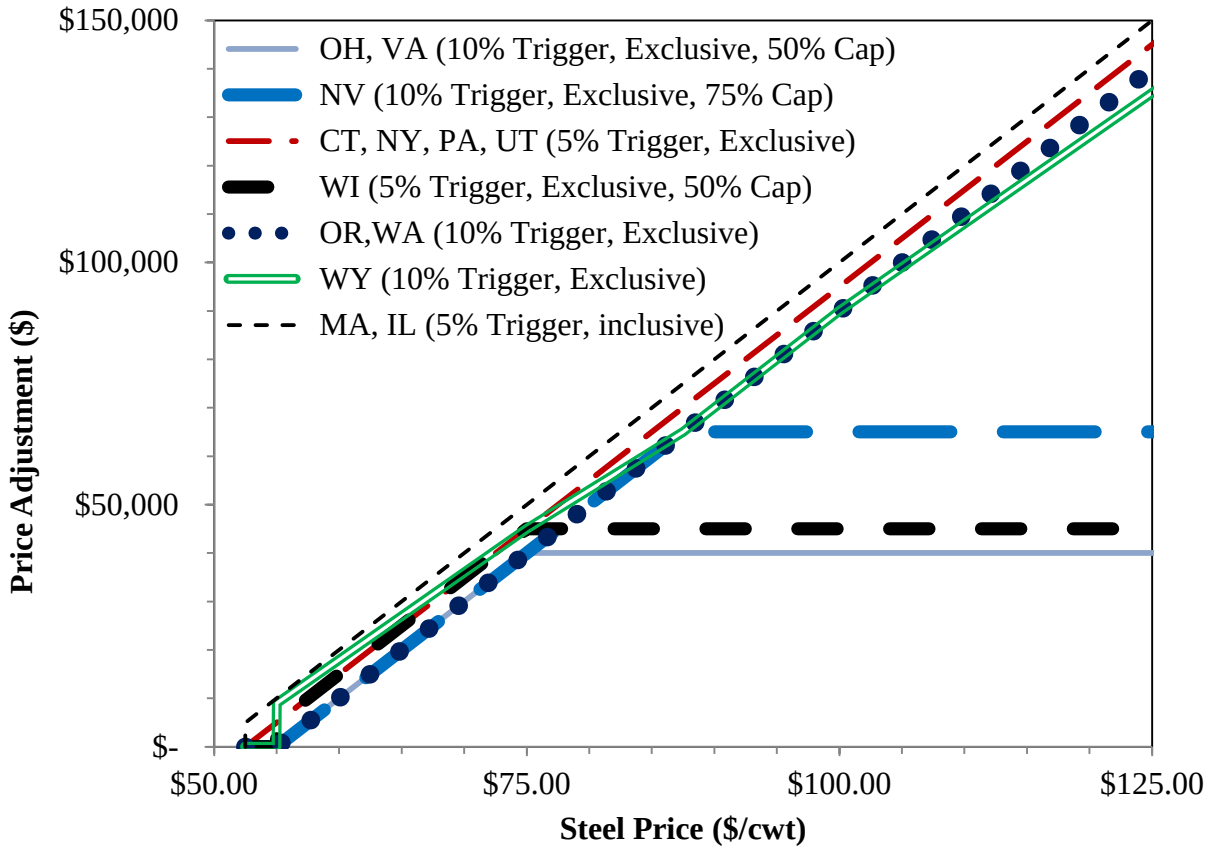

Figure 5.2 Price Adjustment vs. Steel Price for a 150% Price Increase

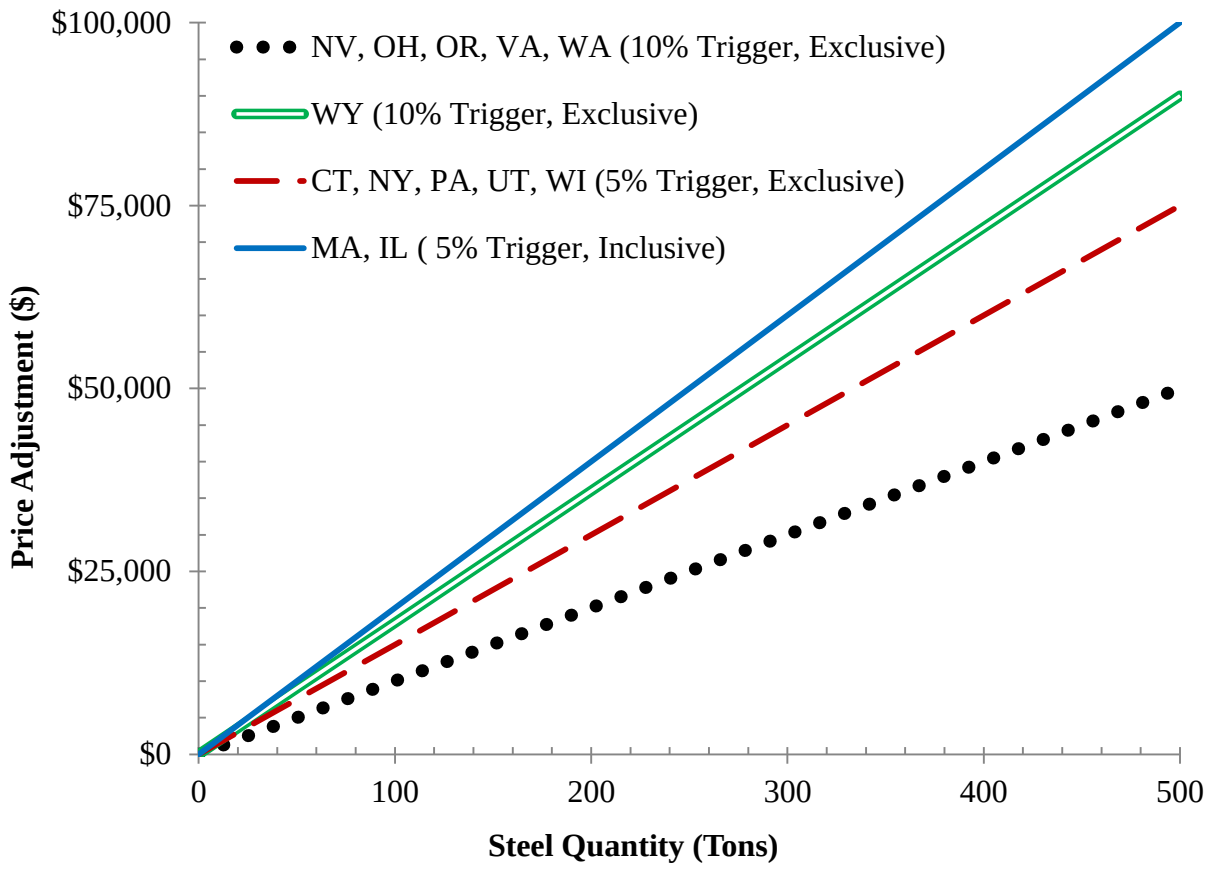

Figure 5.3 Steel Price Adjustment vs. Steel Quantity, 20% Price Increase

5.4 Steel PAC Recommendations for SCDOT

The following sections discuss some of the considerations for developing a steel PAC. It is noted that NCHRP (2011) does not recommend price adjustment for steel, assuming that provisions for stockpiling steel can be made or if long-term fixed price contracts are available. That said, there is sufficient evidence that steel PACs at state DOTs have met performance expectations. As illustrated in Table 5.2, there is a wide range on the number and type of steel products that are eligible for adjustment, which can complicate the selection of an appropriate index for calculating price adjustments. Utah DOT makes accommodations by using three separate indexes from three separate sources for steel girders, steel piles, and steel rebar. This is less difficult if fewer products are considered for adjustment. SCDOT is considering a clause for reinforcing steel, and the next section contains a focused discussion on selecting an appropriate index.

5.4.1 Steel Price Sources

In order to avoid price manipulation, a reliable national price source is recommended for the steel index. As discussed in Section 5.1, the two most common index sources for steel PACs are from the U.S. Bureau of Labor Statistics and the Engineering New Record. NCHRP (2011) suggests that there is a limited relationship between the available steel indexes and actual steel costs on transportation contracts. However, an index that reflects accurate price changes from month to month can be used successfully, even if the actual costs are not comparable.

5.4.1.1 U.S. Bureau of Labor Statistics (BLS) Producer Price Index (PPI)

The U.S. Bureau of Labor Statistics (BLS) Producer Price Index (PPI) is a comprehensive monitor of a broad range of commodities. Within PPI, there are numerous levels and sublevels of products that can be viewed at ftp://ftp.bls.gov/pub/special.requests/ppi/comrlp11.txt. Each level and sublevel has its own index, which is published monthly for free public access. Metals and metal products represent one of the categories of commodities. The following list illustrates some of the levels and sublevels that are available for steel, with a particular focus on indexes that could be used for reinforcing steel. The series identification number is provided in parentheses after each item. To view the index online (http://www.bls.gov/ppi/data.htm), the

series identification number must be entered, preceded by "WPU" (e.g. WPU10 for metals and metal products).

Metals and metal products (series id: 10):

- Iron and steel (series id: 101)
    - Iron and steel scrap (series id: 1012)
        - Carbon steel scrap (series id: 101211)
        - Shredded carbon steel scrap (series id: 10121193)
        - Cut plate and structural scrap (series id: 10121194)
    - Steel mill products (series id: 1017)
        - Semifinished steel mill products (series id: 101702 or 10170201)
        - Wire rod, carbon (series id: 10170202)
        - Concrete reinforcing bar, carbon (series id: 10170405)

There are more indexes than those shown here. Iron and steel scrap contains 13 separate indexes, which includes carbon steel, stainless steel, cast iron, and other ferrous metal scrap. Under steel mill products, there are 38 separate indexes. Many of those 38 indexes are for hot rolled and cold rolled steel shapes.

Figure 5.4 provides the monthly index values for iron and steel scrap (series id: 1012) and steel mill products (series id: 1017). A comparison of these two indexes illustrates the importance of selecting an appropriate index for price adjustment. The iron and steel scrap index is much more volatile than the steel mill products index; this is evident when comparing 2007-2008 index values. The iron and steel scrap more than doubled in that period, while the steel mill products increased at a lower rate. For example, there was a 107% increase in iron and steel scrap from July 2007 to July 2008. The corresponding increase in steel mill products was 33%. The month-to-month price adjustments would be substantially different, depending on which index was in place.

Producer Price Index-Commodities
Original Data Value

Series Id: WPU1012
Not Seasonally Adjusted
Group: Metals and metal products
Item: Iron and steel scrap
Base Date: 198200
Years: 2001 to 2011

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	127.2	119.0	120.3	120.5	120.2	119.4	123.5	125.0	124.3	118.5	110.6	111.6	120.0
2002	115.5	122.1	126.1	135.5	147.4	150.6	152.2	154.8	153.7	151.5	144.3	142.6	141.4
2003	153.9	167.9	176.1	174.8	168.7	163.7	167.9	183.2	193.4	196.1	209.9	235.1	182.6
2004	267.5	317.5	337.8	302.6	255.5	250.5	333.2	368.3	338.5	371.2	386.7	354.6	323.7
2005	333.8	309.8	296.2	317.7	270.9	212.5	217.5	272.0	324.4	288.5	317.6	316.3	289.8
2006	296.9	321.6	326.4	344.2	356.7	369.5	368.7	335.5	341.1	323.2	313.8	325.4	335.2
2007	351.1	393.8	463.1	451.3	400.2	394.2	387.8	393.2	412.8	413.7	398.8	421.2	406.8
2008	494.6	516.7	530.3	700.4	751.5	762.9	802.8	771.7	598.1	366.1	234.2	272.8	566.8
2009	306.1	295.8	272.4	250.6	284.9	298.4	348.3	394.1	414.6	401.6	373.7	417.0	338.1
2010	487.3	499.4	549.8	605.7	582.3	545.9	511.8	527.2	546.1	524.5	534.1	579.3	541.1
2011	649.0	660.9	653.0	653.5	638.9								

Producer Price Index-Commodities
Original Data Value

Series Id: WPU1017
Not Seasonally Adjusted
Group: Metals and metal products
Item: Steel mill products
Base Date: 198200
Years: 2001 to 2011

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	103.8	102.7	102.6	101.9	101.6	101.3	101.3	100.9	100.6	100.0	99.6	99.1	101.3
2002	98.3	98.3	99.6	101.0	102.3	104.5	106.0	107.3	109.7	110.4	110.4	110.1	104.8
2003	109.5	109.8	109.4	109.6	109.0	108.8	108.4	108.4	108.7	110.1	110.7	112.0	109.5
2004	115.4	122.5	129.6	139.1	146.8	147.0	151.1	157.9	161.1	163.3	165.7	166.7	147.2
2005	169.6	169.9	166.3	164.1	161.0	156.2	152.7	148.1	152.0	155.6	160.2	160.4	159.7
2006	163.5	163.5	163.8	165.2	167.5	173.2	179.8	181.7	185.3	187.3	180.0	179.0	174.1
2007	175.8	178.0	181.7	188.3	190.3	190.5	189.4	183.4	180.2	177.7	179.0	180.6	182.9
2008	183.2	186.6	196.9	209.7	229.9	246.0	251.8	257.0	251.8	231.4	213.6	189.3	220.6
2009	178.8	171.5	167.3	157.0	153.0	153.3	156.4	161.9	168.6	173.7	170.6	170.8	165.2
2010	175.7	181.1	187.4	195.3	202.6	204.8	197.0	190.9	191.1	191.7	190.5	192.2	191.7
2011	198.2	205.2	216.0	220.7	223.1								

Figure 5.4 Iron and Steel Scrap Index and Steel Mill Products Index from BLS PPI

These two indexes are well established and should be considered reliable national indicators of price movement. However, either one or both might not provide an accurate reflection of the price fluctuations observed in a particular region or state, such as South Carolina. As shown in Figure 5.4, the baseline for both indexes is January 1982, and there is ample data to make a comparison to historical costs of steel products, such as reinforcing steel, in South Carolina.

The index for concrete reinforcing bar, carbon (series id: 10170405) would be a logical choice for the development of a steel clause for reinforcing steel only. This particular index, however, is either new or reintroduced from a discontinued series. A baseline index of 100 was established in December 2010, and there is no data provided prior to that date. The most recent index values are: 107.6 (January 2011), 109.6 (March 2011), 119.1 (April 2011), and 118.3 (May 2011). No index was published for February, and index values for the most recent four months are considered preliminary since "all indexes are subject to revision four months after original publication."

5.4.1.2 Engineering News Record (ENR)

Engineering News Record (ENR) provides direct prices for 20 cities throughout the U.S., and it compiles price information from these 20 cities to produce an average price. ENR lists prices for standard structural shapes, reinforcing bars (coated and uncoated), hot rolled carbon steel plate, and steel piling, as shown in Table 5.5. It should be noted that all prices are spot prices quoted from a single source and are not intended to represent the prevailing or average price in a particular city. Rather, the reported prices are intended to reflect price movement and provide information on rising or falling trends. ENR would be an appropriate source for a steel index if 1) a steel clause contains eligible items that are comparable to the specific products monitored in ENR and 2) one of the 20 cities is considered a representative market.

Like the BLS PPI, ENR is well established and should be considered reliable. ENR provides a more regional measure of market conditions for steel, thus it might be more suitable than the BLS PPI. The effectiveness of adopting ENR for a SCDOT steel index will depend on the appropriateness of the selected source, whether it is one of the 20 cities, a select combination of cities, or the 20-city national index. Connecticut and Utah DOTs utilize an ENR index from

cities in neighboring states, i.e., Boston and Denver, respectively. On the other hand, Illinois, Nevada, and Washington DOTs use an average index instead of a city-specific ENR index.

ENR tracks prices in 14 cities located on or east of the Mississippi River: Atlanta, GA; Baltimore, MD; Birmingham, AL; Boston, MA; Chicago, IL; Cincinnati, OH; Cleveland, OH; Detroit, MI; Minneapolis, MN; New Orleans, LA; New York, NY; Philadelphia, PA; Pittsburgh, PA; and St. Louis, MO. Thus, the 20-city national index is weighted heavily on prices within the easternmost regions of the U.S. Atlanta and Birmingham are the two nearest cities to South Carolina. While Atlanta is the closest, it represents a much larger metropolitan area than all cities in South Carolina, and therefore its local market might not be comparable. Birmingham is more comparable in geographic size and population to Columbia.

Table 5.5 compares prices for a range of steel products in Atlanta, Baltimore, Birmingham, and Boston. Baltimore and Boston were added for two additional reference points in the eastern U.S. In this sample, taken during the month of February 2010, the average price for standard structural shapes and the price for reinforcing bars (Grade 60, #4) are comparable in Atlanta, Baltimore and Boston. In Birmingham, the average price for standard structural shapes is nearly 17% higher than in Atlanta. However, the price for reinforcing bar is about 14% lower in Birmingham than in Atlanta. The actual prices may or may not reflect those available in South Carolina, although it is recognized that price equivalency is less important than the change in prices observed on a month-to-month basis. If ENR is adopted as a price index for steel reinforcement, it should be noted that prices are not reported for epoxy-coated bars in Atlanta or Birmingham; there are only prices for Grade 60, #4 bars.

5.4.2 Price Adjustment Clause Qualifications

A minimum contract duration or material cost is applied in some of the current DOT steel clauses. The minimum time requirements range from 200 working days to 2 years, and the minimum steel cost ranges from $1,000 to $10,000. New Jersey DOT requires a 500 ton minimum to invoke consideration for steel price adjustments. In order to determine what minimum qualifications are most appropriate for SCDOT, a review of a select sample of SCDOT contracts that include reinforcing steel should be performed.

Table 5.5 Sample of ENR Prices for Steel Products (February 2010)

Structural Steel, Rebar, Building Sheet, Piling					
Item	Unit	Atlanta	Baltimore	Birmingham	Boston
Standard Structural Shapes: Avg	cwt.	42.21	+43.00	49.35	43.72
Channel beams, 6" DEEP, 8.2 LB/LF	cwt.	43.52	+42.00	47.50	41.37
I-beams, 6" DEEP, 12.5 lb./lf	cwt.	45.95	+46.00	58.20	44.78
Wide-flange, 8" DEEP, 31 LB/LF	cwt.	37.15	+41.00	42.35	45.00
Reinforcing Bars					
Grade 60, #4	cwt.	41.70	+40.00	35.70	39.47
Epoxy-coated	cwt.	—	—	—	56.33
Hot-rolled Carbon-Steel Plate:					
12 gauge, 48" x 10'	cwt.	+43.00	+41.00	41.35	37.23
Expanded Metal lath:					
Std diamond mesh, 3.4 LB/SY, Galvanized	cwt.	195.38	+236.00	150.00	179.04
Flat-ribbed, 3.4 lb./sy	cwt.	218.00	—	193.00	208.00
Building Sheet and Plate:					
Aluminum sheet, 3003H14, 36" x 96"	cwt.	+197.55	+175.00	243.00	188.40
Stainless-Steel Sheet:					
14 gauge	cwt.	+175.00	–158.00	218.00	148.86
16 gauge	cwt.	+171.40	–159.00	219.00	152.00
20 gauge	cwt.	+175.00	–165.00	226.00	155.20
Stainless-Steel Plate:					
304, 1/4", 72" x 240"	cwt.	+180.25	–169.00	267.00	158.00
316, 1/4", 96" x 140"	Cwt.	+247.68	–315.00	—	243.51
Steel Piling: H-Pile					
HP10 x 42	Cwt.	+28.73	42.00	41.10	28.05

+ or – denotes price has risen or fallen since previous report. Monthly market quotations by ENR field reporters as of Feb. 12, 2010. All prices are spot prices quoted from a single source. All prices are FOB warehouse except metal lath, which is FOB city. Stainless-steel sheet prices are for type 304, 2B finish, 48 x 120-in. Steel piles are high-strength A572. Some prices may include taxes or most accessible in a city. All quantities are truckloads unless noted. The above prices are not intended to represent the prevailing or average price in a city but are designed to track price movement from a single source for a given quantity and specification over time.

5.4.3 Price Adjustment Calculations

Based on conversations with contractors and a Rhode Island DOT representative, along with supporting guidance from NCHRP (2011), it is suggested that a no-trigger clause be considered to avoid higher bid prices associated with a trigger value. However, there is no data to quantify the magnitude of bid price reduction that might be generated with a no-trigger clause. If a trigger is desired, it is recommended to adopt an exclusive clause with a low trigger, such as 5%. A low value should mitigate the risk to contractors and thus reduce the amount of financial risk built into bids. Excluding price adjustment for the amount associated with the trigger, such as the first 5% increase or decrease in steel prices, provides some risk-sharing with the DOT. This is a common calculation basis, as five of the 15 steel clauses are exclusive with 5% trigger. Four of those five clauses allow reinforcing steel, including Connecticut DOT, whose clause is just for reinforcing steel.

5.4.4 Price Adjustment Caps

Price adjustment caps are utilized in one third of the steel clauses. The most common adjustment limit is 50%; however, the three state DOTs with caps on reinforcing steel are each different. Virginia DOT has a 50% cap, Nevada DOT has a 75% cap, and Utah DOT maintains a $500,000 cap. A percent-based cap is recommended because a maximum dollar cap does not provide equal benefit to large and small contracts and is therefore less efficient. A cap of 50% is recommended for consideration, especially in conjunction with a no-trigger clause. This combination provides increased or decreased payments at even the smallest changes in steel price, mitigating risk in the bid price, and it provides risk-sharing when prices rise or fall significant levels, since the adjustment is limited to 50% price change. Two state DOTs (Ohio and Virginia) have exclusive clauses with 10% trigger and 50% cap. This means that the maximum adjustment is 40% of the base price, since there is no adjustment made for the first 10% change or above the cap. If a trigger is desired, then a higher cap of 75%, or even 100%, could also be considered.

6 Summary, Conclusions and Recommendations

6.1 Summary

Price adjustment clauses are an effective risk mitigation technique employed by USDOTs. The risk associated with construction material costs is transferred from the contractor to the agency. PACs can be invoked in a variety of ways. Minimum quantities, minimum time periods, and minimum dollar amounts are all methods being utilized currently by USDOTs. Trigger values are the biggest factor in determining the amount of reimbursement due for a specific contract. Inclusive and exclusive formulas yield very different results for reimbursements. While both are used, exclusive formulas are more common. Caps are used to protect the agencies from extreme shifts in material cost and while effective, most states do not specify caps in their PACs. Quantities can be calculated different ways for different materials. Fuel quantity may be calculated with a usage factor that correlates units of construction work items to gallons of fuel. Quantity of fuel can also be calculated as a function of percentage of total job or percentage of completed work.

49 of 52 state DOTs that were studied provide PACs for at least one material. 41 of those DOTs provide PACs for fuel or asphalt, and 33 of those 41 state DOTs provide PACs for both. Though it cannot be proven, zero trigger values are believed to reduce bid prices, effectively saving the agency money. There are some regional influences on which materials are accepted for price adjustments. There is a small group of states (Arkansas, New Mexico, Oklahoma, and Texas) in the southwestern U.S. that do not allow fuel price adjustments. Most of the states that do not allow asphalt price adjustments are grouped in the upper Midwestern U.S. (Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, South Dakota, and Wisconsin). States in the southeast region tend towards price adjustment for fuel and asphalt. From North Carolina to Louisiana, all states allow price adjustment for only fuel and Asphalt.

Fewer state DOTs offer similar clauses for steel (15) or concrete (4). Connecticut and Massachusetts are the only two state agencies that invoke PACs for all four materials. Steel price adjustment clauses are allowed in three distinct groups of states: the upper

western/northwestern U.S. (e.g. Washington and Wyoming), the Midwestern U.S. (e.g. Ohio and Wisconsin), and the northeastern U.S. (e.g. Massachusetts and Pennsylvania).

6.2 Conclusions

The following conclusions can be made regarding price adjustment clauses:

1. Based on the responses of contractor interviews and surveys, there is substantial evidence that contractors are in favor of price adjustment clauses. NCHRP Report 274 recommends price adjustment clauses as an appropriate mechanism for certain construction materials. Based on a weighting of the financial risks and benefits associated with price adjustment clauses, the findings suggest that such clauses are "moderately positive." A risk-benefit analysis of fuel and asphalt suggests that PACs are appropriate for both materials.

2. Based on a review of more than 75 PAC documents, there are two common formulations to calculate price adjustment. An inclusive clause pays the entire difference between the current price and base price, while an exclusive clause pays a partial difference. Most clauses require a trigger value to invoke a price adjustment calculation; the most common trigger value is 5%. However there are a number of clauses that do not require a trigger.

3. There appears to be sufficient anecdotal evidence that a zero trigger value can lower bid prices and increase bid competition. When there is a trigger value required to invoke price adjustment, contractors must take that risk into account in the bid formulation, causing bid prices associated with those materials to be higher. It is reasonable to conclude that the impact on bid prices is more profound when the trigger value is higher. Anecdotal evidence is based on communications with local contractors and other DOTs, in conjunction with NCHRP Report 274, which suggests that PACs without triggers are preferred.

4. Steel PACs are less common than for asphalt and fuel. In some states, steel PACs have been underutilized or even removed from specifications. NCHRP Report 274 does not

recommend steel as an appropriate material for PACs, although that assessment assumes that provisions for stockpiling steel are available. However, most of the state DOTs with steel PACs are satisfied with their performance. There are some factors that make steel indexing and price adjustment more complicated than asphalt and fuel, most notably that the number of products is larger and the manufacturing of such products differs. These complexities can be addressed by using multiple indexes, one for each group of steel items, and/or limiting the steel items eligible for price adjustment. Some state DOTs have reported difficulties in monitoring transaction dates, such as mill shipping dates, for making proper price adjustments.

5. Caps are more common for steel PACs than for asphalt or fuel. For all materials, caps range from 50% to 100% of the base price index. Caps limit the payment when price changes are unusually high.

6. PACs for other construction or landscaping materials are not available, with the exception of a few states that have PACs for Portland cement concrete. Most materials are not considered to be good candidates for price adjustment because there is either a lack of reliable price indexes or materials are consumed in limited quantities.

6.3 Recommendations

Based on the findings presented in this report, the following recommendations are made for consideration by the SCDOT Steering and Implementation Committee. The recommendations are not prioritized and should be considered as points for discussion to determine which recommendations, if any, are the most viable for the current needs of SCDOT. Some of the recommendations will require further research.

- Revise the current PAC documents for asphalt and fuel to explicitly identify the price adjustment elements outlined in the general framework, which includes qualifications, price adjustment calculations showing the specific formulae, and caps. Some, but not all, of this information is provided in the current PAC documents. A statement should be included that specifies there are no caps on price adjustment payments or returns for

asphalt and fuel. The current specifications do not provide language on what, if any, material price changes would warrant contract cancellation or renegotiation. If desired, the addition of such conditional statements should be considered.

- Consider the adoption of a national, published source for price indexing of asphalt and/or fuel, rather than local suppliers. At this time, it is recommended to consider an alternative source for fuel, not asphalt.
    - Local suppliers are used regularly for the determination of asphalt price indexes, which suggests the practice provides reliable and unbiased information. The best alternative source for asphalt price indexing is Asphalt Weekly Monitor, which is used at a significant number of DOTs but is relatively expensive. If a national source for asphalt is desired, then a one-year subscription to Asphalt Weekly Monitor can be purchased for assessment. In addition, the Engineering News-Record (ENR) and Bureau of Labor Statistics Producer Price Index (BLS PPI) can be assessed at low or no cost. ENR and BLS PPI are well established and recognized, but neither one is used regularly for asphalt price indexing.
    - Local suppliers are not common sources for the determination of fuel price indexes; SCDOT is one of the few DOTs that use them. Alternatively, fuel price indexes can be based on the U.S. Energy Information Administration (USEIA) for free or the Oil Price Information Service (OPIS) for a reasonable fee, depending on the number of subscribed cities. USEIA does not provide fuel prices for South Carolina; it reports an average price for the Lower Atlantic region, which includes the Carolinas, Virginias, Georgia and Florida. On the other hand, OPIS provides prices for four cities in South Carolina: Belton, Charleston, North Augusta, and Spartanburg. The neighboring cities of Charlotte, NC and Savannah, GA are also available through OPIS. If desired, a one-year subscription to all four cities in South Carolina can be purchased for assessment and comparison to the prices reported by USEIA.
- Adopt a no trigger adjustment clause for either asphalt or fuel. There are a sufficient number of state DOTs with no trigger clauses for either material, and those state DOTs could be consulted for guidance. Since a no trigger clause is expected to increase the

amount and frequency of payments and/or returns, administrative costs associated with this change should be considered. The increase in adjustment frequency is expected to be greater for fuel than for asphalt, given that fuel adjustments are allowed on more work items and the reduction from a 10% trigger to 0% trigger is more significant. Given that scenario, asphalt might be a better candidate for a no trigger clause.

- If a no trigger clause is considered for adoption, then it is recommended to conduct a trial with a no trigger clause applied to a select group of contracts, while other contracts retain the current trigger. A trial conducted in this manner would allow a more direct comparison of the bid prices for that commodity, such as asphalt. If a trial is conducted, it is also recommended to couple it with an evaluation of other asphalt price indexes, as described above, to compare the impacts of triggers and price indexes on the adjustments made for a specified and controlled number of projects.
- The fuel usage factors for fuel price adjustment should be evaluated; although the current factors might be warranted, some of them are high compared to other state DOTs. However, it is recommended that SCDOT first consider the findings from an active NCHRP investigation, NCHRP 10-81 Fuel Usage Factors in Highway and Bridge Construction, which is scheduled for completion in 2012.
- Develop a specification for steel price adjustment of reinforcing steel based on the information provided in this report.
    - Price indexes specific to reinforcing steel are available through the BLS PPI and ENR at no or low cost; one of these is recommended for a SCDOT PAC. Prior to selecting a single index, a comparison of these steel indexes should be conducted, particularly since the BLS PPI index for reinforcing steel was initiated in December 2010. This comparison should include reinforcing steel prices reported by ENR in Atlanta, GA; Birmingham, AL; and the 20-city average.
    - To be consistent with the asphalt and fuel PACs at SCDOT, an inclusive clause with a trigger can be used. However, it is recommended to consider either a no-trigger clause or an exclusive clause with a low trigger, such as 5%. The vast majority of steel PACs use exclusive calculation methods, and all steel PACs have either 5% or 10% triggers. The anticipated impacts of using a no-trigger

clause, which would be uncommon for steel (but not for asphalt or fuel), or a more common exclusive clause with 5% trigger should be considered in terms of bid prices, payments and returns, management, and contractor support.

  - A cap should also be considered, although the anticipated impacts on bid prices and contractor support need to be weighed in the decision. State DOTs with caps for steel price adjustment use either 50% or 75%. Given that no caps are in place for either asphalt or fuel, a higher cap of 100% might be reasonable.

- No recommendations are made at this time for the development of PACs for other materials.

7 References

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Appendix A Survey Questions and Responses

Responding State	2. Please select the most appropriate response for each material below: [Fuel]	2. Please select the most appropriate response for each material below: [Asphalt Cement]	2. Please select the most appropriate response for each material below: [Portland Cement]	2. Please select the most appropriate response for each material below: [Coarse Aggregate (Crushed Stone)]	2. Please select the most appropriate response for each material below: [Fine Aggregate (Sand)]	2. Please select the most appropriate response for each material below: [Steel]
AK	Yes	Yes				
AL	Yes	Yes				Discontinued
AL	Yes	Yes	No	No	No	No
IA	Yes	No	No	No	No	No
IN	No	Yes	No	No	No	No
KS	Yes	Yes	No	No	No	No
MD	Yes	Yes	No	No	No	No
ME	Considering	Yes	No	No	No	No
MO	Yes	Yes	No	No	No	No
MT	Yes	Discontinued	No	No	No	No
OR	Yes	Yes	No	No	No	Yes
TX	No	No	No	No	No	No
WA	Yes	Yes				Yes
WY	Yes	Yes	No	No	No	Yes
WV	Yes	Yes	Yes	No	No	Yes

Responding State	2. Please select the most appropriate response for each material below: [Aluminum]	2. Please select the most appropriate response for each material below: [Lumber]	2. Please select the most appropriate response for each material below: [Polymer Modifiers (for asphalt)]	2. Please select the most appropriate response for each material below: [Agricultural Products (seeding and/or fertilizer)]	2. Please select the most appropriate response for each material below: [Supplementary Cementitious Materials (such as fly ash and/or silica fume)]
AK					
AL			Yes		
AL	No	No	No	No	No
IA	No	No	No	No	No
IN	No	No	No	No	No
KS	No	No	No	No	No
MD	No	No	No	No	No
ME	No	No	No	No	No
MO	No	No	No	No	No
MT	No	No	No	No	No
OR	No	No	No	No	No
TX	No	No	No	No	No
WA					
WY	No	No	Yes	No	No
WV	No	No	No	No	No

Responding State	3. If you currently allow any price adjustments, please indicate the source(s) of cost data or price indices that are used for each material.
AK	The Alaska asphalt material price index is calculated bi-monthly on the first and third Friday of each month, and will remain in effect from the day of calculation until the next bi-monthly calculation. Compensation is based on the amount of change over/under 7.5%.
AL	Based on bulk average prices from quotes by major oil companies.
AL	Asphalt Fuel adjustment is assigned by LADOTD using average price (submitted monthly in confidence by all suppliers listed on QPL, qualified products list) Fuel Adjustment: Price based on public oilgram document.
IA	Oil Price Information Service #2 high sulfur diesel price
IN	The monthly PG asphalt binder index (BI) is determined by averaging the weekly selling prices in Indiana as listed in the Poten & Partners Asphalt Weekly Monitor publication.
KS	http://www.ksdot.org/burConsMain/specprov/2007/pdf/07-01008-r03.pdf is web link to fuel adjustment. http://www.ksdot.org/burConsMain/specprov/2007/pdf/07-01009-r05.pdf is web link to asphalt adjustment
MD	Fuel - US Energy Information Administration Asphalt Cement - Average price from local vendors
ME	Asphalt - The period price of performance graded binder will be determined by the Department by using the average New England Selling Price, listed in the Asphalt Weekly Monitor current with the paving date. Diesel - The period price of diesel fuel will be determined by the Department by using the weekly retail diesel price for the New England area, as listed on the Energy Information Administration's webpage current with the pay period ending date of the progress estimate.
MO	Fuel adjustment is calculated from Platt's Oilgram - PAD 2 - St. Louis Area Asphalt adjustment is calculated from Asphalt Weekly Monitor published by Poten & Partners Inc.
MT	Poten and partners
OR	http://www.oregon.gov/ODOT/HWY/ESTIMATING/asphalt_fuel.shtml http://www.oregon.gov/ODOT/HWY/ESTIMATING/steel.shtml Not sure to answer the question about polymer Modifiers, at times we do pay for anti-stripping additives.
TX	
WA	Fuel - Dept of Energy website, monthly price for West Coast No. 2 Diesel. Asphalt Cement - Poten & Partners Asphalt Weekly Monitor. Prices are averaged twice a month and posted on WSDOT website. Steel - ENR Materials Cost Index for Steel $/CWT
WY	opis for fuel and U.S. Department of Labor (USDOL), Bureau of Labor Statistics and Potent for Asphalt
WV	ENR - cement, OPIS - fuel / asphalt steel - we have only done on 2 large bridge projects - ENR

Responding State	4. If you discontinued any price adjustments, please indicate the reason(s) for discontinuation for each material.	5. Does your state agency purchase options on or stockpile any materials at favorable prices and make those options or stockpiled materials available for use on contracts?	6. If you answered Yes in Question 5, please indicate what material(s).
AK		No	
AL	Agreement between the Department and Industry once the price leveled off.	Yes	aggregate Only on specified contracts
AL		No	During recent (1998) upswing of asphalt prices, informal discussions regarding stockpiling asphalt ensued. Initial cost of tankage was a deterent.
IA		No	
IN	NA	No	NA
KS		No	
MD		No	
ME		Considering	
MO		No	
MT	Industry and suppliers in Montana could not reach a consensus regarding the structure of the specification language.	Yes	We have optioned sources on a limited number of projects in the last few years but are exploring ways of possibly expanding this practice. We have also crushed material as part of one highway contract to be used on subsequent contract(s).
OR		No	
TX		No	
WA	Not applicable	No	N/A
WY		Considering	
WV	NA	No	NA

Responding State	7. Does your state agency allow contractors to purchase options on or stockpile any materials at favorable prices in advance of construction?	8. If you answered Yes in Question 7, please indicate what material(s).
AK	No	
AL		
AL		
IA	Yes	Prior to letting contractors may stockpile materials at their own expense and risk. After contract award, stored material payments may be made for stockpiled materials not yet incorporated into work.
IN	No	NA
KS	No	
MD	Yes	Yes, to the extent that the acquisition of materials with a long lead time may proceed upon notice of low bid but prior to award.
ME	No	
MO	Yes	109.7.2 Material Allowance. The engineer may, in any payment estimate, include the value of any non-perishable material that will be finally incorporated in the completed work. The material shall be in conformity with the plans and specifications in the contract, and shall not have been used at the time of such estimate. The value of such material in a single submission from one supplier shall be no less than $10,000.00. The material shall be delivered to the project or other location that is approved by the engineer. Any storage area not within the right of way shall be leased at the contractor's expense with provisions for right of entry by the engineer during the period of storage. Invoices for material payment shall be submitted to the engineer at least four days prior to the estimate date. Receipted invoices for all material payments previously allowed on the estimate shall be submitted to the engineer within 42 days of the date of the estimate on which material allowance was made or such material allowance will be deducted from future payments.
MT	Yes	Any material that the contractor chooses. The vast majority of our contracts are contractor optioned sources so any aggregate, borrow, etc. can be procured ahead of the contract. Any other materials incorporated must simply meet contract requirements. When and where the contractor procures them is entirely up to them. Any action a contractor takes prior to award is at the contractor’s risk.
OR	Yes	The Contractors are free to do whatever they want. If a Contractor wants to purchase or make a long term deal with asphalt or fuel or anything else and then bid on our Contracts that is fine. We pay bid prices. We have a provision to pay advancement for materials on hand for most materials if certain conditions are met.
TX	Yes	
WA	No	N/A
WY	No	
WV	Yes	Aggregates, Steel, Electrical Items, Fencing, Guardrail

Responding State	9. Does your state agency provide construction market pricing forecasts for any materials?	10. If you answered Yes in Question 9, please indicate what material(s).	11. Please provide your contact information below in case we wish to follow up.
AK	No		James Green, Construction Standards Engineer, State of Alaska DOT, 907-465-1222
AL	No		David.Chason@DOT.State.FL.US
AL			Chris Abadie, Materials Research Administrator, LTRC Note that our construction division would be better suited to answer this questionaire and confirm my answers and I ask that you forward this to: attn: Charles Smith, LADOT construction (charles.smith@la.gov) 225-279-1568
IA	No		Ed Kasper, P.E., Assistant Contracts Engineer Iowa Department of Transportation, 515-239-1414 edward.kasper@dot.iowa.gov
IN	No	NA	Ron Heustis, Manager of Construction Technical Support 317-234-2777, rheustis@indot.in.gov
KS	No		Susan Darling, Assistant Bureau Chief, Construction & Maintenance, 785-296-7138, sdarling@ksdot.org
MD	No		Mr. Terry A Florey, tflorey@sha.state.md.us
ME	No		Scott Bickford, Contracts & Specifications Engineer Maine Department of Transportation S.H.S. #16 Augusta, Me. 04333-0016 (207) 624-3533
MO	No		Dale Williams, Missouri Department of Transporation Field Materials Engineer PO Box 270 Jefferson City, MO 65102 Tel: (573) 526-4350 E-mail: dale.williams@modot.mo.gov
MT	No		
OR	Yes	Yes, see the fuel trend analysis: http://www.oregon.gov/ODOT/HWY/ESTIMATING/docs/asphalt_fuel_prices/fuel_trend_analysis.doc	Dan Anderson Construction Section (Central HQ) Contract Administration Construction Claims Engineer 800 Airport Rd SE, Salem OR 97301-4798 503-986-3136 daniel.a.anderson@odot.state.or.us
TX	Considering		
WA	No	N/A	Jim Spaid, Roadway Construction Engineer, WSDOT P. O. Box 47354 Olympia, WA 98504 phone (360) 705-7824
WY	No		
WV	No	NA	Stephen T. Rumbaugh, P.E., Director Contract, Admin (304)558-3304 stephen.t.rumbaugh@wv.gov

Appendix B South Carolina Price Adjustment Clause Documents for Asphalt and Fuel

March 3, 2009

ASPHALT BINDER ADJUSTMENT INDEX

General: The Bidder is advised that the Department will apply Asphalt Binder Adjustments *for specified items of work* when the Index for Asphalt Binder (PG64-22) varies more than 5% from the Base Index price established for the contract.

Index: The Department maintains an Index for Asphalt Binder, which is an average of quotations from current asphalt binder suppliers, effective on the 1st and 17th of each month. The resulting Index is posted in spreadsheet form on the Department's Internet at http://www.scdot.org/doing/monthlyindexes.asp.

Base Index: The Department sets a Base Index date for each contract subject to Asphalt Binder adjustments with the date set prior to the highway letting. The Index for Asphalt Binder on that Base Index date sets the framework of the 5% adjustment increments to be used for the contract. Tables showing the adjustment increments are displayed in the above noted spreadsheet (AC Binder Chart tab).

Asphalt Binder Content Factors: The following table shows the Asphalt Binder Content factor (tons of Asphalt Binder per unit of work) for SCDOT work items that are subject to this specification. In order to be eligible for index adjustments, the work item(s) must be specifically indicated in the Special Provisions of the Contract.

Items of Work Eligible for A.C. Binder Adjustments	Unit	AC Binder Tons
Liquid Asphalt Binder (PG64-22)	TON	1.0000
Liquid Asphalt Binder (PG76-22)	TON	1.0000
Full Depth Patching - 4" (AC Binder)	SY	0.0110
Full Depth Patching - 6" (AC Binder)	SY	0.0165
Full Depth Patching - 8" (AC Binder)	SY	0.0220
Full Depth Patching - 10" (AC Binder)	SY	0.0275
Full Depth Patching - 12" (AC Binder)	SY	0.0330
Single Treatment Type-1 (0.38 gal/sy AC)	SY	0.0016
Single Treatment Type-2 (0.38 gal/sy emulsion)	SY	0.0011
Single Treatment Type-3 (0.25 gal/sy emulsion)	SY	0.0007
Single Treatment Class-A (0.30 gal/sy emulsion)	SY	0.0008
Double Treatment Type-1 (0.82 gal/sy emulsion)	SY	0.0023
Double Treatment Type-2 (0.97 gal/sy emulsion)	SY	0.0027
Double Treatment Type-2 (0.55 gal/sy emulsion)	SY	0.0015
Double Treatment-Class A Special (0.66 gal/sy emulsion)	SY	0.0018
Triple Treatment-Type 1 (0.85 gal/sy emulsion)	SY	0.0024
Triple Treatment-Type 2 (0.71 gal/sy emulsion)	SY	0.0020
Triple Treatment-Type 4 (0.82 gal/sy emulsion)	SY	0.0023
Asph Surf Trmt - Single Treatment (0.28 gal/sy mod. Emulsion)	SY	0.0008
Asph Surf Trmt - Double Treatment (0.48 gal/sy mod. Emulsion)	SY	0.0013
Microsurfacing, Type II	SY	0.0007
Microsurfacing, Type II - Leveling	TON	0.0800
Emulsion for High Performance Chip Seal (Macrosurfacing)	Gal	0.0028

Per unit index adjustments are determined by multiplying the Asphalt Binder Content factor by the Asphalt Binder Index Change (minimum of incremented range). The resulting per unit amount is then applied to the construction estimate as a line item adjustment.

Additional Provisions:

A. The Department will calculate and apply Asphalt Binder Index Adjustments to estimates based on Index values set at the beginning of the estimate period.

   - Districts 2, 3, and 5 - Estimate period begins on the 1st of the month and ends on the last day of the month. The 1st of the month Index will be compared to the contract Base Index to determine Index adjustments for the estimate period.

   - Districts 1, 4, 6, and 7 - Estimate period begins on the 17th of the month and ends on the 16th day of the following month. The 17th of the month Index will be compared to the contract Base Index to determine Index adjustments for the estimate period.

B. In the event the work (on a contract item subject to asphalt binder adjustment) continues after expiration of the contract completion date, the asphalt binder index in effect on the contract completion date will become the ceiling (or maximum) of indexes to be applied for the work. Lower indexes will be applied, while higher indexes will be limited to the ceiling noted.

C. This provision shall apply to supplemental agreements, overruns and extensions to this project for the specified item(s) to be adjusted.

D. The Base Index, Current Index and Adjustments may be referenced directly on the Department's Index spreadsheet at http://www.scdot.org/doing/monthlyindexes.asp.

December 1, 2009

FUEL ADJUSTMENT INDEXES

General: The Bidder is advised that the Department will apply Fuel Adjustments *for specified items of work* when the Indexes for Diesel and Unleaded fuels vary more than 10% from Base Indexes established for the contract.

Indexes: The Department maintains Indexes for Diesel and Unleaded fuel based on fuel prices from the South Carolina Budget and Control Board – Materials Management Office, which negotiates fuel contracts for the state. The Department averages Zone 1 (upper state) and Zone 2 (lower state) prices for Diesel and Unleaded fuel to calculate the Indexes for the 1st and 17th of each month. The resulting indexes are posted in spreadsheet form on the Department's Internet site at http://www.scdot.org/doing/monthlyindexes.asp.

Base Index: The Department sets a Base Index date for each contract subject to fuel adjustments with the date set prior to the highway letting. The Indexes for Diesel and Unleaded fuel on that Base Index date sets the framework of the 10% adjustment increments to be used for the contract. Tables showing the adjustment increments are displayed in the above noted spreadsheet (Fuel Charts tab).

Fuel Usage Factors: The following table shows the Fuel Usage factor (gallons of fuel per unit of work) for SCDOT work items that are subject to this specification. In order for contract work items to be eligible for index adjustments, the work item(s) must be specifically indicated in the Special Provisions of the Contract.

Items of Work Eligible for Fuel Adjustments	Units of Measure	Diesel Fuel	Unleaded Fuel
Excavation (Unclassified, Borrow, etc.)	Gallons/CY	0.29	0.15
Embankment in Place	Gallons/CY	0.29	0.15
Sand Clay Base Course 6" Uniform	Gallons/SY	0.05	0.02
Sand Clay Base Course 8" Uniform	Gallons/SY	0.06	0.03
Graded Aggregate Base Course 6" Uniform	Gallons/SY	0.10	0.06
Graded Aggregate Base Course 8" Uniform	Gallons/SY	0.13	0.06
Hot Mix Asphalt (Base, Binder, Surface Courses)	Gallons/Ton	2.90	0.71
Full Depth Patching - 4" (Fuel)	Gallons/SY	0.64	0.16
Full Depth Patching - 6" (Fuel)	Gallons/SY	0.96	0.23
Full Depth Patching - 8" (Fuel)	Gallons/SY	1.28	0.31
Full Depth Patching - 10" (Fuel)	Gallons/SY	1.60	0.39
Full Depth Patching - 12" (Fuel)	Gallons/SY	1.91	0.47
Portland Cement Concrete Pavements	Gallons/SY	0.25	0.20
Structural Concrete	Gallons/CY	1.00	0.20
Permanent Pipe Culverts (24" or less)	Gallons/LF	0.50	0.15
Permanent Pipe Culverts (greater than 24")	Gallons/LF	0.75	0.15

Per unit index adjustments are determined by multiplying the Fuel Usage factor by the Fuel Index Change (minimum of incremented range) for each type of fuel. The total of these two results is then applied to the construction estimate as a line item adjustment. If only one type of fuel changes in excess of 10%, then the adjustment will be based on that figure alone.

SUPPLEMENTAL SPECIFICATIONS

Additional Provisions:

A. The Department will calculate and apply fuel adjustments to estimates based on index values set at the beginning of the estimate period.

   - Districts 2, 3, and 5 - Estimate period begins on the 1st of the month and ends on the last day of the month. The 1st of the month Index will be compared to the contract Base Index to determine index adjustments for the estimate period.

   - Districts 1, 4, 6, and 7 - Estimate period begins on the 17th of the month and ends on the 16th day of the following month. The 17th of the month Index will be compared to the contract Base Index to determine index adjustments for the estimate period.

B. In the event the work (on a contract item subject to fuel adjustments) continues after expiration of the contract completion date, the fuel indexes in effect on the contract completion date will become the ceiling (or maximum) of indexes to be applied for the work. Lower indexes will be applied, while higher indexes will be limited to the ceiling noted.

C. This provision shall apply to supplemental agreements, overruns and extensions to this project for the specified item(s) to be adjusted.

D. The Base Index, Current Index and Adjustments may be referenced directly on the Department's Index spreadsheet at http://www.scdot.org/doing/monthlyindexes.asp.

Appendix C Communication

1.1 Interview with Bret Murray, Project Estimator for REA on 7/21/2010

General Info about Contractor:

Plant locations: North Columbia, Columbia, I-20 (portable), Orangeburg, Ulmer, I-95 in Jasper, Commercial Location in Beaufort

We are currently trying to implement our own index on transportation expenses.

Fuel price paid to transport is the average of a week's worth of prices, averaged. It is checked every day by our trucking coordinator.

The paving season is March until the end of November. That means no surface work can be done outside of those time and no resurfacing can be done during rain

Commercial asphalt represents about 20% of our business. SCDOT is about 80%. Interstate rehab work is our bread and butter.

We use DOT Index for pricing. We do not use any of the sources that were found in the first part of this project.

DOT goes strictly by low number in regular letting; on design build, reputation and better design are taken into account

Asphalt supplied by NuSTAR in Savannah (reasons include price and convenience). We sub-out: guardrails, striping, grass, road signs, rumble strips. We do stockpile.

Bid Software:

Columbia- HCSS Software (Heavy Bid)

Charlotte-Oman Systems in Knoxville-Bid Tabs Pro and Bid Tabs Plus

Turn-in bid online

Have bid bonds, most often 5%. Small companies may have trouble completing or starting projects and may have to call in bonds; Lane or Rea has never called in a bond

Price Adjustment

For DOT index, local suppliers send in weekly rack price, then DOT averages that for index.

We track costs "fervently". "We believe the index helps everyone, fair to both sides, protects both sides"

"Steel industry wants an index." – It helps contractors that supply guardrails, steel bridges, and concrete rebar.

Price changes are fueled by changes in price of rock and asphalt cement changes

Can see no risks in price adjustment

One problem that could arise is bid-rigging, due to the fact that DOT does not award a contract if there is only one bid. Brett has to sign contracts every year to ensure he is not colluding with other bidders

His take on exclusive trigger: Estimators could put the extra 5% in bid to cover below the trigger

Project Sizes

Smallest DOT Project = Sidewalk Repair (15 tons)

Smallest that Brett has bid = 3000 tons

Biggest Project: Design Build -> Highway 170 in Beaufort worth $120 million

DOT gave basic design

ACE Basin worth $120 million (350,000 tons)

Biggest that Brett has bid = 345,000 tons ($42 million) for I-26

20,000 Ton Job:

Total package (line striping, grass, etc.) -$100/Ton -> $2 million

Complete work in 2 months

7.1 miles of two-lane road (2inch overlay)

Rea bids 700,000-800,000 tons of asphalt per year

Month of June: Bid 7 Jobs ->166,500 tons ; was low bidder for 87,500 tons

Check SCDOT bid tabs under "doing business with dot"

Oman systems bid tabs pro and plus is another bidding software

Yes they stockpile, he says you have to

Jobs are bid on the 2nd Tuesday of the month for highway letting

He told us about a resin that is used in paint markings. The resin couldn't be made for some reason and the price went through the roof. It shut down paving. Over the course of about three weeks the price went up 300% if you could find it. The subs were going crazy and losing tons of money. This was in the last few months.

1.2 Interview with Andy Gillis, United LLC on 8/18/10

General Info about Contractor:

DOT accounts for about 99% of their work, roadway widening, bridge reconstruction

Bid in other states, currently have an ongoing project in Missouri

Binder is usually 6% of surface mix

Bid software: Oman Systems-bid TABS Professional

Do not stockpile

Price Adjustment:

Use suppliers for price of fuel and other materials

It is helpful to look at other sources of prices for materials when you are inexperienced in working with that certain material.

Price adjustment eases risk for contractors, and he can see no risk with price escalation clauses

Can stockpile to avoid price escalation, DOT pays for storage: Problem is where to store the material.

Picks materials costs from lowest supplier at the time of letting

Sees asphalt as most volatile, also sign structures since that is the last thing built during a project.

Project Sizes:

Smaller-$180,000

Larger - $200,000,000 (all concrete, 520 exchange)

1.3 Survey Banks Construction, Reid Banks

1. What kinds of construction work do you do for SCDOT?
   Highway-heavy construction

2. What size construction contracts (e.g. large jobs vs. small jobs) do you bid for and complete for SCDOT ?
   100k and up

3. What construction materials are consumed in your construction work for SCDOT?
   Stone, pipe, sand, asphalt cement, etc….

4. What range of quantities of each construction material is consumed in your construction work for SCDOT?
   It depends on each job and varies widely.

5. Is there any other relevant information?

6. When preparing bids, what sources do you use for price information for the following materials?
   a. Fuel – currently purchasing price
   b. Asphalt- index and current rack price
   c. Portland cement and/or PCC – N/A
   d. Steel – N/A

7. Do you track material costs on a consistent basis (or just at time of bid preparation)?
   Yes
   a. What materials or bid line items are the most volatile? – Liquid Asphalt

8. How do you use published price information to select the cost of materials when making a bid for each particular construction material? – Don't

   a. How do you balance local costs versus ENR or other published sources?
      We don't
   b. Are there seasonal considerations for choosing bid prices?
      No
   c. Does your materials cost selection process differ for different materials/project size/project duration?
      Yes

9. What have your experiences been with SCDOT projects that allow price adjustments? Very favorable

10. In your opinion, what are the risks (perceived or real) associated with allowing price adjustments for materials? – Price adjustments (such as Asphalt Index) shift the market price risk to the owner. I strongly believe that the owner/agency comes out ahead by taking the risk vs. shifting it to the contractor.

    a. Are the impacts different for small vs. large contractors? – Yes. Small contractors may have a more difficult time absorbing a higher material price on a project.

11. What are the viable alternatives to mitigating risks (instead of using price adjustments)?

    a. Building, buying, or leasing storage for contingency supplies of asphalt volumes – not reasonable or cost effective in most cases.
    b. Market-based risk management options provided by vendors equipped to do so (i.e. vendors with storage, weigh scales, polymer mixing equipment, etc.) - Vendors will not provide the service.
    c. Purchasing hedges based on "similar" commodities (heating oil, crude oil, gasoline) on the New York Mercantile Exchange (NYMEX) - haven't found a commodity that is strongly enough to correlate.
    d. Collaborating with surrounding states to reconcile specifications in order to pool supply requirements, garner joint supply, coordinate deliveries, etc. – Not to be expected.
    e. Considering long-term material market behaviors in long-range (20-yr) planning – including concrete, asphalt, polymer, etc. – market to volatile and hard to predict.

12. Would you opt in for each of the construction materials that you normally use? Why or why not?
    a. Is the trigger value the most significant factor for opting in?

13. Do you or would you stockpile materials for SCDOT projects? Why or why not? Yes, we do when advantageous.

1.4 Survey, HRI Bridge Company, Ted Geddis

1. What kinds of construction work do you do for SCDOT?
   Build bridges of most types. Steel pile, concrete pile and drilled shaft supported concrete foundations. Concrete superstructures on steel or precast concrete girders. Bridge demolition. Bridge deck repair, including latex modified concrete (LMC) overlay. Concrete retaining walls and mechanically stabilized earth (MSE) walls.

2. What size construction contracts (e.g. large jobs vs. small jobs) do you bid for and complete for SCDOT ?
   $400K to $45M, 1 month to 3 years

3. What construction materials are consumed in your construction work for SCDOT?
   Concrete, reinforcing steel, structural steel girders, precast concrete, bridge expansion joints, bridge bearings, various structural steel fabrications, timber, pipe, steel H pile, steel pipe pile, pre-stressed concrete pile, metal bridge rail, coatings/paint, geo-fabrics, processed stone/rip rap.

4. What range of quantities of each construction material is consumed in your construction work for SCDOT?
   A few examples: 20 – 4,000 cy concrete. 5,000 – 2,000,000 lbs. rebar. 2,000 – 20,000 lf various piling type(we are doing a job with a million ft. of h-pile right now), up to 3 million pounds of structural steel, 15,000 feet of steel girders

5. Any other relevant information?

We currently use Bid2Win estimating software and are planning on switching to HCSS soon.

6. When preparing bids, what sources do you use for price information for the following materials?
    a. Fuel – average market price
    b. Asphalt – quotes from subcontractors
    c. Portland cement and/or PCC – quotes from concrete suppliers, we typically do not get cement prices
    d. Steel – quotes from fabricators
    e. Other …

7. Do you track material costs on a consistent basis (or just at time of bid preparation)?
   Fairly consistent basis, and at bid time

    a. What materials or bid line items are the most volatile?
       Fuel, concrete, steel, asphalt

8. How do you use published price information to select the cost of materials when making a bid for each particular construction material?
   We do not; we rely on quotes for the particular item for a particular job

    a. How do you balance local costs versus ENR or other published sources?
       We use quoted prices at bid time

    b. Are there seasonal considerations for choosing bid prices?
       Rain, wind, extreme cold or heat all affect productivity, and therefore, cost. Working at night and vehicular traffic volumes and restrictions also affect price in relation to higher delivery cost for night delivery, i.e. steel girders, concrete girders, concrete

c. Does your materials cost selection process differ for different materials/project size/project duration?

   Yes, some suppliers have escalation costs which must be factored for longer duration projects.

9. What have your experiences been with SCDOT projects that allow price adjustments?

   They tend to hold the price down slightly, as escalation additions may not be as large.

10. In your opinion, what are the risks (perceived or real) associated with allowing price adjustments for materials?

    The formulas that are specified to calculate the adjustments can allow inadequate or incorrect adjustment.

    a. Are the impacts different for small vs. large contractors?

       Dollar magnitude may be different due to quantities.

11. What are the viable alternatives to mitigating risks (instead of using price adjustments)?

    a. Building, buying, or leasing storage for contingency supplies of asphalt volumes

       Not viable all the time due to money that is tied up with stock piles hurts cash flow.

    b. Market-based risk management options provided by vendors equipped to do so (i.e. vendors with storage, weigh scales, polymer mixing equipment, etc.)

       Payment for materials on hand helps.

    c. Purchasing hedges based on “similar” commodities (heating oil, crude oil, gasoline) on the New York Mercantile Exchange (NYMEX)

       This may work for large companies. But small companies could not do this

    d. Collaborating with surrounding states to reconcile specifications in order to pool supply requirements, garner joint supply, coordinate deliveries, etc.

       This would probably help some, but good luck getting it to happen.

e. Considering long-term material market behaviors in long-range (20-yr) planning – including concrete, asphalt, polymer, etc.

   I would not consider this. The DOT does not always have an option when a job can be bid due to cash flow problems therefore trying to consider long term prices is a crystal ball guess.

12. Do you or would you stockpile materials for SCDOT projects? Why or why not?

    We stockpile temporary materials used for construction (concrete formwork, traffic control devices, and temporary works structures). We stockpile permanent materials for projects only if the SCDOT pays for stored materials. Cash flow and availability of the material dictates any other permanent materials we store Some materials have shelf lives, some require weather protection, steel can rust, specifications for material can be revised. These thoughts must be considered in the decisions to stockpile and store materials.

1.5 Sanitary Plumbing Contractors, Sally Paul

1. What kinds of construction work do you do for SCDOT?

   Concrete culverts, retaining walls, specialty concrete

2. What size construction contracts (e.g. large jobs vs. small jobs) do you bid for and complete for SCDOT?

   Average is around $350k

3. What construction materials are consumed in your construction work for SCDOT?

   Rebar, concrete, precast panel

4. What range of quantities of each construction material is consumed in your construction work for SCDOT?

5. any other relevant information

6. When preparing bids, what sources do you use for price information for the following materials?
    a. Fuel
    a. Asphalt
    b. Portland cement and/or PCC
    c. Steel
    d. Other …

        Historical prices and job specific quotes
7. Do you track material costs on a consistent basis (or just at time of bid preparation)?

    All job costs are tracked

    a. What materials or bid line items are the most volatile?

        Rebar, fuel

8. How do you use published price information to select the cost of materials when making a bid for each particular construction material?

    We do not use publication

    a. How do you balance local costs versus ENR or other published sources?
    b. Are there seasonal considerations for choosing bid prices?

        No-only if additives are for concrete (there is a word here but I cannot read it) in extreme weather
    c. Does your materials cost selection process differ for different materials/project size/project duration?

        no

9. What have your experiences been with SCDOT projects that allow price adjustments?

    SCDOT publishes a list of items that will be adjusted

10. In your opinion, what are the risks (perceived or real) associated with allowing price adjustments for materials?

none

a. Are the impacts different for small vs. large contractors?

11. What are the viable alternatives to mitigating risks (instead of using price adjustments)?

    a. Building, buying, or leasing storage for contingency supplies of asphalt volumes
    b. Market-based risk management options provided by vendors equipped to do so (i.e. vendors with storage, weigh scales, polymer mixing equipment, etc.)
    c. Purchasing hedges based on "similar" commodities (heating oil, crude oil, gasoline) on the New York Mercantile Exchange (NYMEX)
    d. Collaborating with surrounding states to reconcile specifications in order to pool supply requirements, garner joint supply, coordinate deliveries, etc.
    e. Considering long-term material market behaviors in long-range (20-yr) planning – including concrete, asphalt, polymer, etc.

12. Would you opt in for each of the construction materials that you normally use? Why or why not?

    If possible

    a. Is the trigger value the most significant factor for opting in?

        yes

13. Do you or would you stockpile materials for SCDOT projects? Why or why not?

    If the cost is significant and scdot will pay for the materials stored

1.6 Survey, Sloan Construction, Wendy Thompson

1. What kinds of construction work do you do for SCDOT?

Heavy Highway

2. What size construction contracts (e.g. large jobs vs. small jobs) do you bid for and complete for SCDOT?
   $10,000 - $50,000,000

3. What construction materials are consumed in your construction work for SCDOT?
   Liquid asphalt, aggregate, cement, girders (steel or concrete), expansion materials, reinforcing steel, drainage items

4. What range of quantities of each construction material is consumed in your construction work for SCDOT?
   0 – 300,000 aggregates, 0 – 10,000 cy concrete, 0 – 1,000,000 lbs. reinforcement

5. Is there any other relevant information?

6. When preparing bids, what sources do you use for price information for the following materials?
   a. Fuel - current pricing on SC index
   b. Asphalt - current pricing on SC index
   c. Portland cement and/or PCC - suppliers
   d. Steel - suppliers
   e. Other …

7. Do you track material costs on a consistent basis (or just at time of bid preparation)?
   Just at the time for bid prep usually, indexes consistently

   a. What materials or bid line items are the most volatile?
      Cement, steel

8. How do you use published price information to select the cost of materials when making a bid for each particular construction material?

   Our estimating program handles materials at bid time for review

   a. How do you balance local costs versus ENR or other published sources?

      Local cost prevails – ENR, etc. are just indicators

   b. Are there seasonal considerations for choosing bid prices?

      Yes – prime time for asphalt is summer

   c. Does your materials cost selection process differ for different materials/project size/project duration?

      no

9. What have your experiences been with SCDOT projects that allow price adjustments?

   Good and fair

10. In your opinion, what are the risks (perceived or real) associated with allowing price adjustments for materials?

    Risk is mitigated for owner and contractor

    a. Are the impacts different for small vs. large contractors?

       No, both are protected

11. What are the viable alternatives to mitigating risks (instead of using price adjustments)?

    a. Building, buying, or leasing storage for contingency supplies of asphalt volumes

       The cost would be overwhelming

    b. Market-based risk management options provided by vendors equipped to do so (i.e. vendors with storage, weigh scales, polymer mixing equipment, etc.)

       Vendors are always concerned with profit

c. Purchasing hedges based on “similar” commodities (heating oil, crude oil, gasoline) on the New York Mercantile Exchange (NYMEX)
   Risk!
d. Collaborating with surrounding states to reconcile specifications in order to pool supply requirements, garner joint supply, coordinate deliveries, etc.
   Grows government
e. Considering long-term material market behaviors in long-range (20-yr) planning – including concrete, asphalt, polymer, etc.
   DOT should always consider this

12. Would you opt in for each of the construction materials that you normally use? Why or why not?
    Yes – mitigate risk
    a. Is the trigger value the most significant factor for opting in?
       No

13. Do you or would you stockpile materials for SCDOT projects? Why or why not?
    No – risk and tax implications

1.7 Survey, US Group, Michael McDonald

1. What kinds of construction work do you do for SCDOT?
   We are a general contractor on highway and bridge construction contracts. We perform earthwork, storm drainage, concrete work, erosion control

2. What size construction contracts (e.g. large jobs vs. small jobs) do you bid for and complete for SCDOT?
   We currently have projects ranging from $10 million to $70 million.

3. What construction materials are consumed in your construction work for SCDOT?
   Mainly pipe (RCP & HDPE), concrete, and all erosion control products. Some projects require the purchasing of large quantities of borrow from both commercial and private borrow pits.

4. What range of quantities of each construction material is consumed in your construction work for SCDOT?
   0 – 300,000 aggregates, 0 – 10,000 cy concrete, 0 – 1,000,000 lbs. reinforcement

5. Is there any other relevant information?

6. When preparing bids, what sources do you use for price information for the following materials?
   a. Fuel
   b. Asphalt
   c. Portland cement and/or PCC
   d. Steel
   e. Other …

   Quotations are received from various suppliers and subcontractors for the specific materials and work involved on the project being bid

7. Do you track material costs on a consistent basis (or just at time of bid preparation)?
   Detailed cost records are maintained during the course of the project and past records are referred to when bidding new projects.

   a. What materials or bid line items are the most volatile?
      Concrete, steel, asphalt

8. How do you use published price information to select the cost of materials when making a bid for each particular construction material?

Bids are based on quotations and proposals submitted by suppliers and subcontractors

a. How do you balance local costs versus ENR or other published sources?
   ENR & other sources are good reference, but local costs and trends govern
b. Are there seasonal considerations for choosing bid prices?
   Not normally
c. Does your materials cost selection process differ for different materials/project size/project duration?
   no

9. What have your experiences been with SCDOT projects that allow price adjustments?
   Normally good. On long term projects (2-3 years) they are not always able to anticipate rapid market variations that result in large price increases in products not included in price escalation specs.

10. In your opinion, what are the risks (perceived or real) associated with allowing price adjustments for materials?
    No risks associated with SCDOT covered items. Other quotes must be evaluated and purchases planned to minimize risk
    a. Are the impacts different for small vs. large contractors?
       Impact is a function of cash flow and working capital

11. What are the viable alternatives to mitigating risks (instead of using price adjustments)?
    a. Building, buying, or leasing storage for contingency supplies of asphalt volumes
       Restricted by cash flow concerns
    b. Market-based risk management options provided by vendors equipped to do so (i.e. vendors with storage, weigh scales, polymer mixing equipment, etc.)
       Possible option, but restricted to very small number of vendors
    c. Purchasing hedges based on “similar” commodities (heating oil, crude oil, gasoline) on the New York Mercantile Exchange (NYMEX)
       Not a viable option for most contractors

d. Collaborating with surrounding states to reconcile specifications in order to pool supply requirements, garner joint supply, coordinate deliveries, etc.
   Some states pool material supplies for commonly used products, traffic marking paint is a good example. Northern states commonly do this with de-icing products.
e. Considering long-term material market behaviors in long-range (20-yr) planning – including concrete, asphalt, polymer, etc.
   SCDOT projects are usually planned as a result of public need and available funding, not long term price considerations

12. Would you opt in for each of the construction materials that you normally use? Why or why not?
    I don't believe future needs are predictable enough
    a. Is the trigger value the most significant factor for opting in?
       No
13. Do you or would you stockpile materials for SCDOT projects? Why or why not?
    Would consider stockpiling products not covered under SCDOT Price Escalation provisions; some quotations are conditioned on minimum orders

Appendix D Brief on Hedging for Asphalt Prices

Hedging Asphalt Price Volatility with Market Alternatives – NYMEX Oil Contracts and Options to Buy Oil

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In order to secure a hedge against a market increase in asphalt, the New York Mercantile Exchange (or "NYMEX") offers possible solutions. For example, if a person believes that the price of oil is going to rise above what is currently expressed in the futures market, then that person may want to buy a contract for oil for the month(s) that they actually want to insure against. For instance, if it is currently March, and "July oil" is priced at $81 per barrel (in March), and you believe the price could be higher than $81 when July actually arrives, then one alternative would be to buy a futures contract for July oil, and then sell that contract before maturity (delivery) in order to collect on an upturn in the market. One downside of this approach is in the event that the market actually goes down (i.e. below $81 per barrel). If this happens, then you lose money on owning an actual contract for oil that is now of lesser value than when purchased.

Note: The actual delivery location for a mature oil contract is Cushing, OK (not NY Harbor, as some may believe). In any case, only those who are actually interested in taking physical delivery should hold a contract until maturity.

Another alternative is to buy a "call option" on oil. For example, let's say it is March now, and you are interested in the price of oil in September; which is six months away. If the current "futures" price of oil in September is $82 per barrel, and you believe it could go higher by September, then you can purchase an option to buy (and own) September oil at $82, or perhaps higher, in order to hedge against price increases. If the actual price goes above $82, and you paid a premium of $7 per barrel in order to have the option to buy oil at $82 in September, then the price has to go above $89 in order to make money on owning that call option (in other words to be "in the money"). Note: the $7 premium in this case is for a relatively well-behaved forward market (low volatility anticipated – such as the 2010 forward market), where the prices are rising slightly through time (e.g. reflecting the "holding costs") in the projected futures market.

A variation of this trade might involve buying a (cheaper) option to buy oil at $86 a barrel. In this case the premium might be $5 per barrel, due to the higher "strike price" (i.e. $86 instead of $82). In this case, however, the price would have to go above $91 a barrel in order to net any money for the person buying the option.

Here are some additional thoughts on hedging. The three oil-related commodities traded on the NYMEX are heating oil, crude oil, and gasoline. None of these provides a perfect hedge for asphalt. In addition, heavy crude seems like a natural hedge for asphalt (somewhat of an intuitive proxy due to the physical similarities). But this needs research in order to verify that this would indeed be a better hedge than West Texas Intermediate

(WTI) or even gasoline. WTI is the actual crude (benchmark) commodity traded on the NYMEX. Gasoline seems like it would be a natural hedge as well, due to the "swing" refiner's alternative to make gasoline instead of asphalt, assuming their ability to run coking equipment when needed; depending upon the refined product markets and economics of production at the time.

For the case where WYDOT may wish to "hedge" 10,000 tons of asphalt with a current value at, say, $490 per ton -- this would be a total value (to be hedged) of $4,900,000. If oil is worth $80 per barrel, this would be equivalent to 61,250 barrels of oil. This amount times $5 per barrel for a premium for buying a 6 month (call option) hedge would be a total of over $300K. To hedge 30,000 tons (the amount related to over $6MM in escalation adjustments made by WYDOT in 2008) would amount to about $1MM.

So, for another summary comparison, let's say a volatile year in asphalt, such as 2008, is anticipated, and the intent is to "protect" 40% (or about 20,000 tons) of the estimated paving season's needs for asphalt. In 2008, the escalation adjustment amounts for this quantity of asphalt totaled between $3MM and $5MM (depending upon which tons we're referring to, and when the adjustments occurred during the season). This amount of asphalt would have cost about $600K to hedge in the manner described above.

Caution -- Keep in mind that a 9 month premium (for a call option) would be more costly, and during a volatile market leading up to the paving season, these premiums could be even higher still. The analysis above also assumes that oil prices move proportionally with asphalt prices. This was roughly true during 2008; however oil prices spiked and then returned to the pre-spike prices fairly rapidly. Asphalt prices also spiked, but in contrast have taken a couple of years since then to decay to what some would consider to be a stable market price. This implies that a market structure exists for asphalt that is not apparent in the overall crude and gasoline markets. In any case, a comparison of these individual markets (asphalt, heating oil, crude, and gasoline) over time would be necessary in order to determine which commodities correlate best, and what the best hedging strategy for asphalt should be.

REFERENCE for NYMEX option premium costs (September 2010 Oil Futures posted in March 2010): Curt Johnson and Steve Platt, ADM Investor Services, Archer Daniels Midland, Chicago, IL.