

## **APPENDIX D: NEWS BRIEF**

### **D.1 Introduction and Research Problem**

Price adjustments of selected commodities in highway construction are used in construction contracting as a way of limiting risks to the contractor arising from price fluctuations of these commodities over the life of a contract. Fuel usage factors are commonly applied by state and local agencies in calculating fuel cost price adjustments in a contract specification that permits cost escalation and de-escalation. The current federal factors, originally developed for Highway Research Board (HRB) Circular Number 158 in 1974, are presented in the 1980 Federal Highway Administration (FHWA) Technical Advisory T5080.3. The advisory contains fuel usage factors, in gasoline and diesel, for a number of heavy construction activities, including excavation, aggregates, hot mix asphalt production and hauling, and Portland cement concrete production and hauling. HRB Circular 158 established fuel usage factors for structures and miscellaneous construction in gallons per \$1,000 of construction cost, with no provision for any adjustment for inflation.

NCHRP Project 10-81 is the first research effort to revisit these factors on the federal level and attempts to account for more than 30 years of inflation, commodity cost increases, and changes in construction practices. The objectives of this research were to (1) identify present highway construction contract activities that are major consumers of fuel; (2) prepare fuel usage factors for these activities, including those items of work presented in Attachment 1 of FHWA Technical Advisory T5080.3, for base year 2012; and (3) develop a recommended practice for state DOTs to implement use of fuel adjustment factors and adjust them for both state-specific conditions and changes in construction costs, methods, and equipment.

### **D.2 Project Scope**

The National Cooperative Highway Research Program (NCHRP) is a major research program within the Transportation Research Board (TRB) of the National Academy of Sciences. The NCHRP is sponsored by the American Association of State Highway and Transportation Officials (AASHTO) in cooperation with the Federal Highway Administration (FHWA). The NCHRP was the sponsor of this project effort, which was designated as NCHRP Project 10-81. Participants included an NCHRP project officer and a technical review panel. The FHWA also contributed one of its employees to serve as a liaison between the NCHRP and the FHWA.

State DOTs have also participated in this study. In the first phase of the project, the project team contacted all 50 state DOTs and acquired information on their price adjustment programs, their perceptions of fuel intensity, and the features that they would like included in the research products of this project effort.

This project has benefitted from the support of several industry organizations. The American Road & Transportation Builders Association (ARTBA), the Associated General Contractors of America (AGC), the National Asphalt Pavement Association (NAPA), and the American Concrete Pavement Association (ACPA) each agreed to cooperate with the project team and aid in survey review and dissemination.

This project in general, and the survey aspect in particular, depended on the participation of highway construction contractors. The project team attempted to contact over 10,000 contractors through email, industry organizations newsletters, and direct phone calls. This study also utilized fuel consumption information provided by the National Ready Mixed Concrete Association (NRMCA). In

total, this study utilized information provided by 270 contractors who provided over 500 individual data points regarding fuel consumption.

### **D.3 Findings**

This study involved the application of the three research methodologies in order to calculate per unit fuel usage by construction task. These methodologies included surveying state DOTs and contractors, an engineering analysis of fuel usage by construction task, and a statistical analysis of the Oman Systems BidTabs database of construction pay items. The study team designed each of these approaches to provide independent calculations of fuel use for highway construction activities. Each section of this chapter provides a sequential description of the research process undertaken and the results for each work item examined.

The first phase of the project involved initial steps that aided in the development of the three project methodologies. A nationwide survey of state DOTs and selected contractors helped to ascertain perceptions regarding fuel usage and data needs. An initial investigation of fuel intensity by an expert engineering team classified work categories and tasks by fuel intensity. Lastly, an initial statistical analysis modeled the relationship between bid prices and fuel prices.

The first effort of the project's more detailed data collection phase was the Contractor Fuel Usage Survey. This effort aided in the identification of heavy fuel use activities and allowed the project team to establish current levels of fuel use across a variety of construction activities and project conditions. The project team utilized several surveys, including an Excel spreadsheet tool and several industry segment specific SurveyMonkey surveys, to elicit contractor responses.

In total, respondents provided over 500 fuel consumption observations for over 40 different activities. As stipulated in the outreach efforts to highway construction contractors and organizations, this report provides results as an average of the valid responses for each activity and does not provide information reported by individual respondents.

The number of observations was sufficient to constitute a valid sample for most work items. With the exception of several outlying responses that would have skewed the calculated averages, the fuel usage estimates provided by the contracting community were within a reasonable range of accuracy as determined by the research team's engineering experts. Results within categories demonstrated consistency as well. The survey results provided utility throughout the remainder of the project, especially as a means to complement and verify the engineering results.

The second effort was the engineering analysis of fuel usage. The objective of the engineering analysis was to estimate the fuel usage of construction activities using engineering cost estimating techniques. The results of this effort, in conjunction with the statistical analysis and Contractor Fuel Usage Survey, allowed the project team to formulate new and updated fuel usage factors.

Building on the results from the initial engineering analysis, which aimed to identify high fuel use activities, the project team extended the analysis to calculate the fuel use per unit for each work task. Using the initial phase calculations as well as estimated quantities of work for a typical project, the project team was able to estimate a fuel usage factor for each work task.

The engineering team first established lists of equipment and production rates for each of the highway construction work tasks considered for this effort. The team then calculated a fuel usage factor for each of these tasks. Each estimator created an estimated task quantity for each task. For example, a

quantity of 1,000 L.F. of pipe was assigned for each of the pipe items. Using an estimated quantity for each crew, a total time for completing the task was established. Total fuel consumption was then calculated by factoring in the total time for the crew and the required equipment for each crew. Dividing the total fuel consumption by the estimated task quantity results in the gallons of fuel used per given unit of measure, i.e. a fuel usage factor.

The third project methodology was the statistical analysis of the BidTabs database of pay items. The objective of the BidTabs statistical analysis was to estimate the fuel usage of construction activities using a statistical model that incorporates changing fuel prices and bid prices. This included specification of the model, testing of different combinations and forms of the variables, exploration of lagged variables, evaluation of residuals and error terms and exploration of different combinations of pay items both within and across states.

The statistical analysis demonstrated that most highway construction activities consume large amounts of fuel and are fuel intensive. However, the approach does not appear to have generated estimates of fuel usage that would be accurate enough to contribute to the development of the final fuel usage factors. However, in developing these fuel factors, the results of the statistical analysis were considered where it was felt that they might be useful.

The final project phase consisted of comparing the fuel usage data gathered during the previous phase, modifying select items based on the knowledge of the expert engineering panel, and developing a final fuel usage factor for construction work tasks. For this effort, the research team compared data across the three study methodologies and the original fuel factors as presented in Technical Advisory T5080.3. Where the research had enough data to make a valid comparison, there was substantial agreement between the sources regarding activity fuel use. In particular, the survey data validated the engineering estimates. Where there was disagreement among the data sources, the engineering estimates were reassessed and generally revised to reflect the figures garnered from the survey effort.

#### **D.4 Recommendations**

The research effort for NCHRP #10-81 produced new and updated fuel usage factors that represent expected fuel consumption per unit for a variety of highway construction work tasks under average conditions. These fuel usage factors are presented within the Recommended Practice and Model Specification that accompanies the final project report. The Recommended Practice and Model Specification also contains background information on fuel usage factors and price adjustment clauses, definitions, sample calculations, and price adjustment worksheets. The new and updated fuel usage factors have also been inputted into the Price Adjustment Calculator Tool (PACT), an Excel-based spreadsheet tool developed by the project team that allows for interactive price adjustment calculations.

The study team recommends that the Recommended Practice and Model Specification, final report, and other project deliverables be publicized to the highway construction community, state DOTs, and federal transportation agencies and committees such as FHWA, AASHTO, and TRB. The products of this project may be useful to other agencies and entities as well. The data can be used by entities other than state DOTs for both highway contracting and construction of facilities for other transportation modes. Associations may value the data for dissemination of information and policy guidance for their members. Officials interested in improving planning and budgeting may find information on fuel use in their projects extremely useful. At the same time, contractors interested in better understanding and managing their fuel use or in preparing more accurate cost estimates will find value in the fuel factors. Finally, researchers examining energy requirements, emissions and climate change, can use the data in preparing estimates, inventories and action plans. An outreach action plan formulated by the research team is presented as an appendix of the final report. This plan contains strategies to maximize the

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publicity of NCHRP #10-81, including conducting webinars, making presentations at conferences and trade shows, and updating the FHWA website to display the new and updated fuel usage factors.