

**Delaware Department of Transportation
Division of Transportation Solutions
Design Guidance Memorandum**

Memorandum Number 1-24

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|-----------------------|----------------------------|----------------------------------|
| 1. Road Design Manual | 2. Bridge Design Manual | 3. Utilities Design Manual |
| 4. Real Estate Manual | 5. Standard Specifications | 6. Standard Construction Details |

Title: Road User Cost Analysis Effective date: April 19, 2010

Sections to Implement:

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|---|---|--|
| <input checked="" type="checkbox"/> Project Development | <input checked="" type="checkbox"/> Planning | <input type="checkbox"/> DTC |
| <input checked="" type="checkbox"/> Bridge | <input checked="" type="checkbox"/> Quality | <input checked="" type="checkbox"/> Traffic |
| <input type="checkbox"/> Team Support | <input checked="" type="checkbox"/> Maintenance &
Operations | <input checked="" type="checkbox"/> Construction |
| <input type="checkbox"/> Utilities | | <input type="checkbox"/> Other _____ |

I. Purpose

To give guidance for calculating the daily user cost for road construction projects. Follow this procedure to determine the work zone impacts to the traveling public resulting from anticipated lane closures and/or detours. The daily user cost value can be used as guidance when determining liquidated damages, contractor incentive/disincentive (if appropriate), or the “B” value for contracts using A+B bidding.

II. Design Guidance

The calculations for road user cost analysis are based on the methodologies presented in the American Association of State Highway and Transportation Officials (AASHTO) publication *User Benefit Analysis for Highways* (August of 2003) commonly referred to as the *Red Book*. The methodology involves calculating two primary components of user cost – delay costs and operating costs – as outlined below. Values to be used are updated each year in the attachment to this memo.

1. Calculating Delay Costs

When a motorist is delayed traveling through or around a work zone, there is a value of time associated with the time lost. The *Red Book* defines a road user’s value of time using the following equations:

Equation 1:

$$\text{Value of time per car} = \text{Average vehicle occupancy} * 50\% * \text{Average wage rate}$$

Equation 2:

$$\text{Value of time per truck} = \text{average vehicle occupancy} * 100\% * \text{average truck driver compensation}$$

Each year, the Traffic Section, in consultation with Contract Administration, will calculate the values of time that should be used. See Table 1 of the attachment for the current values.

The additional delay resulting from the work zone should be calculated on a case-by-case basis. Delay can be calculated using travel time runs, simulation model runs, segment analysis, or software packages such as QuickZone. Calculate delay in hours per vehicle to be consistent with the units used for value of time. Consult the Traffic Section for assistance with the delay calculation.

Once the value of time and delay are known, the daily delay cost associated with the work zone can be calculated using Equation 3:

Equation 3:

$$\text{Daily Delay Cost} = \text{Ave delay} * (\text{ADT} * \% \text{ autos} * \text{VOTa} + \text{ADT} * \% \text{ light} * \text{VOTl} + \text{ADT} * \% \text{ heavy} * \text{VOTh})$$

Where:

Ave delay = average delay per vehicle (hr/veh)

ADT = average daily traffic

% auto = percentage of non-trucks in the traffic stream

VOTa = value of time per auto (\$/hr) from Table 1

% light = percentage of light trucks in the traffic stream

VOTl = value of time per light truck (\$/hr) from Table 1

*% heavy = percentage of heavy trucks in the traffic stream

VOTh = value of time per heavy truck (\$/hr) from Table 1

2. Calculating Operating Costs

DelDOT has adopted the *Red Book's* module for calculating operating and ownership costs. Each year the Traffic Section, in consultation with Contract Administration, will develop a table of operating costs per mile based on travel speed to be used calculating daily operating costs resulting from a construction detour. See Table 2 of the attachment for the current values.

Using the information from Table 2, the additional operating costs resulting from a work zone can be calculated using Equation 4:

Equation 4:

$$\text{Daily Operating Cost} = \text{ADT} * \% \text{ auto} * (\text{Dwz} * \text{AOCwz} - \text{D} * \text{AOC}) + \text{ADT} * \% \text{ truck} * (\text{Dwz} * \text{TOCwz} - \text{D} * \text{TOC})$$

Where:

ADT = average daily traffic

% auto = percentage of non-trucks in the traffic stream

Dwz = travel distance with the work zone in place

AOCwz = operating cost per auto (\$/mile) with the work zone in place from Table 2

D = travel distance without the work zone

AOC = operating cost per auto (\$/mile) without the work zone from Table 2

% truck = percentage of light and heavy trucks in the traffic stream

TOC_{wz} = operating cost per truck (\$/mile) with the work zone in place from Table 2

TOC = operating cost per truck (\$/mile) without the work zone from Table 2

3. Other Cost Components

There are additional potential user cost components that could be applied, including crash costs and vehicle idling costs. However, to simplify the calculations and employ a conservative and defensible user cost value, the DeIDOT methodology only focuses on delay cost and operating costs.

4. Final Daily User Cost

The final calculated daily user cost is determined using Equation 5. The actual cost value used in a contract may be less than the calculated daily user cost, as deemed appropriate by the project design team in consultation with Contract Administration.

Equation 5:

$$\text{Total Daily User Cost} = \text{Daily Delay Cost} + \text{Daily Operating Cost}$$

5. Hourly User Cost

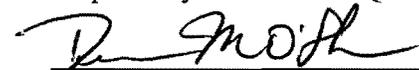
User costs for a project are typically calculated on a daily basis using the procedure already described. However, in some cases, hourly user cost values will be required. In these cases (such as for an overnight lane closure that is required to be re-opened at a specific time), the same procedure can be applied, substituting hourly volumes and delays for daily values.

III. Justification

The calculation of road user costs provides information enabling the designer to make better informed decisions in regards to staging, allowable work hours, project delivery method, and the design itself.

Prepared by: Traffic and Quality Sections

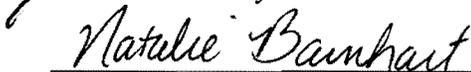
Date: April 7, 2010



4/9/10

Recommended by: Assistant Director – Design

Date



4/12/10

Approved: Chief Engineer

Date

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