Allocation of Road Repair Costs to Multiple Users of Posted Roads

Using ESAL method

Introduction

- Pavement damage depends on weight distribution.
- Weight distribution depends on:
  - Number of axles
  - Weight on each axle
  - Spacing of axles

ESAL Concept Developed

- AASHTO developed a method to convert various truck axles configurations & weights to one standard
- Standard = ESAL (Equivalent Single Axle Load)
- One ESAL is equivalent to an18,000 lb weight on a single axle with dual tires.

ESALs Determined for Specific Axle Types & Weights

- AASHTO developed equivalency factors based on relative damage caused by an axle type & weight compared to the standard ESAL
- Examples:
  - Single axle (18,000 lbs)= 1.0 ESALs
  - Single axle (12,000 lbs)= 0.23 ESALs

  - Tandem axle (24,000 lb)= 0.32 ESALs
  - Tandem axle (34,000 lbs)= 1.11 ESALs

ESALs Determined for Specific Trucks

- Most trucks contain a combination of axle types & loads
- ESALs for entire truck = sum of ESALs for each axle

Simplified ESAL Determination

- Many DOT's have developed average ESAL factors for each truck class based on measurements of trucks throughout state
- Eliminates need to weigh each truck when doing pavement analysis
- PennDOT's average ESAL Factors provided in Publication 242

PennDOT'S Truck ESAL Factors (Publication 242)

TABLE 7.1 Average Initial Truck Factors (ESALs/Truck) by Vehicle Class

VEHICLE CLASSIFICATION			ESAL's	
Line # in DARWin® 3.01	**FHWA Class**	**Corresponding Department Description**	**Rigid**	**Flexible**
1	1	Motorcycle	0*	0*
2	2	Passenger Cars	0*	0*
3	3	SUV/Pick-up	0*	0*
4	4	BUS Factor	0.24	0.24
5	5	2-axle, 6-tire	0.24	0.24
6	6	3-axle, single unit	1.15	0.82
7	7	4-axle, single unit	7.00	4.50
8	8	3-axle, single trailer	0.60	0.44
9	9	3-axle, multiple axle trailer	1.59	1.00
10	10	6-axle, single trailer	1.42	0.75
11	11	5-axle, multiple trailer	2.40	2.33
12	12	6-axle, multiple trailer	1.42	1.28
13	13	7-axle, multiple trailer	1.42	1.28

*Note: Because motorcycles, passenger cars, and SUV/Pick-up trucks do not significantly contribute to the 18-kip ESALs they are considered negligible and an ESAL/truck factor of 0 is assigned. However, the percent of the ADT in this class must be input into DARWin because the Total Percentage must equal 100.00%. If there are any vehicles that are not large enough to be classified in any of the above classes, they should be grouped with the motorcycle percentage.

Example PennDOT ESAL Factors

- Class 7 (Triaxle)
  - 4.50 ESALs

- Class 9 (Tractor Trailer)
  - 1.00 ESALs

PennDOT Procedure to Allocate Repair Costs to Multiple Users

- Previous Method- Publication 23
  - Costs allocated based on % tonnage hauled by each user
- Revised Method-Recently Developed
  - Costs allocated based on % ESALs by each user
  - Spring thaw factor

Example– ESAL Method

COMPANY	TRUCK TYPE	NUMBER OF TRUCKS	ESAL FACTOR	ESALS	PERCENT OF ALLOCATION
A	4-AXLE SINGLE UNIT	65	4.5	292.5	67.66%
	3 AXLE-MULTIPLE AXLE TRAILER	36	1	36	
B	3 AXLE-SINGLE UNIT	55	0.82	45.1	9.29%
C	5-AXLE MULTIPLE TRAILER	40	2.33	93.2	23.06%
	6-AXLE SINGLE TRAILER	25	0.75	18.75	
			TOTAL =	**485.55**	**100.00%**

Damage During Spring Thaw

- Pavement damage from trucks is accelerated during Spring thaw
- PennDOT developed refined procedure to account for additional damage during Spring thaw period
- Independent study of pavement found damage during Spring thaw is approximately 2 times the damage during the rest of the year

ESAL Method Modified to Account For Spring Thaw Damage

- ESALs applied during period of Spring thaw multiplied by damage factor to get equivalent ESALs

COMPANY	HAULING DATA	
XYZ	NUMBER OF TRUCKS (A)	28
	TRUCKS DURING SPRING THAW (B)	8
	TRUCKS OUTSIDE SPRING THAW C=(A-B)	20
	ESAL FACTOR (D)	4.5
	TOTAL EQUIVALENT ESALS (C+(2*B))*D	162