

CALCULATING ESAL'S

"Perfect World"

With Power Formula's For Axle Sets:

1

$$ESAL_{\text{SINGLE AXLE}} = \left(\frac{W_{\text{SINGLE AXLE}}}{18,000 \text{ lbs.}} \right)^4$$

$$ESAL_{\text{TANDEM AXLE}} = \left(\frac{W_{\text{TANDEM AXLE}}}{32,200 \text{ lbs.}} \right)^4 \quad \leftarrow \text{Asphalt}$$

$$ESAL_{\text{TANDEM AXLE}} = \left(\frac{W_{\text{TANDEM AXLE}}}{29,000 \text{ lbs.}} \right)^4 \quad \leftarrow \text{Concrete}$$

2

$$ESAL_i = \sum_{i=1}^{\text{\# of axle sets}} ESAL_{\text{AXLE SETS}}$$

Vehicle i

$$ESAL_{\text{ANNUAL}} = D \sum_{i=1}^{\text{\# of axle types}} (v_i)(ESAL_i)$$

$$= (320 \text{ days/year}) \left[\underbrace{(1000 \text{ veh/day})}_{N_1} \underbrace{(2.96/\text{veh})}_{ESAL_1} + \underbrace{(1500 \text{ veh/day})}_{N_2} \underbrace{(3.41/\text{veh})}_{ESAL_2} \right]$$

$$= 320[2960+5115] = 2,584,000/\text{year}$$

3

$$ESAL_N = ESAL_{\text{ANNUAL}} \times \frac{[1+g]^N - 1}{g} \quad \text{5\% growth rate for 15 years}$$

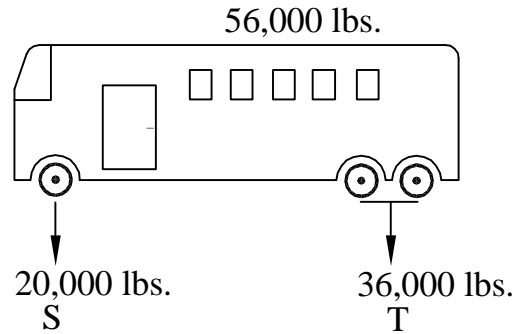
$$ESAL_{15} = 2,584,000 \times \frac{[1+0.05]^{15} - 1}{0.05} = (2,584,000)(21.58)$$

$$ESAL_{15} = 55,795,008$$

9.4

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$$n = 20$$

$$g = 2\% = 0.02$$

$$ESAL_{BUS} = \left(\frac{20,000}{18,000}\right)^4 + \left(\frac{36,000}{33,200}\right)^4 = 1.524 + 1.382$$

$$ESAL_{BUS} = 2.906/\text{bus}$$

$$615\text{buses/day} \times 365\text{days/year} = 224,475\text{buses/year}$$

$$ESAL_{BUS}^{1\text{-YEAR}} = (2.906/\text{bus})(224,475\text{buses/year}) = 652,324/\text{year}$$

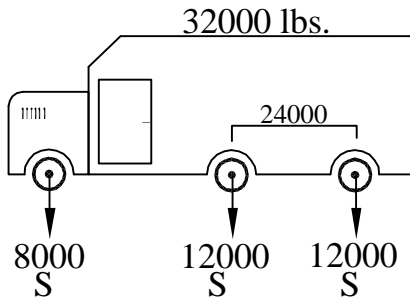
$$ESAL = 652,324 \frac{[(1 + 0.02)^{20} - 1]}{0.02}$$

$$ESAL = \underline{\underline{15,849,757}}$$

9.5 - SAMPLE

CALCULATING ESAL'S

With Power Formula's For Axle Sets:

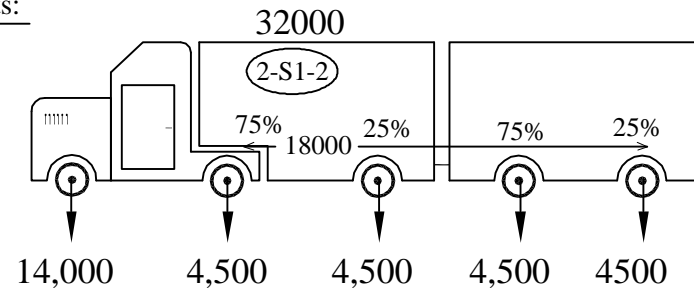


$$ESAL = \left(\frac{8,000}{18,000}\right)^4 + \left(\frac{12,000}{18,000}\right)^4 + \left(\frac{12,000}{18,000}\right)^4$$

$$ESAL = 0.039 + 0.198 + 0.198$$

$$ESAL = 0.434/\text{veh}$$

$$\text{Annual ESAL} = (50\text{veh/day})(320\text{days/year})(0.434/\text{veh}) = \underline{\underline{6,945/\text{year}}}$$

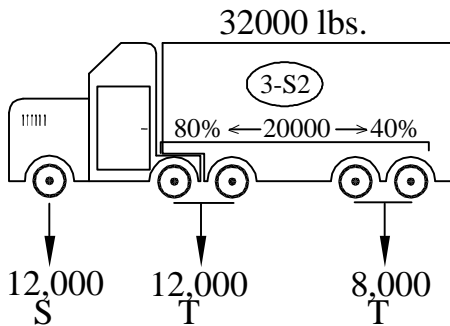


$$ESAL = \left(\frac{14,000}{18,000}\right)^4 + \left[\left(\frac{4,500}{18,000}\right)^4 * 4\right]$$

$$ESAL = 0.366 + 0.016$$

$$ESAL = 0.382/\text{veh}$$

$$\text{Annual ESAL} = (240\text{veh/day})(320\text{days/year})(0.382/\text{veh}) = \underline{\underline{29,338/\text{year}}}$$



$$ESAL = \left(\frac{12,000}{18,000}\right)^4 + \left(\frac{12,000}{33,200}\right)^4 + \left(\frac{8,000}{33,200}\right)^4$$

$$ESAL = 0.198 + 0.017 + 0.003$$

$$ESAL = 0.218/\text{veh}$$

$$\text{Annual ESAL} = (260\text{veh/day})(320\text{days/year})(0.218/\text{veh}) = \underline{\underline{18,138/\text{year}}}$$

CALCULATING ESAL'S

"In Reality"

① & ② are Calculated via some Formula:

FDOT :

$$ESAL_{ANNUAL} = AADT \times T_{21} \times D_F \times F_F \times E_{18} \times 365_{days/year}$$

% Trucks (≥ 6 Tires) → T_{21}
 Directional Factor (= 0.5 for Two-Way Roads) → D_F
 Lane Factor (From Table D.2) → F_F
 Equivalency Factors (Table D.3) → E_{18}

$$ESAL_{ANNUAL} = 20,000veh/day \times 0.06 \times 0.5 \times 0.81 \times 0.96 \times 365$$

6% Trucks → 0.06
 Rural Arterial → 0.81
 2 lanes in each direction → 0.96

$$ESAL_{ANNUAL} = 170,294$$