TEAMS Competition 2019

The Rational Brain? Risk and Decision Making

Story Problem 1

Approximately 56,000 bridges in the United States were rated as "structurally deficient" in the American Society of Civil Engineering's last Infrastructure Report Card (2016). If 3200 "structurally deficient" bridges are remediated each year to reduce risk and then delisted, but each year 131 new additions are made to the "structurally deficient" bridge list, how many bridges will remain on Infrastructure Report Card in 2030?

Calculation from 2016:

Solution = 13,034

Determine the time between 2030 and 2016

$2030 - 2016 = 14\ years$

Determine the # remediated bridges

$3200\ bridges\ per\ year\ x\ 14\ years = 44{,}800\ bridges\ remediated$

Determine the # of new bridges added to the list each year

$131\ bridges\ per\ year\ x\ 14\ years = 1{,}834\ bridges\ remediated$

Determine the # of "structurally deficient" bridges remaining on the Report Card

$$56{,}000\ deficient - 44{,}800\ remediated\ and\ delisted + 1{,}834\ bridges\ added = 13{,}034\ remaining$$

Story Problem 2

Design codes often specify the use of factors of safety. For structural design, one way of calculating the FOS is to use the following equation:

$$FOS = \frac{failure\ load\ (\frac{lb}{ft^2})}{allowable\ load\ (\frac{lb}{ft^2})}$$

if a pedestrian bridge is designed to accommodate a total allowable load of 200 lb/ft^2 with a FOS of 3, what is the failure load (in lb/ft^2) of the bridge?

Solution = 600 lb/ft^2

Use the provided equation and given values to solve for the failure load.

$$FOS = \frac{failure\ load\ (\frac{lb}{ft^2})}{allowable\ load\ (\frac{lb}{ft^2})}$$

When FOS = 3 and the total allowable load is 200 lb/ft^2 and rearranging

$$failure\ load\ \left(\frac{lb}{ft^2}\right) = (FOS)\ allowable\ load\ (\frac{lb}{ft^2})$$

$$failure\ load\ \left(\frac{lb}{ft^2}\right) = 3\ x\ 200\ \frac{lb}{ft^2}$$

$$failure\ load\ \left(\frac{lb}{ft^2}\right) = 600\ \frac{lb}{ft^2}$$