

MASTER OF CONSTRUCTION ENGG.3rd SEM.EXAM-2025
STRUCTURAL SAFETY, RELIABILITY & MAINTENANCE MANAGEMENT

Full Marks: 100

Answer any **Four** Questions. Discuss to the point with neat sketches if require

1.
 - a) Define **Risk** and **Reliability** in the context of **Structural Safety** (5)
 - b) Discuss **Performance function / Limit State function** in the context of Space of State variables of **Load & Resistance** in a two-dimensional space. (12)
 - c) Discuss the need for **Reliability evaluation** and **Measure of reliability**. (8)

2.
 - a) What are the different **Limit States** to be considered in **Structural Safety** and **Reliability analysis**. (10)
 - b) Define **Reliability Index** of **Hasofer** and **Lind** in terms of **Reduced variables**. Illustrate **First Order Second Moment (FORM)** of **Reliability Index**. (15)

3. A propped cantilever beam is subjected to a **concentrated live load P** at **Mid span** and a **Uniformly Distributed load w**. Assuming the span **L (7.5 m)** and the plastic section modulus **Z (2000 cm³)** are **precisely known** but loads **P, w** and yield stress **F_y** are **random variables**, calculate the **Reliability index** with the following data. (25)

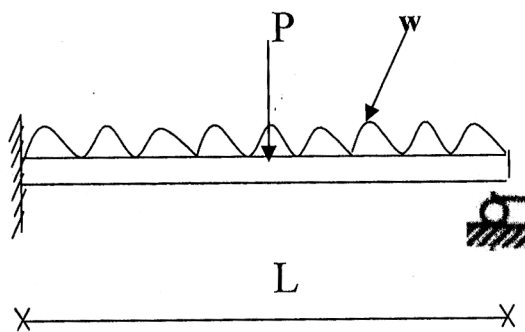


Fig 1: Propped Cantilever

The distribution parameters for **P, w** and **F_y** are given below.

Mean (design) value of **w = 25 kN/m**

Co-efficient of Variation **V_w = 10 %**

Mean (design) value of **P = 125 kN**

Co-efficient of Variation **V_p = 15%**

Mean (design) value of **F_y = 265 MPa**

Co-efficient of Variation **V_F = 6 %**

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4.
 - a) Discuss the need for **reliability evaluation** and **measure of reliability**. (8)
 - b) Discuss **DE Morgan's Rule** in Set Theory of Probability evaluation. (8)
 - c) Travel to another city may be made by Car (C), Ship (S), Flight (F) or Train (T). A Business man made trips **65, 10, 215 and 45 times** by C, S, F & T respectively in the last 50 years. the probability of excessive delay during a trip using those modes are **0.00175, 0.0034, 0.000023 and 0.00011** respectively. Calculate
 - i) What is the total probability of excessive delay in trips ?
 - ii) What is the probability of excessive delay in coming 15 trips ?
 - iii) If there is an excessive delay then what is the probability that the businessman was traveling by flight ? (9)

5.
 - a) Discuss **Bay's theorem** in the context of the theorem of **Total probability**. (8)
 - b) A **building** can be **Collapsed** due to **Fire (F), Cyclone (W), Earthquake (E), Corrosion (C) or Settlement (S)** which are collectively exhaustive and mutually independent. If the probabilities of Severe Damage due to **F, W, E C & S** are **0.01, 0.005, 0.15, 0.028 and 0.09**. The occurrence of **F, W, E, C & S** are **0.17, 0.05, 0.01, 0.59 and 0.18** respectively, then
 - i) What is the **probability of severe damage in building's life**? (4)
 - ii) If the **building got damaged** then what are the **probabilities that the cause is due to F, W, E, C and S** ? (4)
 - c) A **Bridge is damaged** either by **Foundation or Bearing Failure** or by **Superstructure** failure. The corresponding failure probabilities for a particular bridge are estimated to be **8% and 12% and 6.5%** respectively. Also if there is a bearing failure then the probability of superstructure failure is 25%.
 - i) Calculate the **probability of the damage of the bridge**.
 - ii) Calculate the **probability of the damage of the bridge** if these failures are statistically independent events.

Discuss on the above results of the probability of damage. (9)