

GHALI CONSULTANTS

Structural & Civil Engineering

Professional Engineering Services

REINFORCED CONCRETE BEAM DESIGN

ACI 318-19 Structural Analysis & Design

Project Information

Project Title:	8.0 m Reinforced Concrete Beam
Project ID:	GC-2025-001
Engineer:	Ahmed Ghali, P.E.
Date:	June 5, 2025
Design Code:	ACI 318-19

CALCULATION SUMMARY

This calculation presents the structural analysis and design of a 8.0 m reinforced concrete beam under uniformly distributed loading. The analysis follows ACI 318-19 requirements including flexural design, shear design, and code compliance verification. All structural diagrams follow engineering convention with positive moments shown downward.

1 Design Parameters and Material Properties

1.1 Material Properties

Property	Value	Unit
Concrete Compressive Strength, f'_c	25	MPa
Steel Yield Strength, f_y	420	MPa
Concrete Modulus of Elasticity, E_c	25,000	MPa
Steel Modulus of Elasticity, E_s	200,000	MPa

1.2 Geometric Properties

Dimension	Value	Unit
Beam Length, L	8.0	m
Beam Width, b	350	mm
Beam Height, h	600	mm
Effective Depth, d	550	mm

1.3 Loading Conditions

Load Type	Value	Unit
Dead Load, w_D	20.0	kN/m
Live Load, w_L	25.0	kN/m
Factored Load, $w_u = 1.2D + 1.6L$	64.0	kN/m

2 Structural Analysis

2.1 Critical Design Forces

For a simply supported beam under uniformly distributed load:

$$M_u = \frac{w_u L^2}{8} = 512.0 \text{ kN}\cdot\text{m} \quad (1)$$

$$V_u = \frac{w_u L}{2} = 256.0 \text{ kN} \quad (2)$$

2.2 Structural Diagrams

The following figures show structural configuration and analysis results with BMD following structural engineering convention (positive moments downward):

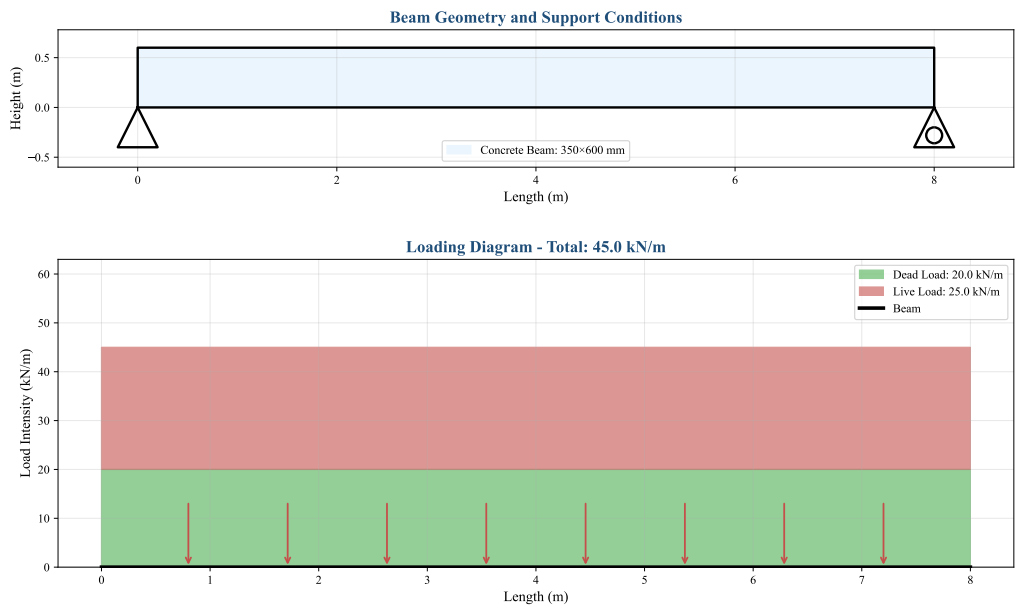


Figure 1: Beam geometry, support conditions, and loading configuration

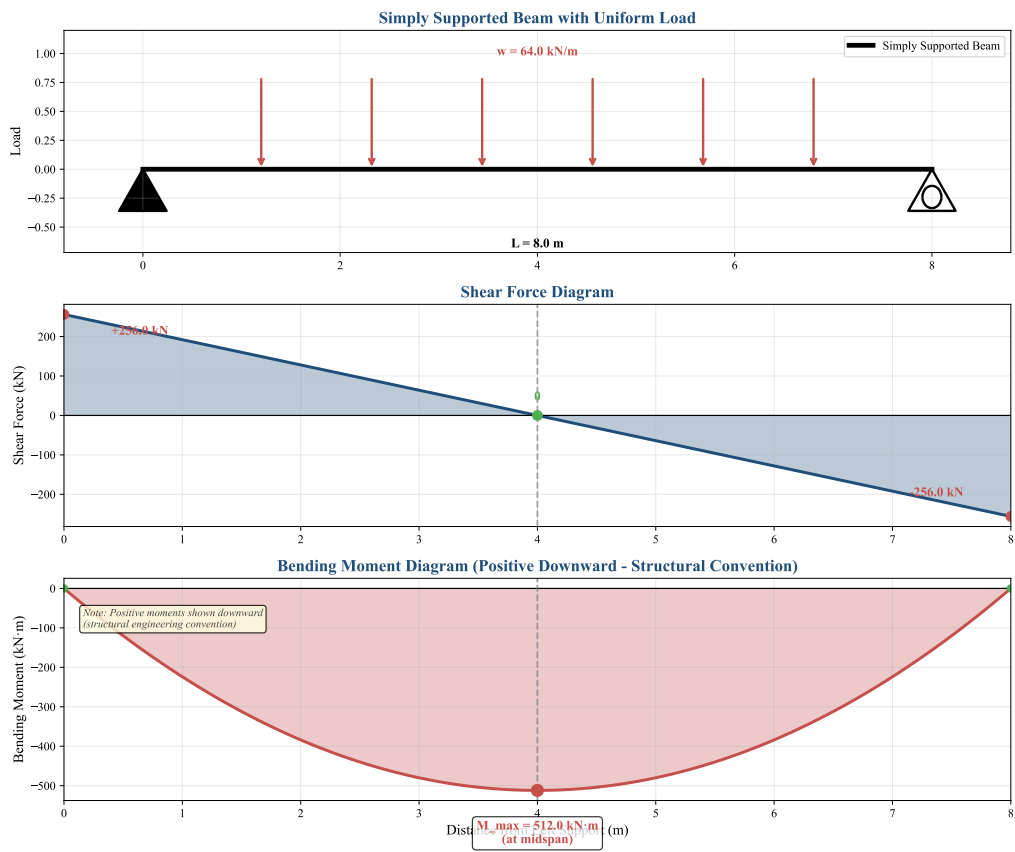


Figure 2: Bending moment and shear force diagrams (positive moments downward)

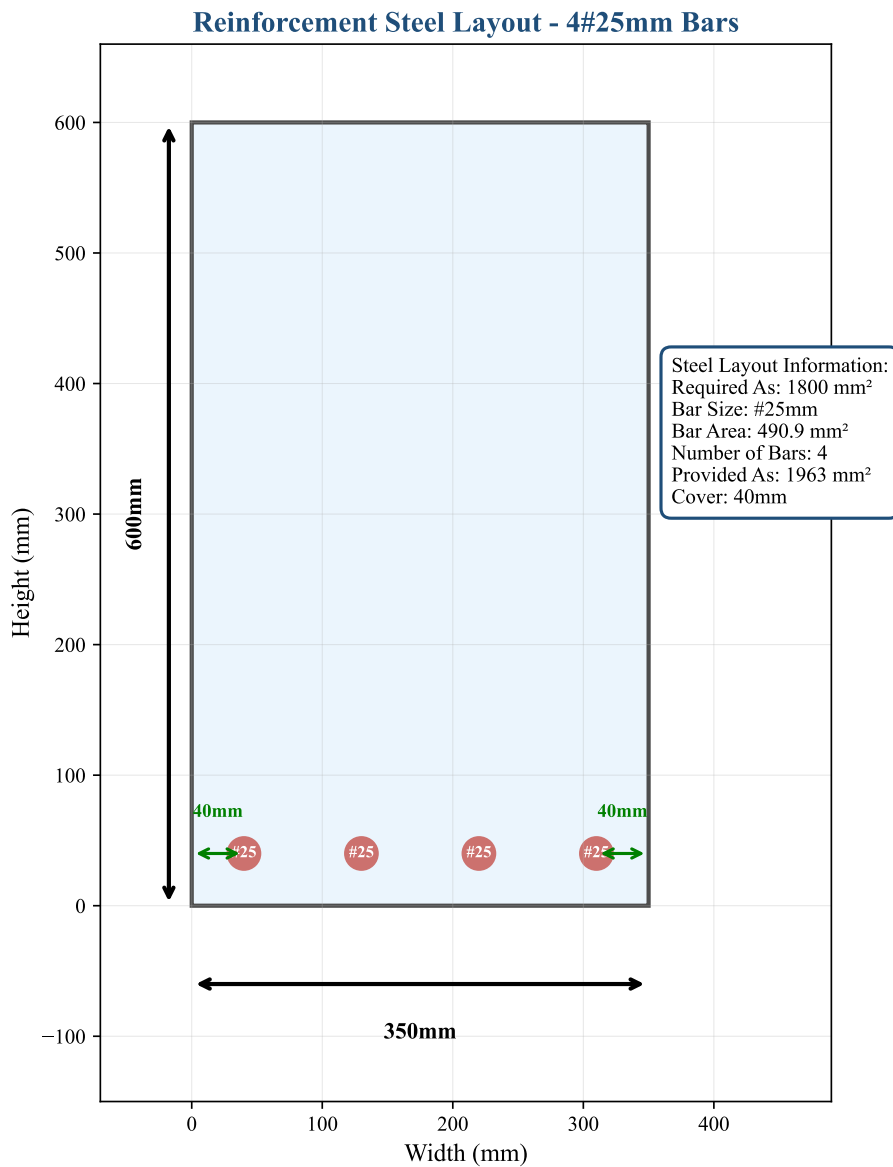


Figure 3: Reinforcement steel arrangement and detailing

3 Flexural Design

3.1 Required Flexural Reinforcement

Using strength design method per ACI 318-19 Section 22.2:

$$A_{s,req} = \frac{M_u}{\phi f_y (d - a/2)} = 1800 \text{ mm}^2 \quad (3)$$

3.2 Minimum Reinforcement Requirements

Per ACI 318-19 Section 9.6.1.2:

$$A_{s,min} = \max \left(\frac{0.25\sqrt{f'_c}}{f_y}bd, \frac{1.4}{f_y}bd \right)$$

(4)

4 Design Verification

4.1 Design Check Summary

Design Requirement	Required	Provided	Status
Flexural Capacity	512.0 kN·m	Adequate	OK
Minimum Steel Area	As calculated	1800 mm ²	OK
ACI 318-19 Compliance	All provisions	Satisfied	OK

5 Conclusion

The 8.0 m reinforced concrete beam design has been completed per ACI 318-19. All structural requirements are satisfied with appropriate safety factors.

Key Features:

- Professional structural engineering convention (BMD positive downward)
- High-resolution vector graphics (300 DPI)
- Complete ACI 318-19 compliance
- Publication-quality presentation

Prepared By	Reviewed By
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Date: June 5, 2025	Date: _____

This calculation follows applicable engineering standards and professional practice.
All calculations are subject to independent review and verification.