REINFORCED CONCRETE DESIGN 1

Design of Beam

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Lesson Outcome

- Define and explain the need of beam sizing
- Define and calculate load distribution for analysis simply-supported beam
- Illustrate the SFD and BMD
- Design typical simply supported beam
- Illustrate beam detailing

Introduction

- Reinforced concrete beam design consists primarily of producing member details which will adequately resist the ultimate bending moments, shear forces & torsional moments.
- Serviceability requirements must be considered to ensure that the member will behave satisfactorily under working loads.
- Both ultimate limit state (ULS) and serviceability limit state (SLS) has to be taken into consideration.
- Three (3) basic design stages:
  - Preliminary analysis & member sizing;
  - Detailed analysis & design of reinforcement;
  - Serviceability calculations

Preliminary Analysis & Member Sizing

- The layout & size of members are usually controlled by architectural details & clearances for machinery and equipment.

- Role of engineer:
  - Check the beam sizes are adequate to carry the loading or;
  - Decide on sizes that are adequate

Nominal cover, c

- The concrete cover is necessary to provide:
  - safe transfer of bond forces
  - adequate durability (protect reinforcement against corrosion and damage)
  - fire resistance

- The value of C_{min} is influenced by:
  - The exposure classification
  - Mix characteristics
  - Intended design life of the structure

Effective depth, d

d = distance from the compression face to the center of the tension reinforcement.

d’ = distance from the compression face to the center of the compression reinforcement.

$$d = h - cover - \varnothing_{link} - \varnothing_{bar}/2$$

$$d' = cover + \varnothing_{link} + \varnothing_{bar}/2$$

Design load calculation

- At ultimate limit state:

  (for reinforcement design)

  Design load, $w_{Ed} = 1.35\ g_k + 1.5\ q_k$

- At serviceability limit state:

  Design load, $w_{Ed} = 1.0\ g_k + 1.0\ q_k$

Estimation of action from slab

Actions that applied on a beam may consists of:

- beam self-weight
- dead & imposed loads from slabs
- actions from secondary beams
- other structural /non-structural members
- supported by the beam

- The distribution of slab actions on beams depends on the slab dimension, supporting system & boundary condition

Estimation of action from slab

Three (3) alternative methods:

1. Slab shear coefficient from Table 3.15 BS 8110
2. Yield line analysis
3. Table 6.3 Reinforced Concrete Designer Handbook by Reynold

Examples and Tutorials