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ENCE 4359
Rm 318

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Structural Concrete Design

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Book keeping
Intro to R.C. Structures
Concrete Reinforcing
Homework

What is Reinforced Concrete?

A composite material of concrete & reinforcing
"Structural concrete"

Concrete
A mixture of:

Aggregate
Portland Cement $\gamma = 7850\ kg/m^3$
Admixtures $1.50/lb
water
AIR
$\gamma \approx 2320\ kg/m^3$
cost $\approx \$95/m^3$

Reinforcing ~~Concrete~~

Usually steel reinforcing
can be other material
FRP
bamboo
anything that can tension

Concrete Proportions

Rule of Thumb

3 parts Coarse Agg.
2 parts Fine Agg.
1 part Cement
water? w/c ratio typically 0.4 - 0.6 by weight

$$\frac{1 \text{ part water}}{1 \text{ part cement}} = \frac{1000\ kg/m^3}{1505\ kg/m^3} \approx 0.66$$

(vol) (wt)

Portland Cement

- early 19th century, Britian
- named after Portland Stone
- Joseph Aspindin (1824 patent issued)

Design Process

- covered in capstone class
- "top down" → follow the load
- when designing P.C. buildings, self-weight is important

Types of Service Loads

Service Load = what you estimate the load to be using ASCE 7-05 or other means

Types [ASCE 7-05]

- Dead Loads (self, MEP, semi-permenant)
- Live loads - occupancy, non-permanent
- Impact
- Wind
- Earthquakes
- Snow
- Rain
- flood/surge
- Ice
- Soil

ACI Design Strength Equation

Design Strength $\geq$ Required Strength

ϕ * Nominal Strength $\geq U$ [ACI 9.1]

(Nominal Strength → Chapt. 2)

Moment → $\phi M_n \geq M_u$

Axial → $\phi P_n \geq P_u$

Shear → $\phi V_n \geq V_u$

ϕ: strength reduction factor

M_n, P_n, V_n: Normal Strength

M_u, P_u, V_u: required Strength

Required Strength

Factored Load

[U] $\cup$ [ACI 9.2]

$$U = \Sigma \gamma_i W_i$$

γ_i = load factor - accounts for uncertainly in accurately determining loads

W_i = Service load

Strength Reduction Factor

ϕ ϕ [ACI 9.3.2]

Accounts for Member Uncertainties

- material Strength
- discrepancies in field
- consiquence of failure
- Strain in rebar

does not accountant for design errors