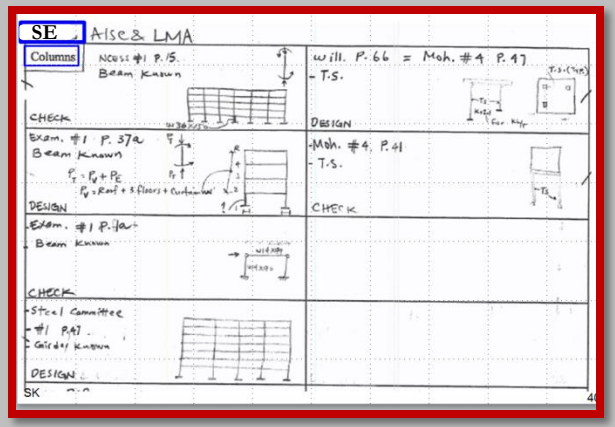
Introduction to the
Structural Engineer (SE)
License Exam



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Importance of Licensing

- License distinguishes you among other candidates / peers
- Owning a firm (consulting)
- Only a Licensed Engineer can sign/seal designs
- Prestigious
- Shows commitment to the engineering profession
- You will earn more than peers with a SE
- *U.S. News & World Report:* "[Engineering] licensure is crucial for career advancement and top pay."

Importance of Licensing

Your degree, work references, and technical skills are not necessarily an objective way to assess the engineer's competence. However, the SE License is a universal standard that is recognized throughout the profession

Steps to be a Licensed Structural Engineer (SE)

1. Pass the FE exam, then you are an EIT (or EI)
2. Graduate from EAC/ABET-accredited college
3. Have 4 years of structural engineering experience (must be under the supervision of a licensed SE)
4. Pass the SE I (8 hours exam)
5. Pass the SE II (8 ours exam)

Then you are a Licensed Structural Engineer (SE)

FE / EIT

FE Exam- Computer Based Testing (CBT)

Seven free-standing, discipline-specific exams:

1. Chemical
2. Civil
3. Electrical and computer
4. Environmental
5. Industrial
6. Mechanical, and
7. Other disciplines

Each exam covers materials commonly found in that discipline's curriculum


SE

The Concept of “Most Nearly”

- Many problems in the exam ask for the option that is “most nearly correct.”

- An answer that exactly matches your calculations is not always given.

- The phrase “most nearly” is used to accommodate solutions that have been derived correctly but that may be slightly different from the option given on the exam.

- Use good engineering judgment when selecting your option.

The Concept of "Most Nearly"

Examples:

1. If the problem asks you to determine the load on a beam, then select the option that is most nearly what you calculated, regardless of whether it is more or less than your calculated value.

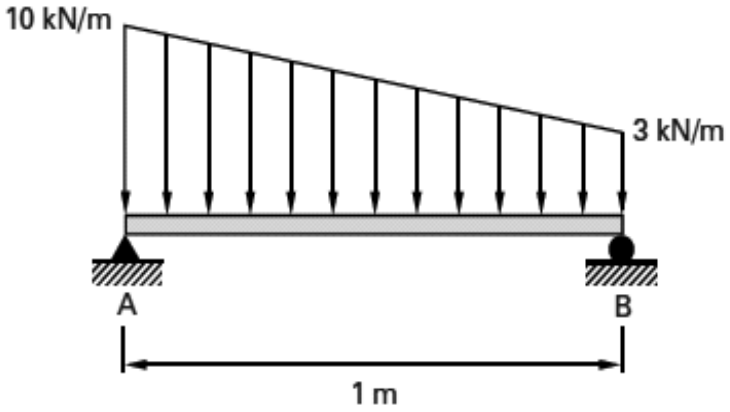
2. If the problem asks you to find the size of a beam to carry a specified load, then select the option that will safely carry the load. In this case, select the option that is equal to or larger than the beam size you calculated. In other words, do not select a beam size that is smaller than the size you calculated

The Concept of "most nearly"

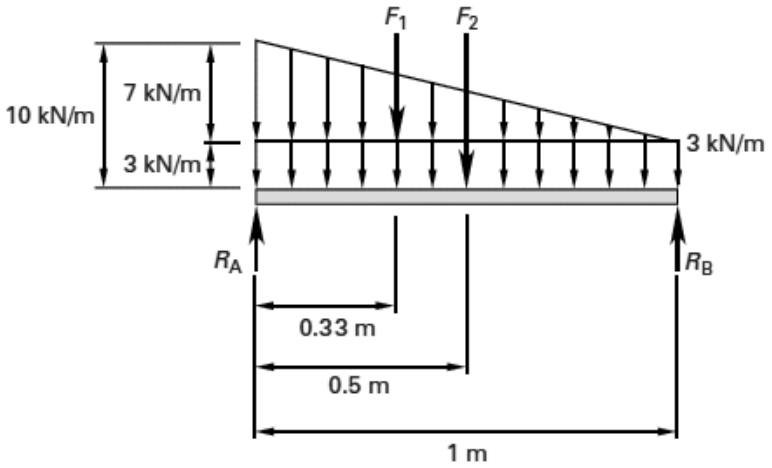
Question:

What is most nearly the reaction at "B"

A) 1.5 kN
B) 2.3 kN
C) 2.6 kN
D) 2.9 kN



Solution:



$$F_1 = \frac{1}{2} Lh = 3.5\,\text{kN}$$

$$F_2 = Lh = 3\,\text{kN}$$

Sum of moments at A

$$\sum \mathrm{M_A} = 0$$

Therefore:

$$\mathrm{R_B} = 2.66\,\text{kN}$$

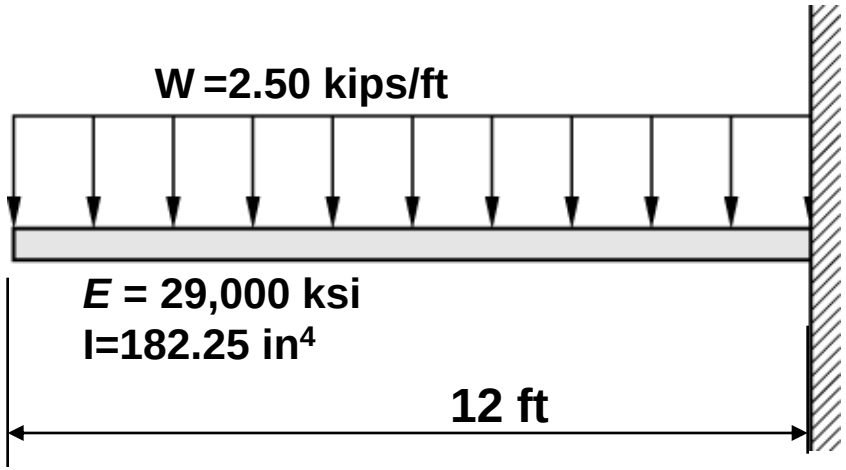
Answer is C), not D)

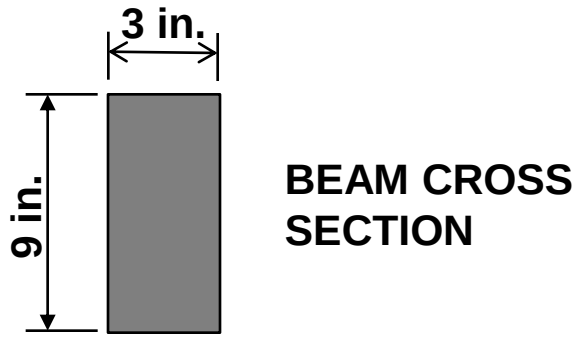
Selection of "most nearly" Option

Question:

The tip deflection (inches) of the beam shown below **is most nearly**:

A) 1.45.
B) 1.98
C) 2.25
D) 2.85





Solution:

$$\delta = \frac{wL^4}{8EI}$$

$$= \frac{\left(2.5\frac{\text{K}}{\text{ft}}\right)(12\text{ ft}))^4\left(12\frac{\text{in}}{\text{ft}}\right)^3}{8\left(29{,}000\frac{\text{K}}{\text{in}^2}\right)\left(\frac{(3)(9)^3}{12}\text{in}^4\right)}$$

$$= 2.10 \text{ inches}$$

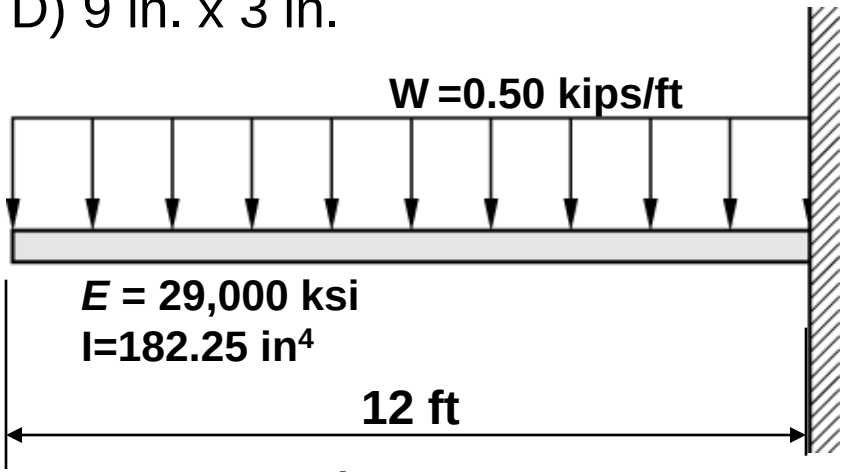
Answer is C), not B)

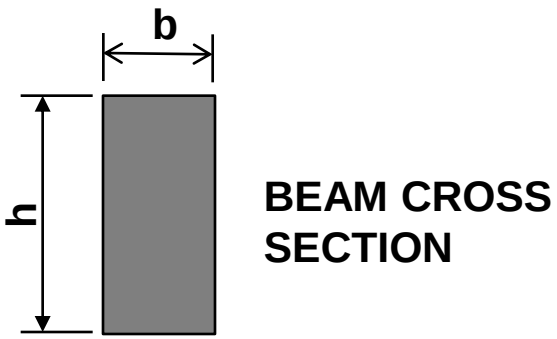
Selection of "most nearly" Option

Question:

The cross sectional dimensions of the beam shown below (to safely support the applied load) **is most nearly:**

A) 9 in. x 5 in.
B) 9 in. x 4 in.
C) 9 in. x 6 in.
D) 9 in. x 3 in.





Solution:

If you calculate the cross sectional dimensions of the beam to be: **9 in. x 3.3 in.**, then you should select option "B", not "D"

Notes: Option "D" is 9 in. x 3 in., which is less than what you calculated. Therefore, the dimensions of the selected beam has to be more than or equal to 9 in. x 3.3 in. The only answer that satisfy this condition is "B"

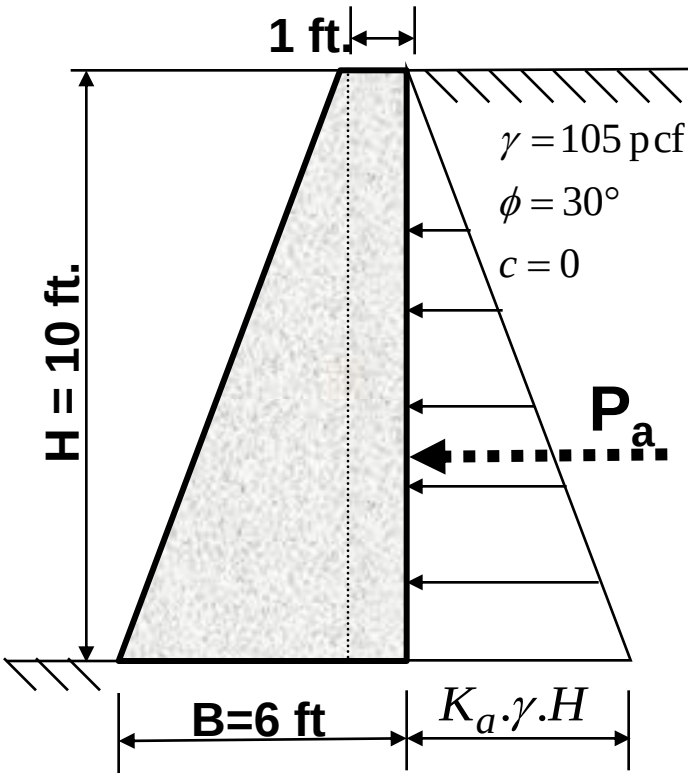
Answer is B, not D

Selection of "most nearly" Option

Question:

A 150 pcf concrete gravity retaining wall is shown. The safety factor against overturning is most nearly:

A) 3.4
B) 3.8
C) 2.2
D) 1.7



Solution:

$$\text{Resisting Moment} =$$

$$(1')(10')(150)(5.5') + \frac{(5')(10')}{2} x(150)(\frac{2}{3} x5') = 20{,}750 \text{ ft - Ib.}$$

Ovedrturning Moment :

$$Ka = \tan^2(45 - \frac{\phi}{2}) = \tan^2(45 - \frac{30}{2}) = 0.33$$

$$P_a = \frac{(K_a \gamma H).H}{2} = \frac{0.33x105x10^2}{2} = 1{,}733\, Ib.$$

$$\textit{Overturning Moment} \quad = P_a(\frac{H}{3}) = 1{,}733(\frac{10}{3}) = 5{,}775\ ft - lb.$$

$$\text{Overturning F.S.} = \frac{\text{ResistingMoment}}{\text{OverturningMoment}} = \frac{20{,}750}{5{,}775} = 3.60$$

Answer is A, not B

SE - Exam Schedule

Year	PE, PS, SE Vertical	SE Lateral
2017	Apr 21, Oct 27	Apr 22, Oct 28
2018	Apr 13, Oct 26	Apr 14, Oct 27
2019	Apr 5, Oct 25	Apr 6, Oct 26
2020	Apr 17, Oct 23	Apr 18, Oct 24
2021	Apr 23, Oct 22	Apr 24, Oct 23
2022	Apr 22, Oct 21	Apr 23, Oct 22
2023	Apr 14, Oct 27	Apr 15, Oct 28
2024	Apr 12, Oct 25	Apr 13, Oct 26
2025	Apr 11, Oct 24	Apr 12, Oct 25

Check NCEES website for updated dates

Allowed Reference Materials in the Exam

- The SE exam is open book. Candidates may bring printed reference materials, as long as they are bound and remain bound during the exam.
- Loose paper may be bound with ring binders, plastic snap binders, spiral-bound notebooks, and screw posts, but not with staples.
- Sticky notes and flags are permitted only when they remain attached to book pages.

Reference Materials in the Exam

References, Materials and Procedures for the Illinois Professional Engineering Examinations

References for Principles and Practice of Engineering Examination:

Please review the NCEES Candidate Agreement (last two pages of this document) for permissible reference materials in the examination room.


SE

SE Exam

- 16-hours (in addition to passing the FE)
- The exam uses separate **vertical and lateral** components:
  - **Friday Component – 8 hour Vertical Forces:** gravity loads and lateral earth pressures
  - **Saturday Component – 8 hour Lateral Forces:** Wind/Earthquake
- **Breadth modules are in the morning sessions:** contain questions from all structural engineering topics. All questions are multiple-choice
- **Depth modules are in the afternoon sessions**: you will choose either **buildings or bridges.** You must work the same topic area on both components. All questions are constructed response (essay)

SE Exam

- You are not required to obtain acceptable results on both 8-hour components in a single exam administration. You can sit for and obtain acceptable results on one component, and then sit for and obtain acceptable results on the second component at a later date.

- You must obtain acceptable results on both 8 hour components within five year period in order to pass the SE exam.

SE Pass Rate

(for the April 2016 exam)

Exam	First-time takers		Repeat takers	
	Volume	Pass rate	Volume	Pass rate
SE Lateral Forces Bridges	49	31%	48	25%
SE Lateral Forces Buildings	326	50%	253	37%
SE Vertical Forces Bridges	54	50%	24	25%
SE Vertical Forces Buildings	334	49%	186	31%

SE Design Standards:

Vertical Forces (Gravity/Other) and Incidental Lateral Component of the Structural Engineering BREADTH Exam Specifications

Effective Beginning with the April 2017 Examinations

Revisions are shown in red.

Check NCEES website for updated list

ABBREVIATION	DESIGN STANDARD TITLE
AASHTO	*AASHTO LRFD Bridge Design Specifications*, 7th edition, American Association of State Highway & Transportation Officials, Washington, DC.
IBC	*International Building Code*, 2012 edition (without supplements), International Code Council, Falls Church, VA.
ASCE 7	*Minimum Design Loads for Buildings and Other Structures*, 3rd printing, 2010, American Society of Civil Engineers, Reston, VA.
ACI 318	*Building Code Requirements for Structural Concrete*, 2011, American Concrete Institute, Farmington Hills, MI.
AISC	*Steel Construction Manual*, 14th edition, American Institute of Steel Construction, Inc., Chicago, IL.
AISC	*Seismic Design Manual*, 2nd edition, American Institute of Steel Construction, Inc., Chicago, IL.
AISI	*North American Specification for the Design of Cold-Formed Steel Structural Members*, 2007 edition with Supplement No. 2 (2010), American Iron and Steel Institute, Washington, DC.
NDS	*National Design Specification for Wood Construction ASD/LRFD*, 2012 edition & *National Design Specification Supplement, Design Values for Wood Construction*, 2012 edition, American Forest & Paper Association, Washington, DC.
NDS	*Special Design Provisions for Wind and Seismic with Commentary*, 2008 edition, American Forest & Paper Association, Washington, DC.
PCI	*PCI Design Handbook: Precast and Prestressed Concrete*, 7th edition, 2010, Precast/Prestressed Concrete Institute, Chicago, IL.
TMS 402/602	*Building Code Requirements and Specifications for Masonry Structures* (and related commentaries), 2011; The Masonry Society, Boulder, CO; American Concrete Institute, Detroit, MI; and Structural Engineering Institute of the American Society of Civil Engineers, Reston, VA.

SE Design Standards:

Vertical Forces (Gravity/Other) and Incidental Lateral Component of the Structural Engineering DEPTH Exam Specifications

Effective Beginning with the April 2011 Examination

ABBREVIATION	DESIGN STANDARD TITLE
AASHTO	*AASHTO LRFD Bridge Design Specifications*, 7th edition, American Association of State Highway & Transportation Officials, Washington, DC.
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Check NCEES website for updated list

SE Design Standards:

STRUCTURAL ENGINEERING Design Standards[1]

These standards apply to the Vertical and Lateral components of the Structural Engineering exam.

Effective Beginning with the April 2017 Examinations

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AASHTO	*AASHTO LRFD Bridge Design Specifications*, 7th edition, American Association of State Highway & Transportation Officials, Washington, DC.
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Check NCEES website for updated list

SE Design Standards:

Lateral Forces (Wind/Earthquake) Component of the Structural Engineering DEPTH Exam Specifications

Effective Beginning with the April 2011 Examination

STRUCTURAL ENGINEERING Design Standards[1]

These standards apply to the Vertical and Lateral components of the Structural Engineering exam.

Effective Beginning with the April 2017 Examinations

Revisions are shown in red.

Check NCEES website for updated list

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Calculators Allowed

The only calculator models acceptable for use during the exam are:

Casio: All fx-115 models. Any Casio calculator must contain fx-115 in its model name. Examples of acceptable Casio fx-115 models include (but are not limited to)

- fx-115 MS
- fx-115 MS Plus
- fx-115 MS SR
- fx-115 ES

Check NCEES website for updated list

Hewlett Packard: The HP 33s and HP 35s models, but no others.

Texas Instruments: All TI-30X and TI-36X models. Any Texas Instruments calculator must contain either TI-30X or TI-36X in its model name. Examples of acceptable TI-30X and TI-36X models include (but are not limited to)

- TI-30Xa
- TI-30Xa SOLAR
- TI-30Xa SE
- TI-30XS Multiview
- TI-30X IIB
- TI-30X IIS
- TI-36X II
- TI-36X SOLAR

Preparing for the Exam

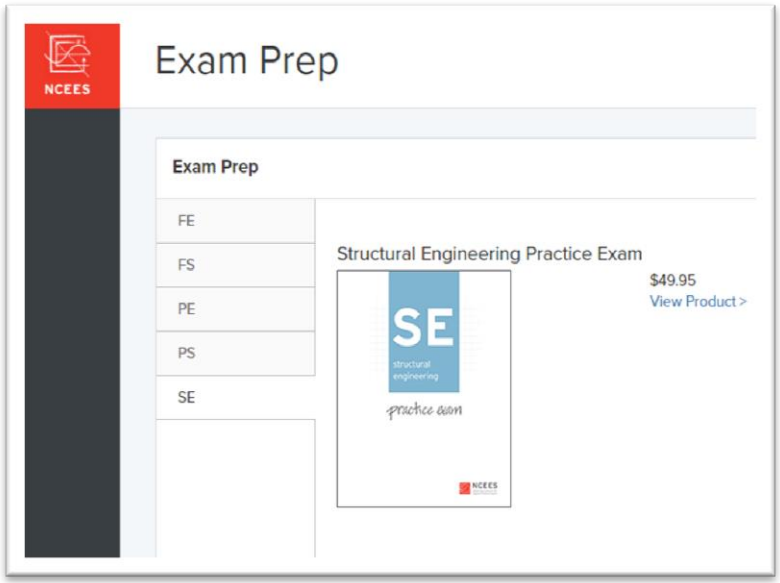
- Study only topics which are directly related to the Exam
- Solve more examples and sample exams, rather then study more in-depth theory
- The selected examples should be as close as possible to the type, length, and format to those given in the exam

NCEES Sample Exam Questions

www.NCEES.org

Exam Preparation Books

www.NCEES.org



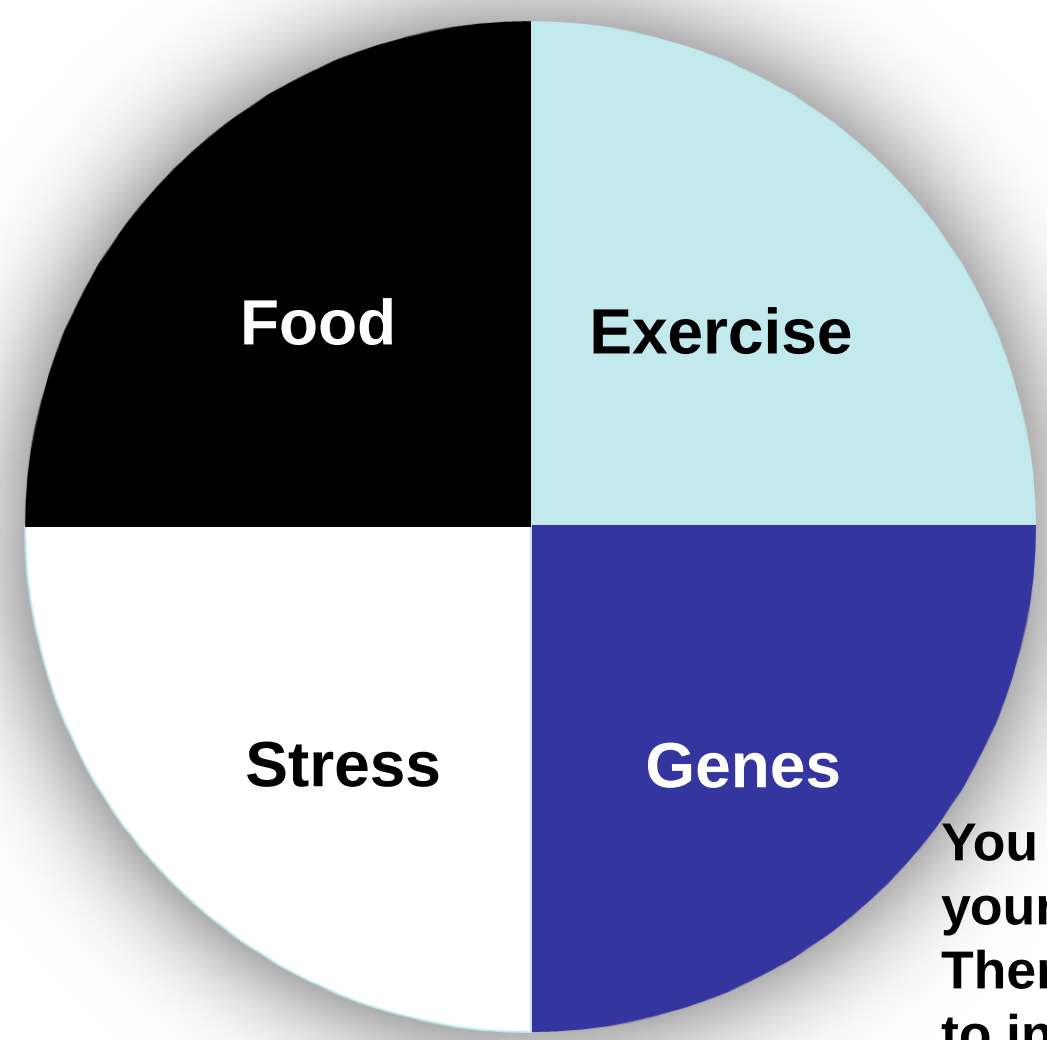
Exam Preparation Books

www.ppi2pass.com

Exam Tips

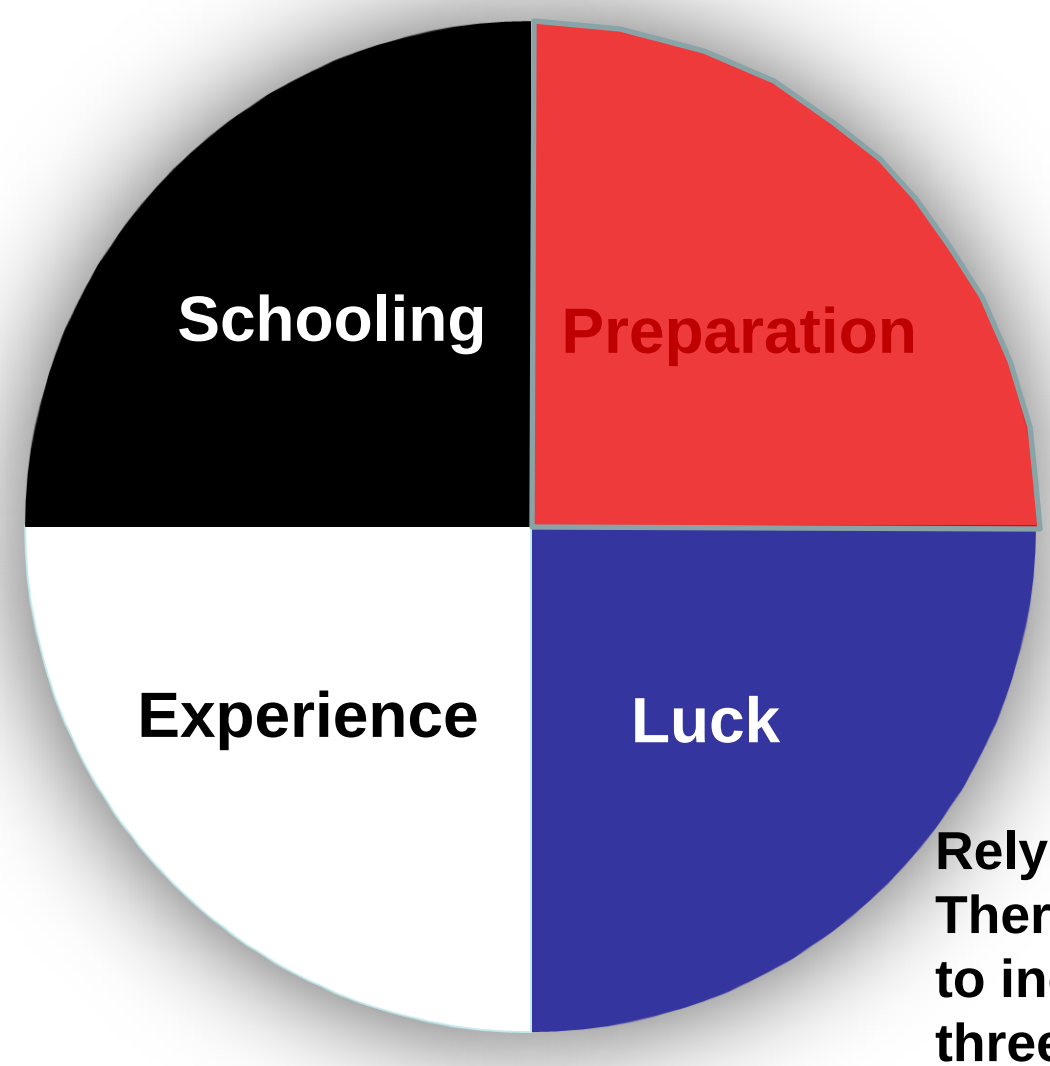
- **Take a mock exam**
- **The day before the actual exam: Solve one complete sample exam**
- **20% of each exam consists of questions repeated from previous examinations - equating subtest**
- **Concentrate on subjects that you know well**
- **Subjects that you do not know well: be prepared to solve at least the easy questions**
- **Take-off a minimum of one week before the exam to study and review**
- **In the exam: use a stop watch to monitor the time**
- **Tag (w/ tabs) the books**
- **If you have to guess, use engineering judgment, not All A's or all C's, for example**
- **Do not spend inordinate time on any single question**
- **Solve first the easy and most familiar questions to you**
- **Strategize: It is better to solve 70% of the questions correctly (with high certainty), rather than solving 100% of the questions (with low certainty)**

Health and Longevity



You can not change your genes. Therefore, you need to increase the other three quarters by more than 25% each

To Pass the Exam



Rely only 5% on luck. Therefore, you need to increase the other three quarters by more than 25% each

Exam Tips

Prepare your own "exam-questions-oriented index"

Example of such index (for the structural discipline):

Concrete Structures:

Beams:

Find A_s : Book….. Page ……..
Find beam width : Book….. Page ……..
Check reinforcement : Book….. Page ……..
Find b_e for "T" beam : Book….. Page ……..

Columns

Axial load only
Axial load and moment

One-way slab

Find A_s
Find (or check) slab thickness

Footing

Concentrated load
Concentrated load and moment

Retaining Walls

Other Topics

Steel Structures:

Connections
Beam
Column (axial load only)
Column (axial load and moment)

Timber:

Beams
Columns
Connections

Masonry:

Structural Analysis:

Other Topics:

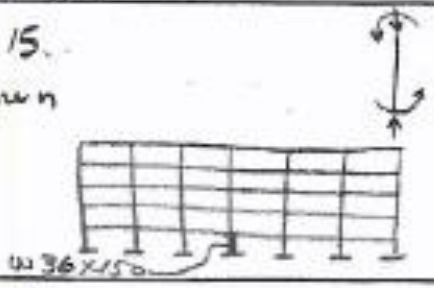
Exam Tips

Actual Sample of "exam-questions-oriented-index" (structural discipline):

STEEL AISC & LMA

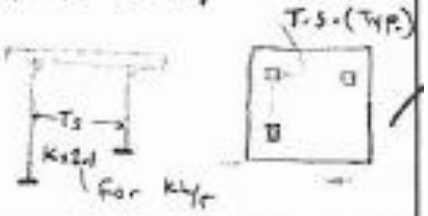
Columns

NCEES #1 P. 15.
Beam known



CHECK

will. P. 66 = Moh. #4 P. 47
- T.S.

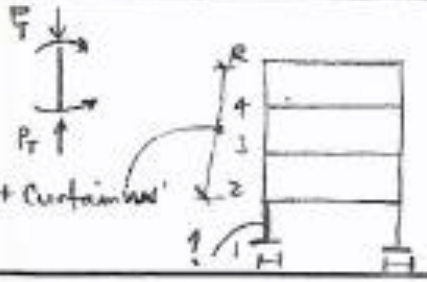


DESIGN

Exam. #1 P. 37a
Beam known

$P_T = P_V + P_E$

P_V = Roof + 3 floors + Curtain wall

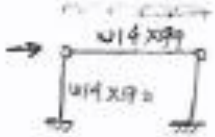


DESIGN

-Moh. #4. P. 41
- T.S.

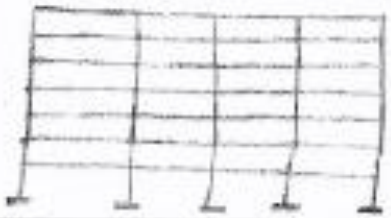
CHECK

-Exam. #1 P. 41a
Beam known



CHECK

-Steel Committee
-#1 P.47.
Girder known



DESIGN

Exam Tips

2. Make your own index for an entire book: Anticipate the exam question, and then index it.

Sample Index for the entire ACI-318 (concrete building code)

A_s shrinkage & temp. p. 81

$U = 1.2D + 1.6L$ p. 97

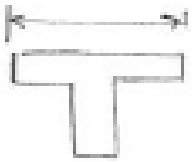
ϕ p. 99

min. thickness t_{min} p. 102, p. 105

Δ 9.5.2.5 p. 103
~~table~~ 9.5(b) p. 105

ψ_n K ψ_g p. 127

IBC vs. ACI p. 14



p. 82 & 92

$M = \frac{w l_n^2}{\#}$ p. 87

U p. 97

Exam Tips

3. Make your own index for each chapter in a book: Anticipate the exam question, and then index it.

Sample Index for concrete design (book: chapter 7 of Notes on ACI-318)

Example	Page	?
7.1	7-23	b, d, A_s = ?
7.2	7-27	One way slab
7.3	7-29	A_s = ? A'_s = ? (See also P. 6-36)
7.4	7-33	A_s = ?
7.5	7-35	A_s = ?
7.6	7-38	One way joist d, A_s = ?
7.7	7-43	Continous beam d, A_s = ?
7.8	7-46	Column M_x & M_y Size = ?, Reinforcement = ?

7

Design for Flexure and Axial Load

SK

End