2.2 Three forces are acting on the eyebolt as shown. All forces intersect at a common point O. Determine the resultant magnitude and direction. Scale: 1 mm = 100 N.

Instructor notes: Solve graphically using Parallelogram Method (you may use whatever scale you like).
2.10 Two cables with known tensions as shown are attached to a pole at point A. Determine the resultant force to which the pole is subjected. Scale: 1 mm = 10 N.

**Note:** The pole and cables are coplanar.

**Instructor notes:** Solve graphically using Parallelogram Method (you may use whatever scale you like)
2.12 One end of a timber roof truss is supported on a brick wall but not securely fastened. The reaction of the brick wall can therefore be only vertical. Assuming that the maximum capacity of either the inclined or horizontal member is 7 kN, determine the maximum magnitudes of \( F_1 \) and \( F_2 \) so that their resultant is vertical through the brick wall.

**Instructor notes**: Solve using Component Method and verify graphically using the Parallelogram Method (you may use whatever scale you like)
2.14 A box weighing 25 pounds (assumed concentrated at its center of gravity) is being pulled by a horizontal force $F$ equal to 20 pounds. What is the moment about point $A$? Does the box tip over?
2.22 Compute the moment of the 1.5 kN force about point A.
Extra Credit Question: Instructor notes: Solve graphically using Parallelogram Method (you may use whatever scale you like)

2.5 A precast concrete wall panel is being hoisted into place as shown. The wall weighs 18 kN with the weight passing through its center through point O. Determine the force $T_2$ necessary for the workers to guide the wall into place. Scale: 1 mm = 100 N.
2.33 A weight \( W = 200\# \) is supported by a cable system as shown. Determine all cable forces and the force in the vertical boom \( BC \).

(Hint: Use Free Body Diagram (FBD) at points D and C)
2.34 A pole AB leans against a smooth, frictionless wall at B. Calculate the vertical and horizontal components of the reactions of A and B.

(Hint: Use Free Body Diagram (FBD) for the Rigid Body AB)
2.40 Determine the reactions developed at support points $A$, $B$, $C$, and $D$.

(Hint: Use Free Body Diagram (FBD) for Rigid Bodies AC and CD)
Extra Credit Question:

2.41 Solve for the support reactions at A, B, and C.

(Hint: no hint... its extra credit!)
3.1 Three equal loads are suspended from the cable as shown. If \( h_B = h_D = 4' \), determine the support components at \( E \) and the sag at point \( C \).

(Hint: Use force components and equilibrium equations)
3.8 For Problems 3.8 solve for the support reactions at A and B.

(Hint: Apply equivalent load at centroid of the triangular load and use equilibrium equations to solve for reactions)
3.13 Using the method of joints, determine the force in each member of the truss shown. Summarize the results on a force summation diagram, and indicate whether each member is in tension or compression.

(Hint: Use full truss Free Body Diagram (FBD) and equilibrium equations to solve for support reactions. Use method of joints starting at A & D, then E and B to solve for truss forces.)
Extra Credit Question:

3.19 Solve for $BC$, $CH$, and $FH$.

(Hint: no hint... its extra credit!)
3.28 Determine all support and pin forces for the multiforce member diagrams listed below.

(Hint: Use FBD for the whole structure to determine support reactions. You will need the '4th equation' at B: ie - the geometric relationship between Bx and By. Use FBD for one of the members to determine the remainder of the forces at C. Use a FBD for the other member as a 'check'.

Name:
3.30 Determine all support and pin forces for the multiforce member diagrams listed below.

(Hint: Use FBD for the whole structure to determine support reactions. You will need the '4th equation' at either A or B: ie - the geometric relationship between Bx and By. Use FBD for one of the members to determine the remainder of the forces at C. Use a FBD for the other member as a 'check'.)

Name:
3.63 Check on the overturning stability of the wall shown if the equivalent fluid pressure is 40 psf and the soil density equals 115 psf. Use a concrete density of 150 psf. Evaluate the bearing pressure developed at the base of the footing.

(Hint: reference example 3.20 as guide. Calculate the centroid of your overturning loads: soil and fluid. Calculate the centroid of your resisting loads: wall, footing, and soil. Determine you overturning and resisting moments at A. Use posted 'cheat sheet' to calculate soil pressure.)
3.49 Determine the support reactions and all internal pin forces.

(Hint: no hints for extra credit)
4.4 Draw FBDs and show load conditions for B-1, G-1, interior column, B-2, and G-2.

Loads:

SL = 25 psf
Roofing and joists (deck) = 10 psf
Truss joist = 3 psf
Insul., mech., elec. = 5 psf
Beams B-1 and B-2 = 15 #/ft.
Girders G-1 and G-2 = 50 #/ft.

(Hint: Draw FBD for B-1, using the reaction as the applied load on G-1, then draw a FBD of G-1. Note that B-1 is a simple span of 24' and all of them are the same. G-1 is a simple span of 40ft and there are 4 of them exactly the same. Draw a FBD of B-2 (16ft) using the reactions as applied loads on G-2 (30ft). The truss joist can be assumed to apply a uniform load on G-2.)
4.10 A two-story warehouse is subjected to lateral forces as shown. Determine the effective tension counters and forces in all other members. Assume the effective diagonal tension counters at the lower level share equally in resisting the horizontal forces.

(Hint: The 'tension counters' are cables which only take tension, therefore, if the force is in compression the cable does not contribute and the cables that are in tension must take all the load. Don't forget that the load accumulates, so the force at the upper level must still make its way down through the middle level and to the foundation.)
4.7 For the illustrated hipped roof, evaluate the load conditions on:

1. Typical jack rafter.
2. Hip rafter.
3. Ceiling joist.
4. Beams B-1, B-2, and B-3.
5. Interior column.

Roof Live Loads:

\[ SL = 25 \text{ psf} \]

Roof Dead Loads:

- Roofing \( = 6 \text{ psf} \)
- Plywood roof sheathing \( = 1.5 \text{ psf} \)
- Joist framing \( = 4 \text{ #/ft} \)

Ceiling Loads:

- DL = 7 psf
- LL = 20 psf

(Hint: no hints for extra credit)
5.2 A 10’ × 20’ hotel marquee hangs from two rods inclined at an angle of 30°. The dead load and snow load on the marquee add up to 100 psf. Design the two rods out of A36 steel that has an allowable tensile stress:
\[ F_t = 22,000 \text{ psi (allowable stress)} \]

Hint: Assume 1/2 th load goes to the front edge of the canopy (side A in the section), and 1/2 goes to the rear edge (side C in the section). Half the load along the front edge then goes to each tie rod. Find the load in the tie rod (adjusting for slope) and determine the required cross sectional area for the given allowable stress.
5.13 A structural steel rod 1\(\frac{1}{2}\) inches in diameter and 25 feet long, in supporting a balcony, carries a tensile load of 29 k; \(E = 29 \times 10^3\) ksi.

a. Find the total elongation \(\delta\) of the rod.

b. What diameter \(d\) is necessary if the total \(\delta\) is limited to 0.1 inch?
5.18 The steel rails of a continuous, straight railroad track are each 60 feet long and are laid with spaces between their ends of 0.25 inch at 70°F.

a. At what temperature will the rails touch end to end?

b. What compressive stress will be produced in the rails if the temperature rises to 150°F?
Determine $I_x$ and $I_y$ for the cross-sections i through 6.8 and I, for Problems 6.9 through
Extra Credit:

6.14 Determine the moments of inertia for the composite areas using the standard rolled sections shown below.

(Section Properties for the C15x50 can be found on page 573)

A built-up box column is made by welding two \( \frac{3}{4}'' \times 16'' \) plates to the flanges of two C15 x 50. For structural reasons, it is necessary to have \( I_x \) equal to \( I_y \). Find the distance \( W \) required to achieve this.
7.5 Construct the load, shear, and moment diagrams for the following beam conditions.
7.10 Construct the load, shear, and moment diagrams for the following beam conditions
Extra Credit:

7.8 Construct the load, shear, and moment diagrams for the following beam conditions.
8.5 A W8 × 18 floor beam supports a concrete slab and a machine weighing 2,400#. Draw shear V and moment M diagrams, and determine the adequacy of the beam based on bending stress. (F_b for A992 steel is 30 ksi.)

(Hint: W8 properties for S_x are in the back of the book p572)
8.19 A plank is being used to support a triangular load as shown. Assuming the plank measures 12 inches wide, determine the required plank thickness if $F_b = 1,200$ psi and $F_v = 100$ psi.
A built-up plywood box beam with 2” × 4” blocking top and bottom is held together by nails along the top and bottom chords. Determine the pitch (spacing) of the nails if the beam supports a 5 k concentrated load at midspan. The nails are capable of resisting 80# each in shear.

Steps:
1. Shear and Moment diagrams
2. Determine maximum shear
3. Calculate I & Q
4. Determine longitudinal shear stress $f_v = \frac{VQ}{Ib}$
5. Multiply $f_v$ by $b$ to determine force/length
6. Divide strength (2x80#) by force/length to get pitch, $p$ (2 nails - 1 each side)
8.22 Design a Douglas fir-Larch No. 1 beam to support the load shown.

- $F_b = 1300$ psi
- $F_v = 85$ psi
- $E = 1.6 \times 10^6$ psi
- $\Delta_{allow(LL)} = L/360$

Steps:
1. Shear and Moment diagrams
2. Determine maximum shear & bending
3. Calculate required $S_x$ and $A_v$
4. Calculate required $I_x$ for given $\Delta_{allow(LL)}$
5. Pick a section that meets the minimum for step 3 & 4 (tables are in the back of the book p.567)
8.6 A lintel beam over a doorway opening 10 feet wide supports a triangular load as shown. Assuming the lintel beam to be a W8 × 15 (A36 steel), determine the bending stress developed. What size timber beam, eight inch nominal width, could be used if \( F_b = 1,600 \) psi?

(Hint: W8 properties for S, are in the back of the book p572)
9.1 A W8 × 31 steel column 20 feet long is pin supported at both ends. Determine the critical buckling load and stress developed in the column. $E = 29 \times 10^3$ ksi.

(Hint: W8X31 Section Properties are tabulated on p572)
9.4 An eight-inch-diameter timber pole is fixed into a large concrete footing at grade and is completely pin connected at its upper end. How high can the pole be and still just support a load of 25 k? $E = 1.0 \times 10^6$ psi.

(Hint: Pick K based on fixed-pinned condition, Solve for L)
9.6 Determine the critical buckling load and stress for the column shown.

Hints:
- W8X24 Section Properties are tabulated on p572
- \( E = 29000 \text{ksi} \)
- \( L_{yy} = 16' \); \( L_{xx} = 26' \)
9.14 Select an appropriate steel column section 24 feet long, braced at midheight about the weak axis, that supports a load of 350 k. Use a W14 section. (See Example Problem 9.11.)
10.4 Determine the number of bolts necessary for each member framing into the truss joint shown. Bolts are $\frac{3}{4}$" diameter A325-X (NSL), and members are A36 steel.

(Hint: Use tables on p504 & 505 for bolts and bearing capacity; $F_u = 58$ ksi)
10.8 A standard beam-column framed connection uses A36 steel with $\frac{3}{4}''$ A325-SC bolts at three inch spacing. For the connection shown, determine the following:

a. The maximum allowable shear capacity for the connection.

b. The number of bolts required.

c. The length $L$ of the clip angle.

(Hint: Use tables on p515 for capacity; W21x93 properties on p570)
10.11 What length $L$ is required to develop the full capacity of the plate?

(Hint: Weld capacities on p524)
EXTRA CREDIT:

10.13 Compute the length and size of the fillet weld needed to develop the full tensile strength of the angle. Use a full-transverse fillet weld on the end and balanced welds on the sides (for minimizing eccentricity).
**Problem#1 (40pnts):** During a still tide, a ferry needs to cross a tidal river at a 3:1 line of action to get from one dock to the other. Unfortunately, at this time of day, the TIDE exerts a force, $F_{TIDE}$, of 200# upriver on the ferry. To counteract the tide, the ferry driver heads down river at a 2:1 line of action.

Using **The Component Method**:
1) Determine the magnitude of force, $F_{FERRY}$, the engine must generate so that the ferry lands properly at the dock on the other side of the river (20pnts)
2) Determine the resultant force, $R$ (10pnts)

Using **The Parallelogram Method**, indicate:
3) Illustrate the vector solution graphically (you will be marked on concept, not graphical accuracy)

**Known:**
- $R$ acts at 3:1 upriver
- $F$ acts at 2:1 down river
- $F_{TIDE} = 200#$ (y-direction)

**Unknown:**
- $F_{FERRY}$
- $R$ (resultant force)

---

**Answer:**

$$F_{FERRY} =$$

$$R =$$

---

**Extra Credit (5pnts):** How many Equations are there for two dimension Static Equilibrium, and what are they?

**Answer:**

$\#$ of equations =

Equations:
Problem#2 (20pnts): A wind force of 3k acts at each level of a house (2nd floor & attic). The home is 24ft high and weighs and weighs 4.5k.

What is the minimum length, L, the house needs to be so that it won't tip over point A in the wind. (ie - \( \Sigma M_A = 0 \))

(note: the line of action of the weight, W, is at L/2)

Known:

\( F = 2k \)
\( W = 4.5k \)
\( h = 24ft \)

Unknown:

\( L_{\text{min}} \)

Answer:

\( L_{\text{min}} = \)

Problem#3 (40pnts): A force, \( F \), of 200# act on a railing with a line of action of 4:3. The railing has an outrigger with a length \( L_{\text{AB}} \) of 14", and a vertical extension with a length \( L_{\text{CB}} \), of 42". The overturning of the railing is resisted by an anchor plate at point A. The two anchors have a separation of 6".

1) What is the moment about Point A? (20pnts)
2) What is the force in the anchor bolts? (10pnts)
3) Draw the direction of the force couple on the illustration (10pnts)

(hint: use Varignon's Theorem)

Known:

\( L_{\text{AB}} = 14" @ 2:1 \)
\( L_{\text{BC}} = 42" \) vertical
\( F = 200# @ 4:3 \)
\( d_{\text{BOLT}} = 6" \)

Unknown:

\( F_{\text{BOLT}} \)

Answer:

\( F_{\text{BOLT}} = \)

Extra Credit (5pnts): How many Equation are there for two dimensional Static Equilibrium, and what are they?
Redemption Question:
(20pnt - additive to Quiz #1 Score)

Two (2) concurrent forces are pulling on an eye-bolt. Determine the Resultant Force, \( B \), and resultant angle, \( \theta_R \).

1) Solve numerically using the **Component Method**
2) Indicate graphical solution using the **Parallelogram** or **Tip-to-Toe Method**
   (you be marked on concept, not graphical accuracy)

**Known:**

\( F_1 = 150\# \)
\( \theta_1 = 30\text{deg} \)

\( F_2 = 225\# \) acting at a slope of 4:3

**Unknown:**

\( R \) (resultant force)
\( \theta_R \) (resultant angle)

![Graphical solution]

Answer:
\( R = \)
\( \theta_R = \)
**Question 1:** (15pnts)

List the three (3) equations of 2-dimensional Static Equilibrium:

<table>
<thead>
<tr>
<th>Equation 1</th>
<th>Equation 2</th>
<th>Equation 3</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

**Question 2:** (35pnts)

A 50# box is hanging from a set of cables. Using equilibrium at a point:

1) Draw a Free Body Diagram (FBD) at Point C (10pnts)
2) Solve for the forces in the cables (25pnts)

![Free Body Diagram]

**Answer:**

- $F_{AB} =$
- $F_{BC} =$
- $F_{CD} =$
Question 3: (50pts)

Using the Equations of Static Equilibrium:

1) Draw a Free Body Diagram (FBD) of the two bars (20pts)
2) Solve for the support reactions at A, C, & D (30pts)

Support Notes:
A = pin (2 reactions)
B = roller (1 reactions)
D = fixed (3 reactions)

Answer:
A_x = 
A_y = 
C_y = 
D_x = 
D_y = 
M_D =

Extra Credit: (10pts)

What is the maximum number of unknowns there can be in a 2-dimensional Statically Determinate structure?
**Question 1:** (100pnts)

Evaluate the truss using the following steps:

1) Using a FBD for the rigid body truss structure, determine the support reactions @ A & E. (30pnts)

2) Using Method of Joints draw FBD at points at Joints A & B to determine the forces in members AB, BC, AF, and BF. Note whether the member is in Tension (T) or Compression (C). (40pnts)

3) Using Method of Sections draw a free body diagram of the RIGHT portion of the truss to determine the forces in element CD, CH, & GH. Note (T) or (C). (30pnts)

**Extra Credit:** (5pnts)

What is the force in member CG?
**Question 1:** (50pnts)
Evaluate the Pinned Frame using the following steps:

1) Using a FBD for the entire structure, determine the support reactions @ A & C. (30pnt)

2) Using a FBD for Bar AB determine the tension force in cable DE. (20pnts)
**Question 2:** (50pnts)

Trace the following floor loads through the indicated structure:

- 50psf  Live Load (occupancy load on floor)
- 12psf  Dead Load (weight of floor)
- 10#/ft  weight of B1 & B2
- 20#/ft  weight of G1 & C1

1) Determine the tributary uniform load on beam: B1 (including beam weight). (10pnts)
2) Determine the tributary uniform load on beam: B2 (including beam weight). (10pnts)
3) Determine the load from B1 and B2 onto the girder: G-1 (10pnts)
4) Determine the load from G1 (including girder weight) onto the column: C1 (10pnts)
5) Determine the load from C1 (including column weight) onto the footing (10pnts)
Extra Credit: (10pnts)

For the structure in Problem 2, determine the tension in brace T1 for the indicated lateral load.

T1 =
**Question 1:** (50pnts)

Draw the Shear and Moment Diagrams for the indicated structure and loading conditions using the following steps:

1) Using equilibrium equations, determine the support reactions @ A & B. (10pnt)
2) Using the loads and support reactions, determine the shear diagram. (20pnts)
3) Integrating the shear diagram, determine the moment diagram. (20pnts)
**Question 2:** (50pnts)

Evaluate the indicated cross sections:

1) Use the provided table to determine the centroid, $y'$. (20pnt)
2) Using the provided table to determine the moment of Inertia, $I_{xx}$. (15pnts)
2) Using the provided table to determine the moment of Inertia, $I_{yy}$. (15pnts)

Part 1)

<table>
<thead>
<tr>
<th>Component</th>
<th>A</th>
<th>$y$</th>
<th>$Ay$</th>
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<tbody>
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<td></td>
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</table>

$\Sigma =

$y' =

Part 2)

<table>
<thead>
<tr>
<th>Component</th>
<th>A</th>
<th>$I_{xc}$</th>
<th>$d_y$</th>
<th>$A_{dy}^2$</th>
</tr>
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</tbody>
</table>

$\Sigma =

$I_{xx} =

Part 3)

<table>
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<tr>
<th>Component</th>
<th>A</th>
<th>$I_{yc}$</th>
<th>$d_x$</th>
<th>$A_{dx}^2$</th>
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</tbody>
</table>

$\Sigma =

$I_{yy} =
**Extra Credit:** (10pnts)

A beam is exposed to a temperature increase

\[ A = 2.5 \text{ in}^2 \text{ (beam area)} \]
\[ \alpha = 6 \times 10^{-6} \text{ (in/in/°F)} \]
\[ \Delta T = 50° \]
\[ L = 240\text{in} \]
\[ E = 29,000\text{ksi} \]

1) What would be the unrestrained elongation? (5pnts)
2) When retrained, what is the induced stress? (5pnts)
Question 1: (75pnts)

Select an appropriate steel beam (W) for the indicated diagram using the following steps:
1) $V_{\text{MAX}}$ & $M_{\text{MAX}}$: Draw the Shear and Moment Diagrams to determine maximums (15pnts)
2) $A_{V}$: Calculate the required shear area for the allowable shear stress, $F_{V}$ (15pnts)
3) $S_{\text{REQ}}$: Calculate the required section modulus for the allowable bending stress, $F_{b}$ (15pnts)
4) $I_{\text{REQ}}$: Calculate the required moment of inertia for the allowable deflection, $\Delta_{\text{allow}}$ (15pnts)
5) $W$: Select a steel section from the given tables that satisfies steps 2-4 (15pnts)

Steel Properties (A36):
- $F_{V} = 14.5\text{ksi}$
- $F_{b} = 22\text{ksi}$
- $\Delta_{\text{allow}} = L/360$
- $E = 29000\text{ksi}$

Answers:
- $V_{\text{MAX}} = $
- $M_{\text{MAX}} = $
- $A_{V} = $
- $S_{\text{REQ}} = $
- $I_{\text{REQ}} = $
- $W_{\text{beam}} = $
# Wide Flange Shapes

## Theoretical Dimensions and Properties for Designing

<table>
<thead>
<tr>
<th>Section Number</th>
<th>Weight per Foot</th>
<th>Area of Section</th>
<th>Depth of Suction</th>
<th>Flange Width Thickness</th>
<th>Flange</th>
<th>Axis X</th>
<th>-X</th>
<th>Axis Y</th>
<th>-Y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b in.²</td>
<td>in.</td>
<td>in.</td>
<td>in.</td>
<td>in.</td>
<td>in.</td>
<td>in.²</td>
<td>in.</td>
<td>in.</td>
</tr>
<tr>
<td>W10 x 70</td>
<td>6.84</td>
<td>10.47</td>
<td>5.810</td>
<td>0.510</td>
<td>0.300</td>
<td>170</td>
<td>32.4</td>
<td>4.38</td>
<td>16.7</td>
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<tr>
<td>W10 x 26</td>
<td>7.41</td>
<td>10.33</td>
<td>5.770</td>
<td>0.440</td>
<td>0.300</td>
<td>144</td>
<td>27.0</td>
<td>4.35</td>
<td>14.1</td>
</tr>
<tr>
<td>W10 x 22</td>
<td>6.49</td>
<td>10.37</td>
<td>5.750</td>
<td>0.360</td>
<td>0.240</td>
<td>118</td>
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<td>11.4</td>
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<tr>
<td>WF x 28</td>
<td>8.25</td>
<td>8.06</td>
<td>6.335</td>
<td>0.465</td>
<td>0.285</td>
<td>98.0</td>
<td>24.3</td>
<td>3.45</td>
<td>21.7</td>
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<tr>
<td>WF x 24</td>
<td>7.00</td>
<td>7.93</td>
<td>6.495</td>
<td>0.400</td>
<td>0.245</td>
<td>82.8</td>
<td>20.9</td>
<td>3.42</td>
<td>15.3</td>
</tr>
</tbody>
</table>

All shapes on these pages have parallel-faced flanges.
**Question 2:** (25pnts)

A 32ft high column is braced in the weak direction at mid-height. Using the following steps, determine whether a W8x24 (50ksi) steel section is sufficient to support a load of 80k:

1) Check the slenderness ratio \((KL/r)\) for each direction (10pnt) 
   \((K=1)\)

2) Determine \(F_a\) for the controlling direction using AISC Eq. E2-1 (p458) or Table C-50 (p462) (10pnts)

3) Calculate \(P_{\text{allowable}}\) using \(F_a\) from step 2 for comparison with \(P\) (5pnts)

**Extra Credit:** (5pnts)

What are the two methods of AISC Steel Design:

---

**Answers:**

\(KL_x/r_x = \)

\(KL_y/r_y = \)

\(F_a = \)

\(P_{\text{allowable}} = \)

Is a W8x24 column sufficient (Y/N):
**Question 1: (40pnts)**

Determine the requested truss forces using the following steps:
1) Determine the support reactions using the Equilibrium Equations (10pnt)
2) Determine the truss forces BC, BE, & DE using the Method of Sections in the indicated location(30pnts)

**Answers:**

\[ \begin{align*}
A_x &= \\
A_y &= \\
C_y &= \\
BC &= \\
BE &= \\
DE &= \\
\end{align*} \]
**Question 2:** (40pnts)

Determine the load on Column C-1 using the following load tracing steps:
1) Determine the uniform load on Beams B-1 & B-2 (20pnts)
2) Determine the reaction of B-2 on Girder G-2 (5pnts)
3) Determine the reaction of B-1 and G-2 on Column C-1 (15pnts)

**Loads:**
- Floor Load = 60psf
- Beam Weight = 10plf
- Girder Weight = 15plf

**Answers:**
- \( w_{B-1} = \)
- \( w_{B-2} = \)
- \( R_{B-2} = \)
- \( R_{B-1} = \)
- \( R_{G-1} = \)
- \( F_{C-1} = \)
**Question 3**: (20pnts)

Determine the Moment about point A using the following steps:
1) Break the force, \( F \), into x & y components (10pnt)
2) Calculate the moments of each component about point A and add to determine \( M_a \) (10pnts)

Extra Credit: (5pnts)

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ARCH2230: Statics
Fall 2011 – Course Syllabus

Faculty
Lecturer: Stratton Newbert, PE
time: 11:40 by appointment

Office Hours: Tue & Fri; 11:40 by appointment

Time and Location
Section 02: Tue & Fri 8:00-9:40am Shillman Hall 415
Section 01: Tue & Fri 9:50-11:30am Snell Library 035

Textbook
Onouye, B., & Kane, K., Statics and Strength of Materials for Architecture and Building
Construction, 4th Edition

Prerequisites
Satisfactory completion of undergraduate level PHYS 1151 and undergraduate level MATH
1341 with a minimum grade of D- for each course is required. If it is discovered that you have
not completed these prerequisites, you may be removed from the course at any time during
the semester as per university policy and deadlines.

Course Objectives
This course seeks to introduce the fundamental concepts of structural design for architecture.
You are expected to develop a clear understanding of the nature of forces and loads, their
effects on structures as well as common structural systems and the individual and
interdependent components that constitute them.

One of the primary goals of an architect, in close collaboration with the structural engineer, is
to evaluate, refine and specify efficient and economical structural systems that are applicable
for a certain building. Such collaboration is fruitful only if the architect has a good
understanding of the engineering concepts, terms and language to achieve maximum
integration of structure with other systems that, in turn, make up the architecture.

The following are some of the principal goals of this course:
• Understand nature of forces, their effects on structures and conditions of equilibrium.
• Learn to analyze components and the whole of a structural configuration.
• Develop an understanding of basic structural elements and their behavior.
• Understand basics of shaping and sizing of structural components and connection
details.
NAAB Student Performance Criteria
This course meets the following NAAB Student Performance Criteria to the extent designated in 2009 Conditions for Accreditation document:

“B.9 Structural Systems: Understanding of the basic principles of structural behavior in withstanding gravity and lateral forces and the evolution, range, and appropriate application of contemporary structural systems.”

Per the same document “understanding” is defined as “the capacity to classify, compare, summarize, explain and/or interpret information.”

Course Materials
In addition to obtaining a copy of the course textbook, you are required to bring a scientific calculator to each class. You will also need a scale and a small 30-60 triangle or a rolling ruler for graphic analysis exercises. You are encouraged to use this tool as much as possible throughout the semester for the sake of neatness as you draw your diagrams.

Neatness
Clarity and proper formatting is a professional requirement for architectural and engineering professions. Hence, neatness, legibility and cleanliness are required for and will be part of the grading for all work submitted by you including quizzes, homework and projects. All homework needs to be completed either electronically or in pencil on graph paper. You may choose to use engineering graph paper (available from office supply stores), create your own or print copies of the PDF file that I will supply to you for use in this class. All multiple page submissions shall be stapled together. Take pride in your work.

Class Notes
You are responsible to attend classes and take your own notes. I will not distribute my teaching notes. I will, however post the slideshows, assignments etc on Blackboard as seen fit. Writing and drafting during class allows you to think through the problems and help build a memory for the concepts being discussed. If you miss a class, please make sure to get a copy of the class notes from your classmates.

Attendance Policy
Late attendance and unexcused absences will be tracked. For every two sessions you are late to class or absent, your participation points will be decreased by 20%. Additionally, four unexcused absences will drop your course grade by one letter grade (ie - from an A to a B). If you miss a class for any reason, it is your responsibility to get a copy of the notes from your classmates and do the catch up work. Excusable absences are as follows per university policy: Participation in athletics, participation in student activities, illness or personal crisis, religious observances, jury duty and military service. All of these conditions except the religious observances require documentation. Please contact College Student Services Office for details on what forms of documentation are acceptable and how it should be submitted. For religious observances please notify me as early as you can.

Advice
• Attend all sessions
• Study in groups and learn from each other
• Take ownership of your work
• Practice: solve example problems from the textbook and handouts
• Studies show that writing and rewriting class notes help immensely with learning
Assessment
Your final grade will be calculated as a composite of the following criteria:

Class participation 10%
Quizzes 40%
Homework 20%
Projects 30%
Extra credit: May be available at instructor’s discretion

Class participation: Active dialogue and discussion is required. You may be asked to help solve problems at the board, suggest methods of analysis, interpret results, discuss how findings would affect your approach to a design problem, etc. Irrespective of assessment, it is in your best interest to participate in class, as you will find it easier to pay attention and absorb the material.

Quizzes: There will be 5 biweekly quizzes and one final ‘double quiz’ during exam week. The quizzes will be based on all material completed up to that session and all lecture material delivered in class up to the time of the quiz. The quizzes will be open-book so you may bring your textbook and notebook for reference. If you are absent without an acceptable excuse (as per school policy) you will fail the quiz for that meeting time. If you are absent due to an acceptable reason, the quiz will not count toward your average. In either case, there are no make-up quizzes. The solutions will be posted to Blackboard once quizzes have been graded and returned. I will try to review each quiz question at the beginning of the next class as time permits or issue.

Homework: Unless otherwise agreed upon, homework will be assigned on a weekly basis, due the by 5pm one week following the class in which it was assigned. Work will be reviewed cursorily and graded in the following manner:

5 extra credit
4 full credit
3 submitted without major problems
2 submitted with major problems
1 submitted without effort
0 not submitted

A late submission will be degraded a point for each day it is late. You may hand your homework in during class or scan and e-mail it to me by the noted deadline. I encourage you to work with your classmates, however, your submission should show your individual understanding and solution for the problems. I will post solutions for the homework sets to blackboard once it has been reviewed and returned. If a particular problem is deemed especially difficult by the students, I will solve and explain it during class. So please speak up!

Projects: There will be three projects. The first project will be done on an individual basis. The remaining projects will be completed in groups. I will assign team members depending on your progress throughout the semester. Submission requirements will be specific to the projects. You may be asked to present your project verbally to test your understanding which may affect your grade for that project.
Final Course Grade
Based on the above assessment and in accordance with The School of Architecture Grading Guidelines for Lecture Classes, student final course grades will be as follows:

A  exemplary quality work
   • exemplary quality performances on exams/quizzes/papers/projects
   • demonstrates a superior understanding of course readings and lectures
   • participates in class discussions cogently and willingly

A-  high quality work
   • high quality performance on exams/quizzes/papers/projects within the class
   • demonstrates a high level of understanding of course readings and lectures
   • participates in class discussions intelligently and willingly

B+  good quality work
   • good quality performance on exams/quizzes/papers/projects
   • demonstrates a good understanding of course readings and lectures
   • participates in class discussions intelligently

B   above average work
   • above average performance on exams/quizzes/papers/projects
   • demonstrates an above average understanding of course readings and lectures
   • participates in class discussions when asked to respond

B-  average work
   • average performance on exams/quizzes/papers/projects
   • demonstrates an average understanding of course readings and lectures
   • meets attendance requirements

C+  below average work
   • below average performance on exams/quizzes/papers/projects
   • demonstrates a below average understanding of course readings and lectures
   • meets attendance requirements

C   well below average work
   • below average performance on exams/quizzes/papers/projects
   • demonstrates a well below average understanding of course readings and lectures
   • engages in excuse-making, tardiness, and absence

C-  minimal work
   • minimal performance on exams/quizzes/papers/projects
   • demonstrates a minimal understanding of course readings and lectures
   • engages in chronic excuse-making, tardiness, and absence

D+, D, D- marginally acceptable work
   • unacceptable performance on exams/quizzes/papers/projects
   • demonstrates an unacceptable understanding of course readings and lectures
   • engages in chronic excuse-making, tardiness, and absence

Grade Dispute Policy
Your final grade is not negotiable. I will make every effort to make sure grading is fair to everyone. If you believe that there is a legitimate problem with your grade on a specific assignment or a quiz, please e-mail me a scanned copy of your returned work and I will make a decision on whether it needs to be reviewed again. You are not allowed to bring up personal grade issues during class.
### Lecture Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Date</th>
<th>Topic</th>
<th>Quiz</th>
<th>Assignment</th>
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<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>9/9</td>
<td>Introduction</td>
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<td>2</td>
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<td>9/13</td>
<td>Forces</td>
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<td>3</td>
<td>9/16</td>
<td>Vectors</td>
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<td>3</td>
<td>4</td>
<td>9/20</td>
<td>Force Systems</td>
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<td>5</td>
<td>9/23</td>
<td>Equilibrium</td>
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<td>4</td>
<td>6</td>
<td>9/27</td>
<td>Static Determinacy</td>
<td>Quiz #1</td>
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<td>7</td>
<td>9/30</td>
<td>Cables</td>
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<td>5</td>
<td>8</td>
<td>10/4</td>
<td>Trusses</td>
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<td>9</td>
<td>10/7</td>
<td>Trusses</td>
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<td>6</td>
<td>10</td>
<td>10/11</td>
<td>Frames</td>
<td>Quiz #2</td>
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<td>11</td>
<td>10/14</td>
<td>Arches</td>
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<td>Project 1 Due</td>
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<td>12</td>
<td>10/18</td>
<td>Load Path</td>
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<td>13</td>
<td>10/21</td>
<td>Lateral Stability</td>
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<td>8</td>
<td>14</td>
<td>10/25</td>
<td>Stress, Strain, &amp; Elasticity</td>
<td>Quiz #3</td>
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<td>15</td>
<td>10/28</td>
<td>Material Properties</td>
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<td>16</td>
<td>11/1</td>
<td>Cross-Sectional Properties</td>
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<td>17</td>
<td>11/4</td>
<td>Shear and Bending</td>
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<td>Project 2 Due</td>
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<td>10</td>
<td>18</td>
<td>11/8</td>
<td>Flexure Design</td>
<td>Quiz #4</td>
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<td><strong>Veteran’s Day</strong></td>
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<td>19</td>
<td>11/15</td>
<td>Flexural Design</td>
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<td>20</td>
<td>11/18</td>
<td>Axial Design</td>
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<td>11/22</td>
<td>Axial Design</td>
<td>Quiz #5</td>
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<td><strong>Thanksgiving</strong></td>
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<td>13</td>
<td>22</td>
<td>11/29</td>
<td>Combined Axial/Flexure</td>
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<td>23</td>
<td>12/2</td>
<td>Connections</td>
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<td>Project 3 Due</td>
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<td>14</td>
<td>24</td>
<td>12/6</td>
<td>The ‘Real World’</td>
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<td><strong>Exam Week</strong></td>
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<td>Final Quiz</td>
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**Note:** lecture schedule, topics, quiz and assignment dates are subject to change. Changes will be distributed and it is the student’s responsibility to track up to date schedules.