CONCEPT DESIGN EXAMPLE, COMPUTER AIDED STRUCTURAL MODELING (CASM)

Report 1

SCHEME A

by

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A

All Steel, Non-Composite,
Lateral Load Resistance = Rigid Frames
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</table>
Scheme A

Typical Rigid Frame Locations

Typical Rigid Frame Locations

Single Ply Adhered Membrane
3" Rigid Insulation
1-1/2" 20 ga Metal Roof Deck

Upper Roof
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf
Lay-In Acoustical Ceiling

Partition Load = 8 psf
5/8" Drywall
3-5/8" Metal Stud
1" Insulation Board
Carpet & Pad

Second Floor
2-1/2" MLW
2"-20ga Metal Floor Deck
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf
Lay-In Acoustical Ceiling
5" Limestone Panels

Single Ply Membrane
3" Rigid Insulation
1-1/2" 20 ga Metal Roof Deck
+ 1-1/2" Concrete

Lower Roof
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf
Scheme B

Second Floor  Lower Roof

Typical X-Bracing Locations

Typical X-Bracing Locations

Single Ply Membrane
3" Rigid Insulation
1-1/2" 20 ga Metal Roof Deck
Upper Roof

Mechanical: 3 psi
Electrical: 1 psi
Sprinklers: 2 psi
Lay-In Acoustical Ceiling

Partition Load = 6 psi
5/8" Drywall
2 3-5/8" Metal Stud
1" Insulation Board
Carpet & Pad
Second Floor

2-1/2" NLT
2"-20 ga Metal Floor Deck
Mechanical: 3 psi
Electrical: 1 psi
Sprinklers: 2 psi
Lay-In Acoustical Ceiling

5" Limestone Panels

Single Ply Membrane
3" Rigid Insulation
1-1/2" 20 ga Metal Roof Deck
+ 1-1/2" Concrete
Lower Roof

Mechanical: 3 psi
Electrical: 1 psi
Sprinklers: 2 psi
Lay-In Acoustical Ceiling

5" Limestone Panels

Accession For
NITS GRAD
DTIC TAB
Unannounced
Justification

Distribution

Lawndale

List Special

A-1
**Project Description**

**Scheme C**

- **Second Floor**
  - Typical 10" Concrete Shear Walls
  - Trusses
  - Joists @ 4' o.c.

- **Upper Roof**
  - Typical 10" Concrete Shear Walls

- **Concrete Slab**
  - 4" Concrete Slab
  - Sanded

- **Partitions**
  - 5/8" Drywall
  - 3-5/8" Metal Stud
  - 1" Insulation Board
  - Carpet & Pad

- **Lower Roof**
  - Single Ply Membrane
  - 3" Rigid Insulation
  - 1-1/2" 20 ga Metal Roof Deck
  - 1-1/2" Concrete

- **Sprinklers**
  - Mechanical: 3 psi
  - Electrical: 1 psi
  - Sprinklers: 2 psi

- **Flooring**
  - Carpet & Pad

- **Hello 6.0**

- **Load**
  - 6 psi

- **Part Load**
  - 5 psi

- **Partition Load**
  - 6 psi
Project Description

This 1 and 2 story project is to provide approximately 9,500 gross square feet of office space for one of two possible sites:

(a) Charleston, South Carolina

(b) Radford AAP, Virginia

Soil conditions are unknown at both sites.

The following project criteria has been established:

1. The 33' x 72' space on the first level shall be column free for open office planning.

2. The 42' x 72' first and second floor areas shall provide 24' square bays.

3. The first floor shall be a slab on grade with the tops of perimeter continuous wall footings set at 2'-6" below grade. Column footings will be isolated spread footings.

4. The second floor occupancy live loads located on the plan are:

   - Offices: 50 psf
   - File Storage: 150 psf
   - Corridor, Stair & Lobby: 100 psf

5. Structural framing schemes to be designed and compared shall be as follows:

   - Scheme A: All steel, non-composite, lateral load resistance = rigid frames.

   - Scheme B: All steel, composite, lateral load resistance = X braced frames.

   - Scheme C: Monolithic concrete for two story portion, steel for lower roof portion, lateral load resistance = shear walls.
6. The typical exterior envelope consists of 5" limestone panels, 1" rigid insulation, 3-5/8" metal studs, and 5/8" drywall.

7. Window and door openings are uniformly distributed to all elevations.

8. Load Assumptions:

<table>
<thead>
<tr>
<th>Importance Category</th>
<th>Exposure Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snow:</td>
<td>I</td>
</tr>
<tr>
<td>Wind:</td>
<td>I</td>
</tr>
<tr>
<td>Seismic:</td>
<td>IV</td>
</tr>
</tbody>
</table>

9. Material Assumptions:

- Concrete: 4,000 psi, NLWT
- Steel Reinforcing: Grade 60
- Steel: A36

10. Fire resistance rating shall be achieved by a wet sprinkler system.
Computer Aided Structural Modeling

Start

Criteria

City/Installation Database

Draw Model

Import DXF Reference Drawing

Snow Loads

Wind Loads

Main Wind Force Resisting

Components & Cladding

Calculate After Structure is Drawn

Open Roof

Dead & Live Loads

Dead Loads

Area Loads

Wall Loads

Point Loads

Occupancy Live Loads

Live Load Reduction

Area Loads

Point Loads

Minimum Roof Live Loads

Loads Database

Calculate After Structure is Drawn
Project Data

- **Project Name:** Office Building - Scheme A
- **City/Installation:** Radford AAP
- **Country:** USA
- **State:** VA
- **County:** Pulaski
- **Design Load:** TM 5-809-1 1991
- **Building Code:** BOCA
- **Seismic Code:** TM 5-809-10 1991
- **Elevation Above Sea Level:** 3300 ft
- **No. Of Stories:** 2
- **Floor Area:** 9504 sq ft
- **Occupancy:** Use Group B
- **Type Const:** 3A
- **Seismic Lateral Load Resistance**
  - N-S System: Blank
  - E-W System: Blank

Review Regional Data

- **Wind**
  - **Basic Wind Speed:** 70.0 mph
  - **Coastal:** No
  - **Maximum Wind Speed:** 58.0 mph
  - **Wind Direction:** SE

- **Snow**
  - **Ground Snow Load:** 25.0 psf
  - **Maximum Snow Depth:** 15.0 in
  - **Snow Density:** 17.3 pcf

- **Rain**
  - **Average Annual Rainfall:** 44.0 in
  - **Maximum Rainfall:** 4.0 in

- **Temperature**
  - **Maximum temperature:** 92 °F
  - **Minimum Temperature:** -24 °F

- **Seismic Zone:** 2A
  - **Frost Depth:** 22 in
Site Specific

Wind
Exposure: C
Importance: I: 1.00

Snow
Exposure: C: 1.00
Importance: I: 1.00
Roof Slippery: No
Thermal Factor: 1.0

Seismic
Importance: IV: 1.00
Soil Factor: S3: 1.5

Soil
Blank

Print Data
- Basic Design Criteria
- All Other
- Print To File
- Execute Notepad

Scroll Output

Page Setup
Left Margin: 0.5 in
Right Margin: 0.0 in

Print File

Exit Notepad

End
Basic Design Criteria

Project Data

- **Project Name**: Office Building - Scheme A
- **City/Installation**: Radford AAP
- **Country**: USA
- **State**: VA
- **County**: Pulaski
- **Design Load**: TM 5-809-1 1991
- **Building Code**: BOCA
- **Seismic Code**: TM 5-809-10 1991
- **Elevation above sea level**: 3300 ft.
- **No. of Stories**: 2
- **Floor Area**: 9504 sqft.
- **Occupancy**: Use Group B
- **Type of Construction**: 3A
- **Seismic Lateral Load Resistance**
  - **N-S System**: 0
  - **E-W System**: 0

Regional Data

- **Wind**
  - **Basic Wind Speed**: 70.0 mph
  - **Coastal**: No
  - **Maximum Wind Speed**: 58.0 mph
  - **Wind Direction**: SE

- **Snow**
  - **Ground Snow Load**: 25.0 psf
  - **Maximum Snow Depth**: 15.0 in.
  - **Snow Density**: 17.3 psf

- **Rain**
  - **Average Annual Rainfall**: 44.0 in.
  - **Maximum Rainfall**: 4.0 in.

- **Temperature**
  - **Maximum Temperature**: 92.0 deg F
  - **Minimum Temperature**: -24.0 deg F
  - **Seismic Zone**: 2A
  - **Frost Depth**: 22 in.

Site Specific Data

- **Wind**
  - **Exposure**: C
  - **Importance**: 1.00

- **Snow**
  - **Exposure**: C
  - **Importance**: 1.00

- **Roof Slippery**: No

- **Thermal Factor**: 1.0

- **Seismic**
  - **Importance**: IV
  - **Soil Factor**: S3
  - **Importance Factor for Snow and Wind**:
    
    I All buildings and structures except those listed below.
    II Buildings and structures where primary occupancy is one in which
      more than 300 people congregate in one area.
    III Buildings and structures designated as essential facilities,
      including, but not limited to:
      Hospital and other medical facilities having surgery or emergency
      treatment areas.
      Fire or rescue and police stations.
      Primary communication facilities and disaster operation centers.
      Power stations and other utilities required in an emergency.
      Structures having critical national defense capabilities.

---

Notes

- **Importance Factor for Snow and Wind**:
  - I All buildings and structures except those listed below.
  - II Buildings and structures where primary occupancy is one in which
    more than 300 people congregate in one area.
  - III Buildings and structures designated as essential facilities,
    including, but not limited to:
    Hospital and other medical facilities having surgery or emergency
    treatment areas.
    Fire or rescue and police stations.
    Primary communication facilities and disaster operation centers.
    Power stations and other utilities required in an emergency.
    Structures having critical national defense capabilities.
IV. Buildings and structures that represent a low hazard to human life in the event of failure, such as agricultural buildings, certain temporary facilities, and minor storage facilities.

Wind Exposure Category:
Exposure C:
Open terrain with scattered obstructions having heights generally less than 30 ft.

Snow Exposure Category:
Exposure C:
Locations in which snow removal by wind cannot be relied on to reduce roof loads because of terrain, higher structures, or several trees nearby.

* The conditions discussed should be representative of those that are likely to exist during the life of the structure. Roofs that contain several large pieces of mechanical equipment or other obstructions do not qualify for sitting category A.

Snow Thermal Factor:
Heated Structure.

* These conditions should be representative of those that are likely to exist during the life of the structure.

Importance Factor for Seismic:
I. Essential Facilities
Hospitals and other medical facilities having surgery and emergency treatment areas.
Fire and police stations.
Tanks or other structures containing, housing or supporting water or other fire-suppression materials or equipment required for the protection of essential or hazardous facilities, or special occupancy structures.
Emergency vehicle shelters and garages.
Structures and equipment in emergency preparedness centers.
Stand-by power generating equipment for essential facilities.
Structures and equipment in evacuation centers and other facilities required for emergency response.

II. Hazardous Facilities
Structures housing, supporting or containing sufficient quantities of toxic or explosive substances to be dangerous to the safety of the general public if released.

III. Special Occupancy Structure
Covered structures whose primary occupancy is public assembly - capacity more than 300 persons.
Buildings for schools (through secondary) or day-care centers - capacity more than 250 students.
Buildings for colleges or adult education schools - capacity more than 500 students.
Medical facilities with 50 or more resident incapacitated patients, but not included above.
Jails and detention facilities.
All structures with occupancy more than 5000 persons.
Structures and equipment in power generating stations and other public utility facilities not included above, and required for

IV. Standard Occupancy Structure
All Structures having occupancies or functions not listed above.

Seismic Soil Factor:
S3: A soil profile 70 feet or more in depth and containing more than 20 feet of soft to medium stiff clay but not more than 40 feet of soft clay.
The site factor shall be established from properly substantiated geotechnical data. In locations where the soil properties are not known in sufficient detail to determine the soil profile type, soil profile S3 shall be used. Soil profile S4 need not be assumed unless the Building Official determines that soil profile S4 may be present at the site, or in the event that soil profile S4 is established by geotechnical data.
Modeling Philosophy

A. Simplify the geometric model

For buildings with repetitive wings, only one wing needs to be modeled.

Insignificant portions such as chimneys, dormers, and small projections, should not be modeled.

Extra wings are not necessary

Simplified model

B. Make sure planes are in contact

A gap between adjoining shapes will make the surfaces exterior.

Use the Stack options to accurately place adjoining shapes.

C. Do not intersect shapes

When modeling parapet walls, make sure the corners do not intersect.

Incorrect

Correct

D. Verify the model

Use the Tape Measure command, zoom in on a plan, elevation and 3-D views to verify the model.
Draw Model

Start

Use Draw Model Tool Palette

Establish Initial Layout Defaults

- Ground Plane
  - Size: 100' x 100'
  - Spacing: 20' x 20'
  - Show Ground Plane

- Units
  - Increment: 4'
  - Display: ft-in
  - Snap To Units

- Initial Object Size
  - N-S: 73'
  - E-W: 85'
  - Height: 140'
  - Plane Thickness: 10'
  - Orientation: N-S

- Stack On Ground Plane

Draw Building Volume

- Draw First Floor Volume
  - Position Cube On Ground Plane

- Draw Second Floor Volume
  - Stack On Last Shape

- Place Cube On Last Shape

- Drag Plane To Correct Dimension
  - E-W: 45'

Draw Gable Roof Volume

- Place Prism On Last Shape

- Lock N-S & E-W

- Drag Edge To Correct Roof Slope
  - Slope: 5.8 in 12

Double Click Right Mouse Key To End
Snow Loads

Start

Use Loads And Design Tool Palette

Calculate Snow Loads

Review Criteria

Calculate

View Output

View Section

Print Screen

Print Screen (Printer)

View Calculations

Print Data

- Snow
- All Other
- Print To File
- Execute Notepad

Scroll Output

Page Setup

Left Margin: 0.5 in
Right Margin: 0.0 in

Print File

Exit Notepad

View Perspective (3D)

Solid Object

Show Loads

None

End
Snow Loads
Snow Loads

- Snow Unbalanced (psf)
- Snow Balanced (psf)
- Snow Drift (psf)
- Snow Sliding (psf)
- Snow Combined (psf)
Snow Loads

Project : Office Building - Scheme A
Location : Radford AAP
Design Load : TM 5-809-1 1991
Time : Sat Jan 25, 1992 5:40 PM

************************ Flat/Lean-To Roof Snow Load Design ************************

Flat Roof Snow Load (Pf)
Pf = 0.7*Ce*CT*I*Pg
Snow Exposure Category: C
Ce = 1.0
Heated Structure.
CT = 1.0
Importance Category: I
I = 1.0
Pg = 25.0 psf
Pf = 17.50 psf
Roof Slope: 0.00 in 12
Theta = 0 deg
Check minimum Pf where theta <= 15 deg
When Pg > 20.0 psf, min Pf = 20*I
Min Pf = 20.00 psf
Since theta < 1/2 in/ft, 5 psf rain-on-snow surcharge applies.

Pf = 25.00 psf

************************ Sloped Roof Snow Load Design ************************

Sloped Roof Snow Load (Ps)
Ps = Cs*Ps
Roof Slippery. No
Cs = 1.00

************************ Drift Snow Load Design ************************

Pg = 25.0 psf
Snow Density = 17.25 psf
Ps = 20.00 psf (rain-on-snow surcharge not included)
hb = Ps/density
hb = 1.16 ft
Projection Height = 4.00 ft
hc = height-hb
hc = 2.84 ft
hc/hb = 2.45 >= 0.20 Therefore consider drift load.
Importance Category: I
I = 1.0
Snow Exposure Category: C
Ce = 1.0
Separation = 0.00 ft
lu = 35.17 ft
hd = 0.43*lu^1/3*(Pg+10)^1/4-1.5
hd = 1.93 ft
Width of drift: W = minimum of 4*hd or 4*hc >= 10 ft
w = 4*hd = 7.71 ft
w = 4*hc = 11.36 ft

hd = (hd*(20-a))/20 = 1.93 ft
hd <= hc
Pd = hd*density

Pd = 33.23 psf

26
Snow Loads

******************************************************************************
Drift Snow Load Design ******************************************************************************

Pg = 25.0 psf
Snow Density = 17.25 psf
Ps = 20.00 psf (rain-on-snow surcharge not included)
hb = Ps/density
hb = 1.16 ft
Projection Height = 4.00 ft
hc = height-hb
hc = 2.84 ft
hc/hb = 2.43 >= 0.20 Therefore consider drift load.
Importance Category: I
I = 1.0
Snow Exposure Category: C
Ce = 1.0
Separation = 0.00 ft
lu = 72.00 ft
hd = 0.43*lu^1/3*(Pg+10)^1/4-1.5
hd = 2.95 ft
Width of drift: W = minimum of 4*hd or 4*hc => 10 ft
w = 4*hd = 11.40 ft
w = 4*hc = 11.36 ft

hd = hd*(20-m)/20 = 2.34 ft
hd <= hc, therefore hd = hc = 2.34 ft
Pd = hd*density
Pd = 40.44 psf

******************************************************************************

Pg = 25.0 psf
Snow Density = 17.25 psf
Ps = 20.00 psf (rain-on-snow surcharge not included)
hb = Ps/density
hb = 1.16 ft
Projection Height = 4.00 ft
hc = height-hb
hc = 2.84 ft
hc/hb = 2.43 >= 0.20 Therefore consider drift load.
Importance Category: I
I = 1.0
Snow Exposure Category: C
Ce = 1.0
Separation = 0.00 ft
lu = 72.00 ft
hd = 0.43*lu^1/3*(Pg+10)^1/4-1.5
hd = 2.95 ft
Width of drift: W = minimum of 4*hd or 4*hc => 10 ft
w = 4*hd = 11.40 ft
w = 4*hc = 11.36 ft

hd = hd*(20-m)/20 = 2.34 ft
hd <= hc, therefore hd = hc = 2.34 ft
Pd = hd*density
Pd = 40.44 psf

******************************************************************************
Wind Assumptions

**Proportions For B/L & h/L**

---

**Defaults:**
- Height Ratio: 0.75
- Plan Ratio: 0.75

---

**Building Height Maximum 60 Feet**

Assumed for components and cladding
Main Wind Force Resisting Loads

Start

Use Loads And Design Tool Palette

Calculate Wind Loads

Review Criteria
- % Opening Coef: ±0.25 & ±0.25
- Main Wind Force Resistance System

Calculate

View Output

View Section

Print Screen

View Calculations

Print Data
- Wind
- All Other
- Print To File
- Execute Notepad

Scroll Output

Page Setup
- Left Margin: 0.5 in
- Right Margin: 0.0 in

Print File

Exit Notepad

View Perspective (3D)

Solid Object
Main Wind Force Resisting Loads

View Output

Show Loads
GCpl = 0
GCpl Positive
GCpl Negative
B & L Assumptions
none

End
### Main Wind Force Resisting Loads

**Project:** Office Building - Scheme A  
**Location:** Radford AAF  
**Design Load:** TM 5-609-1 1991  
**Time:** Tue Feb 10, 1992 4:16 PM

<table>
<thead>
<tr>
<th>Velocity</th>
<th>Importance</th>
<th>Exposure</th>
<th>Width Perpend.</th>
<th>Length Parallel to Wind</th>
<th>Roof Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>(mph)</td>
<td>Factor</td>
<td></td>
<td>(ft)</td>
<td>(ft)</td>
<td></td>
</tr>
<tr>
<td>70.0</td>
<td>1.00</td>
<td>C</td>
<td>36.0</td>
<td>73.7</td>
<td></td>
</tr>
</tbody>
</table>

**Distance to ocean line:** > 100 mi.  
**h/d:** 0.39 <= 5

### Main Framing Pressures

#### Parallel to Ridge or Length

<table>
<thead>
<tr>
<th>Location</th>
<th>s or h (ft)</th>
<th>Ch</th>
<th>Ks</th>
<th>qx (psf)</th>
<th>Cp</th>
<th>External Pressure P (psf)</th>
<th>Gcpi=0</th>
<th>-0.25</th>
<th>0.25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windward Wall</td>
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<tr>
<td>parapet</td>
<td>18.0</td>
<td>1.32</td>
<td>0.84</td>
<td>10.5</td>
<td>0.60</td>
<td>11.1</td>
<td></td>
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<tr>
<td>level 1</td>
<td>14.0</td>
<td>1.32</td>
<td>0.80</td>
<td>10.0</td>
<td>0.60</td>
<td>10.6</td>
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<td>1.32</td>
<td>0.80</td>
<td>10.0</td>
<td>0.60</td>
<td>10.6</td>
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<td>0.80</td>
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<td>4.0</td>
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<td>14.0</td>
<td>1.32</td>
<td>0.80</td>
<td>10.0</td>
<td>-0.70</td>
<td>-9.2</td>
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<tr>
<td>Roof</td>
<td>14.0</td>
<td>1.32</td>
<td>0.80</td>
<td>10.0</td>
<td>-0.70</td>
<td>-9.2</td>
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<td>14.0</td>
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<td>10.0</td>
<td></td>
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<td></td>
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</tbody>
</table>

#### Velocity | Importance | Exposure | Width Perpend. | Length Parallel to Wind | Roof Type |
| (mph)        | Factor      |           | (ft)           | (ft)                    |           |
| 70.0         | 1.00        | C         | 73.7           | 49.7                    |           |

**Distance to ocean line:** > 100 mi.  
**h/d:** 0.56 <= 5

### Main Framing Pressures

#### Parallel to Ridge or Length

<table>
<thead>
<tr>
<th>Location</th>
<th>s or h (ft)</th>
<th>Ch</th>
<th>Ks</th>
<th>qx (psf)</th>
<th>Cp</th>
<th>External Pressure P (psf)</th>
<th>Gcpi=0</th>
<th>-0.25</th>
<th>0.25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windward Wall</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>level 3</td>
<td>28.0</td>
<td>1.26</td>
<td>0.96</td>
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<td>12.1</td>
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<td>0.80</td>
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<tr>
<td>Roof</td>
<td>28.0</td>
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<td>0.96</td>
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<td>-10.6</td>
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<tr>
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<td>28.0</td>
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<td></td>
<td>0.0</td>
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</table>
### Main Wind Force Resisting Loads

#### Velocity Importance Exposure Width Length Roof Type

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<th>Velocity Importance Exposure</th>
<th>Width Perpendicular to Wind</th>
<th>Length Parallel to Wind</th>
<th>Roof Type</th>
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<tbody>
<tr>
<td>(mph)</td>
<td>(ft)</td>
<td>(ft)</td>
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</tr>
<tr>
<td>70.0</td>
<td>1.00</td>
<td>C</td>
<td>49.7</td>
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</table>

Distance to ocean line >= 100 mi. h/d = 0.56 <= 5

#### Main Framing Pressures

<table>
<thead>
<tr>
<th>Location</th>
<th>s or h (ft)</th>
<th>Ks (psf)</th>
<th>qs (psf)</th>
<th>Cp</th>
<th>External Pressure P (psf)</th>
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<td>1.26</td>
<td>0.96</td>
<td>12.0</td>
<td>0.80</td>
</tr>
<tr>
<td>Level 2 - 3</td>
<td>21.0</td>
<td>1.26</td>
<td>0.88</td>
<td>11.0</td>
<td>0.80</td>
</tr>
<tr>
<td>Level 1 - 2</td>
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<td>10.0</td>
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<td>0.96</td>
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<td>0.96</td>
<td>12.0</td>
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</tbody>
</table>

#### Wind Load - 4

| Velocity Importance Exposure Width Length Roof Type |
|-----------------------------|-----------------------------|-----------------------------|-----------|
| (mph)                       | (ft)                        | (ft)                        |           |
| 70.0                        | 1.00                        | C                           | 73.7      | 36.0      |

Distance to ocean line >= 100 mi. h/d = 0.39 <= 5

#### Main Framing Pressures

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<thead>
<tr>
<th>Location</th>
<th>s or h (ft)</th>
<th>Ks (psf)</th>
<th>qs (psf)</th>
<th>Cp</th>
<th>External Pressure P (psf)</th>
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</thead>
<tbody>
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</tr>
<tr>
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<td>0.80</td>
<td>10.0</td>
<td>0.80</td>
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<td>-0.70</td>
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<tr>
<td>Roof</td>
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<td>1.32</td>
<td>0.80</td>
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<tr>
<td>Internal</td>
<td>14.0</td>
<td>0.80</td>
<td>10.0</td>
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</tbody>
</table>

#### Wind Load - 5

| Velocity Importance Exposure Width Length Roof Type |
|-----------------------------|-----------------------------|-----------------------------|-----------|
| (mph)                       | (ft)                        | (ft)                        |           |
| 70.0                        | 1.00                        | C                           | 73.7      | 49.7      |

Distance to ocean line >= 100 mi. h/d = 0.56 <= 5
## Main Wind Force Resisting Loads

### Main Framing Pressures

<table>
<thead>
<tr>
<th>Location</th>
<th>z or h (ft)</th>
<th>Gh (psf)</th>
<th>Kz (psf)</th>
<th>qz (psf)</th>
<th>Cp</th>
<th>External Pressure P (psf) GCpi=0.25</th>
<th>0.25</th>
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</thead>
<tbody>
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<tr>
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<td>28.0</td>
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<td>0.96</td>
<td>12.0</td>
<td>0.80</td>
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<td>9.1</td>
</tr>
<tr>
<td>Level 1 - 2</td>
<td>14.0</td>
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<td>0.80</td>
<td>10.0</td>
<td>0.80</td>
<td>10.1</td>
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<tr>
<td>Level 1</td>
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<td>0.80</td>
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<td>0.96</td>
<td>12.0</td>
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<td>-10.6</td>
</tr>
<tr>
<td>Side Wall</td>
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<td>1.26</td>
<td>0.96</td>
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<td>-10.6</td>
<td>-13.6</td>
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<tr>
<td>Roof</td>
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<td>28.0</td>
<td>1.26</td>
<td>0.96</td>
<td>12.0</td>
<td>-0.70</td>
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<td>-13.6</td>
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<td>Internal</td>
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<td>0.0</td>
<td>-3.0</td>
<td>3.0</td>
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</tbody>
</table>

**Notes for main framing:**

Positive pressures act toward surfaces.

Pressure or suction = \( P = q*Gh*cp - qh*(GCPi) \)

- \( q \): \( qz \) for windward wall evaluated at height \( z \).
- \( qh \): \( qz \) for leeward wall, side walls, and roof evaluated at mean roof height.
Wind Components & Cladding Loads

Start

Use Loads And Design Tool Palette

View Perspective (3D)

Calculate Wind Loads

Review Criteria
- % Opening Coefs: -0.25 & +0.25
- Components & Cladding

Calculate

Select Wall Plane

Tributary Area

<table>
<thead>
<tr>
<th>Horizontal</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Point: 0°</td>
<td>0°</td>
</tr>
<tr>
<td>Point 2: 40°</td>
<td>140°</td>
</tr>
<tr>
<td>Length: 40°</td>
<td>140°</td>
</tr>
</tbody>
</table>

Wind Components & Cladding

☐ Add Opposite Side Of Roof
Name: Limestone Panel

Component Tributary Width

☐ Yes, Use Code Provision

Cancel Defining Tributary Areas

View Output

View Section

Print Screen

Mouse: Double Click
Right Mouse Key

F2 Key For Keyboard Input

Add Opposite Side Of Roof
Name: Limestone Panel
Wind Components & Cladding Loads

View Output → View Calculations → Print Data
- Wind
- All Other
- Print To File
- Execute Notepad

Scroll Output

Page Setup
- Left Margin: 0.5 in
- Right Margin: 0.0 in

Print File

Exit Notepad

View Perspective (3D) → Solid Object

Show Loads
Components & Cladding
Zone Areas
none

End
Wind Load: Components & Cladding (psf)

Wind Load: Components & Cladding (psf)

Wind Load: Components & Cladding (psf)
**Wind Components & Cladding Loads**

Project: Office Building - Scheme A  
Location: Radford AAP  
Design Load: TM 5-809-1 1991  
Time: Sat Jan 25, 1992 5:49 PM

<table>
<thead>
<tr>
<th>Velocity</th>
<th>Importance Factor</th>
<th>Exposure</th>
<th>Width</th>
<th>Length</th>
<th>Roof Type</th>
<th>Wind</th>
<th>Parallel</th>
</tr>
</thead>
<tbody>
<tr>
<td>(mph)</td>
<td></td>
<td></td>
<td>(ft)</td>
<td>(ft)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70.0</td>
<td>1.00</td>
<td>C</td>
<td>49.7</td>
<td>73.7</td>
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</table>

Distance to ocean line \(> 100 \text{ ml.}\)  \(h/d = 0.56 < 5\)

<table>
<thead>
<tr>
<th>Height (ft)</th>
<th>(K_h)</th>
<th>(q_h)</th>
<th>(GC_{pi})</th>
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</thead>
<tbody>
<tr>
<td>28.0</td>
<td>0.96</td>
<td>12.0</td>
<td>-0.25</td>
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</table>

Height \(\leq 60 \text{ ft}\)

**Component/Cladding Pressures (p.f)**

--- Walls ---

<table>
<thead>
<tr>
<th>Tributary Area (sf)</th>
<th>Zone 4</th>
<th>Zone 5</th>
<th>Zone 4</th>
<th>Zone 5</th>
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<tr>
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<td>corners</td>
<td>middles</td>
<td>corners</td>
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<td></td>
<td>(G_{CP})</td>
<td>(P)</td>
<td>(G_{CP})</td>
<td>(P)</td>
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<tr>
<td><strong>Internal</strong></td>
<td>-3.0</td>
<td>-3.0</td>
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<td>3.0</td>
</tr>
<tr>
<td><strong>Limestone Panel</strong></td>
<td>4.27 ft x 14.00 ft</td>
<td>1.21</td>
<td>17.5</td>
<td>1.21</td>
</tr>
</tbody>
</table>

**Notes for components and cladding:**

- \(P = q_h(G_{CP}) - q_h(G_{CPi})\)
- Internal pressures have been included in above values.
- For roof overhangs: algebraically add this pressure to the above values. \(P = q_h(G_{CP}) = 0.8q_{h}\)
- To comply with TM 5-809-1, wall external pressures have not been reduced 10% per ASCE figure 3, note 3.
- **For a rectangular tributary area, the width of the area need not be less than one-third the length of the area.**
Dead & Live Loads

Start

Use Loads And Design Tool Palette

Live Loads → Use Occupancy (LL)

Add
Office: Offices 50 psf

Add
Office: Corridor (Main) 100 psf

Add
Office: Files & Storage 80 psf

Increase Files & Storage Load To 150 psf

Stop Using Occupancy (LL)

Dead Loads → Floor Dead Loads → Use Floor (DL)

Input

<table>
<thead>
<tr>
<th>Name</th>
<th>Second Floor Type</th>
<th>psi</th>
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<tbody>
<tr>
<td>Partition</td>
<td>51-100 psf</td>
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</tr>
<tr>
<td>Finish</td>
<td>Carpet &amp; Pad</td>
<td>1.0</td>
</tr>
<tr>
<td>Deck</td>
<td>MTL DK 2.0/NLWT 2.5</td>
<td>42.0</td>
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<tr>
<td>Structure</td>
<td>Steel Beams</td>
<td>0.0</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Mech A/C Ducts</td>
<td>3.0</td>
</tr>
<tr>
<td>Electrical</td>
<td>Elect/Lighting</td>
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</tr>
<tr>
<td>Fire Protection</td>
<td>Sprinklers Wet</td>
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<tr>
<td>Ceiling</td>
<td>Susp Chn/Tile</td>
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<tr>
<td>Total</td>
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</tr>
</tbody>
</table>
Dead & Live Loads

Dead Loads

Floor Dead Loads

Save

Stop Using Floor (DL)

Roof Dead Loads

Use Roof (DL)

Input

Name: Lower Roof
Type: psf
Roofing: Single Ply 1.5
Deck: MTL DK 1.5 w/ 1.5 36.0
Structure: Steel Bar Jst 24'@4' 1.8
Mechanical: Mech A/C Ducts 3.0
Electrical: Electrlighting 1.0
Fire Protection: Sprinklers Wet 2.0
Insulation: Rigid Roof Ins 3" 2.4
Ceiling: 2.0
Total: 47.7

Save

Input

Name: Upper Roof
Type: psf
Roofing: Single Ply 1.5
Deck: Steel 1-1/2" 20ga 2.5
Structure: Steel Beams 0.0
Mechanical: Mech A/C Ducts 3.0
Electrical: Electrlighting 1.0
Fire Protection: Sprinklers Wet 2.0
Insulation: Rigid Roof Ins 3" 2.4
Ceiling: Sup Chnl/Tile 2.0
Total: 14.4

Save

Next To View Lower Roof Load

Stop Using Roof (DL)
Dead & Live Loads

Print

Scroll Output

Page Setup
Left Margin: 0.5 in
Right Margin: 0.0 in

Print File

Exit Notepad

End
### Dead & Live Loads

#### Floor Dead Loads

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>psf</th>
</tr>
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<tbody>
<tr>
<td>Partition</td>
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<tr>
<td>Finish</td>
<td>Carpet &amp; Pad</td>
<td>1.0</td>
</tr>
<tr>
<td>Deck</td>
<td>MTL DK 2.0/HLMT 2.5</td>
<td>42.0</td>
</tr>
<tr>
<td>Structure</td>
<td>Steel Beams</td>
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<td>Mechanical</td>
<td>Mech A/C Ducts</td>
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</tr>
<tr>
<td>Electrical</td>
<td>Elect/Lighting</td>
<td>1.0</td>
</tr>
<tr>
<td>Fire Protection</td>
<td>Sprinklers Wt</td>
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<tr>
<td>Ceiling</td>
<td>Susp Chnl/Tile</td>
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<tr>
<td><strong>Total</strong></td>
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#### Roof Dead Loads

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<th>Type</th>
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<td>MTL DK 1.5/HLMT 2.5</td>
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<table>
<thead>
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<th>Name</th>
<th>Type</th>
<th>psf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roofing</td>
<td>Single Ply</td>
<td>1.5</td>
</tr>
<tr>
<td>Deck</td>
<td>Steel 1-1/2&quot; 20ga</td>
<td>2.5</td>
</tr>
<tr>
<td>Structure</td>
<td>Steel Beams</td>
<td>0.0</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Mech A/C Ducts</td>
<td>3.0</td>
</tr>
<tr>
<td>Electrical</td>
<td>Elect/Lighting</td>
<td>1.0</td>
</tr>
<tr>
<td>Fire Protection</td>
<td>Sprinklers Wt</td>
<td>2.0</td>
</tr>
<tr>
<td>Insulation</td>
<td>Rigid Roof Ins 3&quot;</td>
<td>2.4</td>
</tr>
<tr>
<td>Ceiling</td>
<td>Susp Chnl/Tile</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>14.4</td>
</tr>
</tbody>
</table>

#### Wall Dead Loads

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>psf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finish</td>
<td>Limestone 5&quot;</td>
<td>68.8</td>
</tr>
<tr>
<td>Sheathing</td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>Structure</td>
<td>Stl Stud 16ga 4&quot;x16</td>
<td>1.1</td>
</tr>
<tr>
<td>Insulation</td>
<td>Exp Polysty Rigid 1&quot;</td>
<td>0.2</td>
</tr>
<tr>
<td>Finish</td>
<td>Gypboard 5/8&quot;</td>
<td>3.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>73.2</td>
</tr>
</tbody>
</table>
Dead & Live Loads

## Name: Parapet

<table>
<thead>
<tr>
<th>Type</th>
<th>psf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finish</td>
<td>68.8</td>
</tr>
<tr>
<td>Sheathing</td>
<td>0.0</td>
</tr>
<tr>
<td>Structure</td>
<td>0.0</td>
</tr>
<tr>
<td>Insulation</td>
<td>0.0</td>
</tr>
<tr>
<td>Finish</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Total: 68.8

### Occupancy Live Loads

<table>
<thead>
<tr>
<th>Name</th>
<th>psf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office: Offices</td>
<td>50</td>
</tr>
<tr>
<td>Office: Corridor (main)</td>
<td>100</td>
</tr>
<tr>
<td>Office: Files &amp; Storage</td>
<td>150a</td>
</tr>
</tbody>
</table>

**Notes**

Uniformly distributed live loads for supporting members, i.e., two-way slab, beam, girder or columns having an influence area of 400 sq ft or more may be reduced with: $L = L_0 [0.25 + \frac{15}{\text{sq rt}(A_i)}]$

The reduced design live load will not be less than 50% of the unit live load for members supporting one floor, nor less than 40% of the unit live load for members supporting two or more floors.

Exceptions: For live loads less than 100 psf, no reduction is permitted for members supporting floor(s) in the following areas:
- Public Assembly
- Garages (except where 2 or more floors are supported)
- One-way slab floor

For live loads greater than 100 psf and for garages used for passenger cars only, no reduction is permitted for members supporting one floor; however, where two or more floors are supported, a 20% reduction is permitted.
Minimum Roof Live Load

View Output → View Calculations → Print File → Exit Notepad

→ View Perspective (3D) → Solid Object

→ Show Loads
  - None

End
**Minimum Roof Live Load**

Project: Office Building - Scheme A  
Location: Redford AAP  
Design Load: TM 3-809-1 1991  
Time: Sat Jan 25, 1992 6:16 PM

************** Minimum Roof Live Load (LR) **************

Tributary area (At): 96 sf  
Roof slope (F): 0.00 in 12

\[
L_r = 20 \cdot R_1 \cdot R_2 \geq 12  
At \leq 200 \quad R_1 = 1.00  
F \leq 4 \quad R_2 = 1.00  
L_r = 20.00 \text{ psf}  
\]

minimum \( L_r = 12 \text{ psf} \)

<table>
<thead>
<tr>
<th>( L_r = 20.00 \text{ psf} )</th>
</tr>
</thead>
</table>

Check minimum roof live load, \( L_r \), against minimum snow design loads.

Additionally, for the design of secondary members such as roof decking and rafters, a concentrated live load with 250 lbs uniformly distributed over an area of 2 feet square (4 sqft) will be included. The concentrated load will be located so as to produce the maximum stress in the member.
**Loads Database**

Start

Run Notepad

Open LOADS.DAT

Scroll To Location In File

Add New Item

Save File

Add Another Item

Yes

No

Exit Notepad

End

Insert A Single Tab Character Between The Text And The Load
**Draw Grid & Openings**

1. **Start**

2. **Use Draw Structure Tool Palette**

3. **Define Structural Grid**

4. **Select Second Floor/Lower Roof Horizontal Structural Plane**

5. **Structural Plane Information**
   - **Name:** Second Floor/Lower Roof

6. **Close Structural Plane Information Dialog Window**

7. **Define Grid**
   - **N-S Spacing:** 24'0"
   - **E-W Spacing:** 24'0"
   - **Perimeter Offset:** 10"

8. **Delete Grid Lines D & E**

9. **Delete Grid Lines**

10. **Select Grid Line E Then D**

11. **Double Click Right Mouse Key To End Deleting Grid Lines**

12. **Add Main Grid Line Between C & D**

13. **Add Main Grid Line**

14. **Select Handle Between C & D**

15. **Keep Dimensions To The Left & Right At 18' And Click The Left Mouse Key**
Draw Openings

Add Opening

<table>
<thead>
<tr>
<th>Horizontal</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Point:</td>
<td>10&quot;</td>
</tr>
<tr>
<td>Point 2:</td>
<td>8'10&quot;</td>
</tr>
<tr>
<td>Length:</td>
<td>80&quot;</td>
</tr>
</tbody>
</table>

F2 Key For Keyboard Input

Opening
Name: Stairs

Continuous

End
**Structure Hierarchy**

**Surface/Deck**
- (horizontal)
- 1 way
- 2 way (not activated)

**Linear**
- (horizontal)
- Narrowly Spaced (joists)
  - places uniform loads on girders
- Widely Spaced (beams)
  - places concentrated loads on girders

**Surface**
- (vertical)
- (planar)
  - uniform loads

**Linear**
- (vertical)
  - concentrated loads
Draw Structure

Start

Use Draw Structure Tool Palette

Draw Upper Roof Framing

Select Upper Roof Horizontal Structural Plane

Structural Plane Information
Name: Upper Roof

Close Structural Plane Information Dialog Window

Draw Linear Beams On All Grid Lines

Draw Third Point Beams In Bay A1-B2

Linear: Widely Spaced

Select Handle On Grid A1-B1

Select Handle On Grid A2-B2

Double Click Right Mouse Key To End Defining Area

Save Linear Elements
Orientation: N-S
Number Of Elements: 2

Draw One-Way Surface In Bay A1-B2

Surface: One-Way
Draw Structure

1. Draw Upper Roof framing
2. Draw Surface in Bay A1-B2
   - Select Handle On Grid Line B1-B2
   - Double Click Right Mouse Key To End Defining Area
   - Save Surface Element Orientation: E-W
4. Copy Beams & One-Way Surface To Other Bays
   - Copy Structure
     - Select Third Point Beams
     - Select One-Way Surface
       - Double Click Right Mouse Key To End Selecting Structure
     - Select Grid Location A1 As The Base Point
     - Paste Structure
     - Select Grid Locations B1, A2, B2, A3, B3
       - Double Click Right Mouse Key To End
Draw Upper Roof framing

Draw Columns

Column All Grid Intersections

Save Column Elements
Orientation: N-S
All Floors

Draw Second Floor/ Lower Roof Framing
Select Second Floor/ Lower Roof Horizontal Structural Plane

Draw Linear Beams On All Grid Lines

Delete Beams At Grid Locations Inside C1-E4

Draw Third Point Beams And One-Way Surface In Bays A1-B2, B1-C2, B2-C3, A3-B4, B3-C4

Paste Structure

Select Grid Locations A1, B1, B2, A3, B3

Double Click Right Mouse Key To End

Draw Third Point Beams In Bay A2-B3

Linear: Widely Spaced
Draw Structure

- Draw Second Floor/ Lower Roof Framing
- Draw Third Point Beams in Bay A2-B3
- Select Handle on Grid B2-B3
- Select Handle on Grid A2-A3
- Double Click Right Mouse Key To End Defining Area
- Save Linear Elements
  - Orientation: N-S
  - Number Of Elements: 2
- Draw Surface In Bay A2-A3-B3
- Surface: One-Way
- Select Handle on Grid Line B2-B3
- Double Click Right Mouse Key To End Defining Area
- Save Surface Element
  - Orientation: E-W
- Draw Joists In Bay C1-E2
- Linear: Narrowly Spaced
- Select Handle on Grid C1-C2
- Select Handle on Grid E1-E2
Draw Structure

Draw Second Floor/ Lower Roof Framing

Draw Joists in Bay C1-E2

Double Click Right Mouse Key To End Defining Area

Save Linear Elements
  Orientation: N-S
  Spacing: 48"

Draw Surface In Bay C1-E2

Surface: One-Way

Select Handle On Grid C1-C2

Select Handle On Grid E1-E2

Double Click Right Mouse Key To End Defining Area

Save Surface Element
  Orientation: E-W

Copy Joists & One-Way Surface To Other Bays

Copy Structure

Select Joists

Select One-Way Surface

Double Click Right Mouse Key To End Selecting Structure

Select Grid Location C1 As The Base Point
Draw Structure

Draw Second Floor/ Lower Roof Framing

Copy Joists & One-Way Surface To Other Bays

Paste Structure

Select Grid Locations C2, C3

Double Click Right Mouse Key To End

Select Grid Locations C2-D2, D2-E2

Double Click Right Mouse Key To End Defining Area

Save Linear Elements Orientation: E-W

Truss-Custom

Include Opposite Side Of Roof
Depth Of Support: 3'
Scissors Height: 0'

Repeat For Grid Location C3-E3

Draw Trusses

Linear Truss-Custom

Select Grid Locations C2-D2, D2-E2

Double Click Right Mouse Key To End Defining Area

Save Linear Elements Orientation: E-W

Repeat For Grid Location C3-E3

Draw Columns

Column One Grid Intersection

Select Grid Locations D1, E1, E2, E3, D4, E4
Draw Structure
Assign Wall Loads Philosophy

- No wall weight
- Wall wt
- Assign all floors
- Separate
- Perimeter wt
- Wall wt

User's choice

This approach saves memory
Assign Loads

Start

Use Loads & Design Tool Palette

Assign Live Loads

Select Second Floor/ Lower Roof Horizontal Structural Plane

Use Occupancy (LL)

Highlight Office 50 psf

Assign Offices 50 psf

Horizontal Vertical
base Point: 24'10" 10'
Point 2: 48'10" 72'10"
Length: 240" 720"

Highlight: Corridor (main) 100 psf

Assign Corridor (main) 100 psf

Horizontal Vertical
Base Point: 8'10" 24'10"
Point 2: 24'10" 48'10"
Length: 160" 240"

Highlight: Files & Storage 150 psf
Assign Loads

Assign Dead Loads

Assign Ground Floor Wall Loads

Assign Exterior Wall Load

Assgn All Floors

Horizontal Vertical

Wall Height

Start: 140°
End: 140°

Assign Exterior Wall Load

Wall Height

Start: 140°
End: 140°

Stop Using Wall (DL)

View Loads

Show Loads

None

End
Analysis & Design Philosophy

Preliminary Analysis

A. Select: * Material  
   * Load Combination  
     (Live Load Reduction)  
   * Element To Analyze

B. Review: * Attributes  
   * Guidelines

C. Connectivity

D. Self Weight Estimate  * Guidelines

E. Analysis  * Review Loads  
   * Connectivity  

   * Analysis Output  
     I = 1  
     E = 1  
     A = 1000

F. Re-Analysis  (with real properties)
**Preliminary Design**

* Maximum V's, M's, R's, etc. sent to Excel

**Spreadsheets**

<table>
<thead>
<tr>
<th>Connectivity</th>
<th>Loads</th>
<th>M</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowable Stresses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowable Deflections</td>
<td></td>
<td></td>
<td>Required: I &amp; S</td>
</tr>
</tbody>
</table>

**Choices & Options Table**

**Selection**

sent back to CASM
Surface Element Analysis

Start

Use Loads & Design Tool Palette

Select Upper Roof Horizontal Structural Plane

Material Steel

Load Combination D + S

Use Load Combination

Set Factors
Dead: 1.0
Snow: 1.0

Add

OK Button To Close Dialog Window

Highlight D+S In List

Select Element To Analyze & Design

Surface One-Way Roof Deck

Select A One-Way Surface Element

Review Element Attributes & Guidelines
Surface Element Analysis

Preliminary Analysis

Use Preliminary

Analysis
Units: Feet & Pounds
- Use Actual Properties
- DL=Deck+Self Weight

Decking Analysis
Number Of Spans: 3
Distance From Edge: 12'
Starting Span Number: 1
- Include Superimposed Dead Load

Analysis
Analysis File Name: Optional
Yes, The Loads & Connectivity Are Correct

View Shear, Moment & Deflection Diagrams

Excel Data
- Execute Excel

End
Surface Element Analysis

1.00 Dead (psi)

1.00 Superimposed Dead (psi)

1.00 Snow (psi)

Shear (lb)

Moment (ft-lb)

Deflection

Total Combined Load
Steel Roof Deck Design

Start

Review Spans, Depth Limit, Wind & Deck Loads & Deflection Limits

Use Scratch Pad To Explore Spans, And Loading Alternatives

Select Member

Print Spreadsheet

Return To Preliminary

Select Member:
- Send Member Size To CASM

Print Spreadsheet

Return To CASM

Restore CASM

Double Click On CASM Icon

Cancel Selected Element

End
Steel Roof Deck Design

Steel Deck Selection

STEEL ROOF DECK PRELIMINARY SELECTION

<table>
<thead>
<tr>
<th>Project: Office Building - Scheme A</th>
<th>Date: Feb 26, 1992</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: Radford AAF</td>
<td>Engr:</td>
</tr>
</tbody>
</table>

Load and Analysis Data:

<table>
<thead>
<tr>
<th>Method: Analysis</th>
<th>Load Combination: D + S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member ID:</td>
<td>Factored Moments (lb-ft)</td>
</tr>
<tr>
<td>Connectivity:</td>
<td>Fact. Reactions</td>
</tr>
<tr>
<td>Beam (Left)</td>
<td>Load Type</td>
</tr>
<tr>
<td>Beam (Right)</td>
<td>Deck</td>
</tr>
<tr>
<td></td>
<td>Sup Dead</td>
</tr>
<tr>
<td></td>
<td>Live</td>
</tr>
<tr>
<td>Deck Span:</td>
<td>Snow</td>
</tr>
<tr>
<td>Trib Width:</td>
<td>Wind</td>
</tr>
<tr>
<td>Depth Limit:</td>
<td>Summary</td>
</tr>
</tbody>
</table>

Load Combinations for roof:

- Load Case #1: D + S
  - Est. Deck Wgt = 0.8 psf
- Load Case #2: Deck + Wind
  - Wind Load = -40.0 psf
- Load Case #3: Deck + Construction 200# Point Load

Deck Configuration:

Deck Type: Roof Deck
Cellular: No

Code Load Combinations:

<table>
<thead>
<tr>
<th>Case</th>
<th>Load (psf)</th>
<th>Factor</th>
<th>M+ (f-lb)</th>
<th>M- (f-lb)</th>
<th>S+ (in.3)</th>
<th>S- (in.3)</th>
<th>Ix (in.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>1.00</td>
<td>201.7</td>
<td>92.2</td>
<td>0.121</td>
<td>0.055</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td>-39.2</td>
<td>1.33</td>
<td>293.5</td>
<td>-235.8</td>
<td>0.132</td>
<td>-0.106</td>
<td>0.1650</td>
</tr>
<tr>
<td>#3</td>
<td>0.8</td>
<td>1.33</td>
<td>284.1</td>
<td>-133.1</td>
<td>0.128</td>
<td>-0.060</td>
<td>0.1650</td>
</tr>
</tbody>
</table>

Maximums:

| #1   | 293.5     | -235.8  | 0.132     | -0.106    | 0.1650    |

Steel Roof Deck Selection Table - Spans = 3

<table>
<thead>
<tr>
<th>Deck Type</th>
<th>Gage</th>
<th>Depth (in)</th>
<th>Sx+ (in.^3)</th>
<th>Sx- (in.^3)</th>
<th>Ix (in.^4)</th>
<th>Dk wgt (psf)</th>
<th>Const Span Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>WR 20</td>
<td>20</td>
<td>1.5</td>
<td>0.237</td>
<td>-0.251</td>
<td>0.207</td>
<td>2.2</td>
<td>6'-3&quot;</td>
</tr>
<tr>
<td>WR 20</td>
<td>18</td>
<td>1.5</td>
<td>0.204</td>
<td>-0.211</td>
<td>0.222</td>
<td>2.8</td>
<td>6'-2&quot;</td>
</tr>
<tr>
<td>NW 18</td>
<td>18</td>
<td>1.5</td>
<td>0.176</td>
<td>-0.182</td>
<td>0.203</td>
<td>2.9</td>
<td>5'-11&quot;</td>
</tr>
<tr>
<td>WR 18</td>
<td>18</td>
<td>1.5</td>
<td>0.322</td>
<td>-0.331</td>
<td>0.298</td>
<td>2.9</td>
<td>7'-6&quot;</td>
</tr>
</tbody>
</table>

CASM Preliminary Steel Roof Deck Selection:

<table>
<thead>
<tr>
<th>Deck Type: WR 20</th>
<th>Span= 8.0 ft</th>
<th>Depth: 1.5 in</th>
<th>Description: 2-1/2&quot;Rib@6&quot;oc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight: 2.2 psf</td>
<td>Gage: 20</td>
<td>Ix = 0.207</td>
<td>Construction Load Span Limits:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sx+ = 0.237</td>
<td>1 span: 6'-3&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sx- = -0.251</td>
<td>2+span: 7'-5&quot;</td>
</tr>
</tbody>
</table>

Notes:
1. Steel roof deck properties from representative manufacturer’s data.
Narrowly Spaced Element Analysis

Start

Use Loads & Design Tool Palette

Select Second Floor/ Lower Roof Horizontal Structural Plane

Material Steel

Load Combination D+S

Use Load Combination

Set Factors
Dead: 1.0
Snow: 1.0

Add

OK Button To Close Dialog Window

Highlight D+S In List

Select Element To Analyze & Design

Linear Narrowly Spaced Open-Web Joist-K

Select A Narrowly Spaced Element Near A Corner

Review Element Attributes & Guidelines
Narrowly Spaced Element Analysis

Preliminary Analysis

Use Preliminary Analysis

Analysis
Units: Feet & Pounds
- Use Actual Properties
- DL=Deck+Self Weight

Connectivity
Left: Hinge
Right: Roller

Self Weight
Estimate: Self Weight: 0.0

Analysis File Name: Optional
Yes, The Load & Connectivity Are Correct

View Shear, Moment & Deflection Diagrams

Excel Data
- Execute Excel

End
# Narrowly Spaced Element Analysis

**INPUT**

<table>
<thead>
<tr>
<th>MATERIAL TYPE</th>
<th>ELEMENT AYRAL AREA</th>
<th>NUMBER OF ELEMENTS</th>
<th>ELEMENT X</th>
<th>ELEMENT Y</th>
<th>NUMBER OF NODES</th>
<th>MATERIAL FORM'S FORMS</th>
<th>MATERIAL FORM'S FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
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<td>1.000</td>
<td>1.000</td>
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</tbody>
</table>

**OUTPUT**

<table>
<thead>
<tr>
<th>FIXED END FORCES IN LOCAL COORDINATES</th>
<th>TYPE</th>
<th>ELEMENT</th>
<th>X</th>
<th>Z</th>
<th>FIXED END FORCES IN LOCAL COORDINATES</th>
<th>TYPE</th>
<th>ELEMENT</th>
<th>X</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>11</td>
<td>1</td>
<td>110.00</td>
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</tr>
</tbody>
</table>

**JOINT DATA**

<table>
<thead>
<tr>
<th>JOINT X</th>
<th>JOINT Y</th>
<th>JOINT Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>0.000</td>
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</tr>
</tbody>
</table>

**APPLIED JOINT LOADS AND SURFACE REACTIONS**

<table>
<thead>
<tr>
<th>JOINT X</th>
<th>JOINT Y</th>
<th>JOINT Z</th>
<th>JOINT LOAD</th>
<th>SURFACE REACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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</tr>
</tbody>
</table>

**JOINT X | JOINT Y | JOINT Z | JOINT LOAD | SURFACE REACTION |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<tbody>
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</table>

**NODE DATA**

<table>
<thead>
<tr>
<th>NODE X</th>
<th>NODE Y</th>
<th>NODE Z</th>
<th>NODE LOAD</th>
<th>SURFACE REACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**JOINT X | JOINT Y | JOINT Z | JOINT LOAD | SURFACE REACTION |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
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<td>0.000</td>
<td>0.000</td>
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</tr>
</tbody>
</table>

**PROBLEM COMPLETED**

**OUTPUT**

<table>
<thead>
<tr>
<th>JOINT DISPLACEMENTS</th>
<th>JOINT Y DISPLACEMENT</th>
<th>JOINT Z DISPLACEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**OUTPUT**

<table>
<thead>
<tr>
<th>JOINT X</th>
<th>JOINT Y</th>
<th>JOINT Z</th>
<th>JOINT LOAD</th>
<th>SURFACE REACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**JOINT X | JOINT Y | JOINT Z | JOINT LOAD | SURFACE REACTION |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**JOINT X | JOINT Y | JOINT Z | JOINT LOAD | SURFACE REACTION |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
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<td>0.000</td>
</tr>
</tbody>
</table>

**JOINT X | JOINT Y | JOINT Z | JOINT LOAD | SURFACE REACTION |
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>
### Narrowly Spaced Element Analysis

#### Material Types

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Num.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.000</td>
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</tr>
</tbody>
</table>

#### Output: Displacement, Forces

<table>
<thead>
<tr>
<th>Force Type</th>
<th>Force</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Moment Shear

<table>
<thead>
<tr>
<th>Moment Shear</th>
<th>Shear</th>
<th>Force</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
<td>4.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Stiffness Checks

<table>
<thead>
<tr>
<th>Stiffness Check</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Dead Load

<table>
<thead>
<tr>
<th>Dead Load</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Effective Lengths

<table>
<thead>
<tr>
<th>Effective Length</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Initial Analysis

<table>
<thead>
<tr>
<th>Initial Analysis</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Output, Forces

<table>
<thead>
<tr>
<th>Force Type</th>
<th>Force</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Moment Shear

<table>
<thead>
<tr>
<th>Moment Shear</th>
<th>Shear</th>
<th>Force</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
<td>4.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Stiffness Checks

<table>
<thead>
<tr>
<th>Stiffness Check</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Dead Load

<table>
<thead>
<tr>
<th>Dead Load</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Effective Lengths

<table>
<thead>
<tr>
<th>Effective Length</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Initial Analysis

<table>
<thead>
<tr>
<th>Initial Analysis</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### Output: Output, Forces

<table>
<thead>
<tr>
<th>Force Type</th>
<th>Force</th>
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<tbody>
<tr>
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<table>
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</tbody>
</table>

#### Output: Dead Load

<table>
<thead>
<tr>
<th>Dead Load</th>
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<tr>
<td>1</td>
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</table>

#### Output: Output, Forces

<table>
<thead>
<tr>
<th>Force Type</th>
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</tbody>
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#### Output: Output, Forces

<table>
<thead>
<tr>
<th>Force Type</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
</tr>
</tbody>
</table>
# Narrowly Spaced Element Analysis

## Output: Element Analysis

### Narrowly Spaced Element Analysis

<table>
<thead>
<tr>
<th>TYPE</th>
<th>AXIAL I</th>
<th>SEMMA I</th>
<th>MEMBER I</th>
<th>AXIAL J</th>
<th>SEMMA J</th>
<th>MEMBER J</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.000</td>
<td>444.678</td>
<td>177.568</td>
<td>0.000</td>
<td>444.678</td>
<td>-117.568</td>
</tr>
<tr>
<td>2</td>
<td>4.000</td>
<td>444.678</td>
<td>177.568</td>
<td>0.000</td>
<td>444.678</td>
<td>-117.568</td>
</tr>
<tr>
<td>3</td>
<td>2.000</td>
<td>444.678</td>
<td>177.568</td>
<td>0.000</td>
<td>444.678</td>
<td>-117.568</td>
</tr>
<tr>
<td>4</td>
<td>1.000</td>
<td>444.678</td>
<td>177.568</td>
<td>0.000</td>
<td>444.678</td>
<td>-117.568</td>
</tr>
</tbody>
</table>

## Output: Member Analysis

### Member Data

<table>
<thead>
<tr>
<th>MEMBER</th>
<th>SEMMA</th>
<th>MEMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.000</td>
<td>444.678</td>
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<td>444.678</td>
</tr>
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<td>444.678</td>
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</table>

## Applied Loads and Forces Analysis

<table>
<thead>
<tr>
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<th>SEMMA</th>
<th>MEMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.000</td>
<td>1151.200</td>
</tr>
<tr>
<td>6</td>
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<td>1151.200</td>
</tr>
<tr>
<td>7</td>
<td>0.000</td>
<td>1151.200</td>
</tr>
<tr>
<td>8</td>
<td>0.000</td>
<td>1151.200</td>
</tr>
<tr>
<td>9</td>
<td>0.000</td>
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<td>11</td>
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</tbody>
</table>

## Output: Element Analysis

### Output: Element Analysis

<table>
<thead>
<tr>
<th>TYPE</th>
<th>AXIAL I</th>
<th>SEMMA I</th>
<th>MEMBER I</th>
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<td>444.678</td>
<td>-117.568</td>
</tr>
</tbody>
</table>

## Output: Member Analysis

### Member Data

<table>
<thead>
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</tr>
</thead>
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<td>444.678</td>
</tr>
<tr>
<td>4</td>
<td>1.000</td>
<td>444.678</td>
</tr>
</tbody>
</table>

## Applied Loads and Forces Analysis

<table>
<thead>
<tr>
<th>MEMBER</th>
<th>SEMMA</th>
<th>MEMBER</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>11</td>
<td>0.000</td>
<td>1151.200</td>
</tr>
</tbody>
</table>

---

93
Steel Open-Web Joist Design

Start

- Review Depth Limits & Deflection Limits

- Review Calculations & Selections

  Use Scratch Pad To Explore Span, Spacing, And Loading Alternatives

  - Select Member
  - Print Spreadsheet

  - Return To Preliminary

- Select Member

  - Send Member Size To CASM

- Print Spreadsheet

- Return To CASM

- Restore CASM

- Double Click On CASM Icon

- Cancel Selected Element

- End
Steel Open-Web Joist Design
Steel Open-Web Joist Design

Bar Joist Selection

STEEL BAR JOIST PRELIMINARY SELECTION

<table>
<thead>
<tr>
<th>Project: Office Building - Scheme A</th>
<th>Date: Feb 26, 1992</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: Radford AAP</td>
<td>Engr:</td>
</tr>
</tbody>
</table>

CASM Load & Analysis Data:

Method: Analysis

Load Combination: D + S

<table>
<thead>
<tr>
<th>Member ID:</th>
<th>Connection:</th>
<th>Load Type</th>
<th>Factored Moment (ft-lb)</th>
<th>Factored Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Left</td>
<td>Mid</td>
</tr>
<tr>
<td>Roller (Right)</td>
<td>Dead</td>
<td></td>
<td>518</td>
<td>86</td>
</tr>
<tr>
<td>Span: 24.0 ft</td>
<td>Sup Dead</td>
<td></td>
<td>13,219</td>
<td>2,203</td>
</tr>
<tr>
<td>Spacing: 48.0 in</td>
<td>Live</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth Limit= 24.0 in. max</td>
<td>Lmin Roof</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fy= 36.0 ksi</td>
<td>Snow</td>
<td></td>
<td>13,451</td>
<td>2,200</td>
</tr>
<tr>
<td>Fb= 24.0 ksi</td>
<td>Wind</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E= 29,000 ksi</td>
<td>Summary</td>
<td></td>
<td>27,18$</td>
<td>4,489</td>
</tr>
</tbody>
</table>

Live Defl= L/360 = 0.80 in |

Total Defl= L/240 = 1.20 in

Moment: (EUL) Reaction: (EUL)

CASM Joist Selection Table: (Joist capacities)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>20K4</td>
<td>48.0</td>
<td>430</td>
<td>353</td>
<td>30,960</td>
<td>5,160</td>
<td>0.48</td>
<td>0.92</td>
<td>1.9</td>
</tr>
<tr>
<td>18K5</td>
<td>48.0</td>
<td>434</td>
<td>318</td>
<td>31,248</td>
<td>5,206</td>
<td>0.54</td>
<td>1.03</td>
<td>1.9</td>
</tr>
<tr>
<td>22K4</td>
<td>48.0</td>
<td>475</td>
<td>431</td>
<td>34,200</td>
<td>5,700</td>
<td>0.40</td>
<td>0.76</td>
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<tr>
<td>16K8</td>
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<td>418</td>
<td>269</td>
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<td>5,016</td>
<td>0.63</td>
<td>1.21</td>
<td>2.0</td>
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</tbody>
</table>

CASM Bar Joist Selection:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wgt(tons)</td>
<td>0.09</td>
<td>Mmax: 30,960</td>
<td>Rmax: 5,160</td>
<td>TL defl: 0.92 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LL defl: 0.48 in</td>
</tr>
</tbody>
</table>

NOTES:

1. Bar joist selections based on 1988 SJI Load Tables.
   Edit spreadsheet stajstk.xls to revise selection table.

2. Approximate moment of inertia of the joist in inches^4 is:
   \[ I_J = 26.767 \times (WLL)^*(L^3) \times (10^{-6}) \]
   where WLL = Live Load value in table;
   where \( L = \text{Span} - 0.33 \text{ in feet} \)
Widely Spaced Element Analysis: Beam

Start

Use Loads & Design Tool Palette

Select Second Floor/ Lower Roof Horizontal Structural Plane

Material Steel

Load Combination D + L

Use Load Combination

Set Factors
Dead: 1.0
Live: 1.0

Add

OK Button To Close Dialog Window

Highlight D+L In List

Select Element To Analyze & Design

Linear Widely Spaced Rolled Section

Select A Widely Spaced Element In Bay A3-B4

Review Element Attributes & Guidelines
Widely Spaced Element Analysis: Beam

Analysis
Units: Feet & Kips
- Use Actual Properties
- DL=Deck+Self Weight

Connectivity
Left: Hinge
Right: Roller

Self Weight

Guidelines
Find Estimate For 24' Span & 1.65 k:ft

Close Self Weight Guidelines Dialog Window

Self Weight
Estimated Self Weight: 50 lb
- Update Area Structure Loads
- Add Self Weight

Analysis
Analysis File Name: Optional
Yes. The Loads & Connectivity Are Correct

View Shear, Moment & Deflection Diagrams

Excel Data
- Execute Excel

End
Widely Spaced Element Analysis: Beam

1.00 Dead (kif)  

1.00 Superimposed Dead (kif)  

1.20 Live (kif)  

Shear (k)  

Moment (kft)  

Deflection  

Total Combined Load
Steel Beam Design

1. Start
2. Review Depth Limits, Deflection Limits & Steel Strength
3. Use Scratch Pad To Explore Support Conditions, Span, Spacing, And Loading Alternatives
4. Select Member
5. Print Spreadsheet
6. Return To Preliminary
7. Send Member Size To CASM
8. Print Spreadsheet
9. Return To CASM
10. Restore CASM
11. Double Click On CASM Icon
12. Cancel Selected Element
13. End
Steel Beam Design

Steel Beam Selection

STEEL BEAM PRELIMINARY SELECTION

| Project: Office Building - Scheme A | Date: Feb 26, 1992 |
| Location: Radford AAP | Engr: |

CASM Load & Analysis Data:

- **Method**: Analysis
- **Member ID**: Analysis
- **Load Combination**: D + L

<table>
<thead>
<tr>
<th>Connectivity: Hinge (Left)</th>
<th>Load Type</th>
<th>Factored Moments (k-ft)</th>
<th>Fact. Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roller (Right)</td>
<td>Dead</td>
<td>Left (k)</td>
<td>Mid</td>
</tr>
<tr>
<td>Beam Span: 24.0 ft</td>
<td>Sup Dead</td>
<td>32.8</td>
<td>5.5</td>
</tr>
<tr>
<td>Trib Width= 8.0 ft</td>
<td>Live</td>
<td>86.4</td>
<td>14.4</td>
</tr>
<tr>
<td>Depth Limit= 36.0 in. max</td>
<td>Lmin Roof</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fy= 36.0 ksi</td>
<td>Snow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fb=0.66*Fy= 24.0 ksi</td>
<td>Wind</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fv= 14.4 ksi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E = 29,000 ksi</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Live Ld Defl=** L/360 = 0.60 in
- **Total Defl=** L/240 = 1.20 in
- **Max:** M= 122.8 k-ft
- **R=** 20.5 kips
- **Sx(req)=** 61.4 in^4
- **Ix(req)=** 386.1 in^4

CASM Beam Selection Table:

<table>
<thead>
<tr>
<th>Beam</th>
<th>Depth (in)</th>
<th>Width bf (in)</th>
<th>Sx (in^4)</th>
<th>Sx (in^3)</th>
<th>Live Ld Defl (in)</th>
<th>Total Ld Defl (in)</th>
<th>Shear tv (ksi)</th>
<th>Bending fb (ksi)</th>
<th>Beam Wt (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W 14 x 43</td>
<td>13.7</td>
<td>8.00</td>
<td>428</td>
<td>63</td>
<td>-0.72</td>
<td>-1.03</td>
<td>4.9</td>
<td>23.5</td>
<td>1,032</td>
</tr>
<tr>
<td>W 12 x 50</td>
<td>12.2</td>
<td>8.08</td>
<td>394</td>
<td>65</td>
<td>-0.78</td>
<td>-1.11</td>
<td>4.5</td>
<td>22.8</td>
<td>1,200</td>
</tr>
<tr>
<td>W 16 x 40</td>
<td>16.0</td>
<td>7.00</td>
<td>518</td>
<td>65</td>
<td>-0.60</td>
<td>-0.85</td>
<td>4.2</td>
<td>22.8</td>
<td>960</td>
</tr>
<tr>
<td>W 18 x 40</td>
<td>17.9</td>
<td>6.02</td>
<td>612</td>
<td>68</td>
<td>-0.50</td>
<td>-0.72</td>
<td>3.6</td>
<td>21.5</td>
<td>960</td>
</tr>
<tr>
<td>W 14 x 48</td>
<td>13.8</td>
<td>8.03</td>
<td>485</td>
<td>70</td>
<td>-0.64</td>
<td>-0.91</td>
<td>4.4</td>
<td>21.0</td>
<td>1,152</td>
</tr>
</tbody>
</table>

CASM Steel Beam Selection:

- **Beam** W 16 x 40
- **Span** 24.0 ft
- **lx** = 518
- **Sx** = 65
- **Defl(in):** -0.60
- **fv** = 4.2
- **fb** = 3.8
- **Beam Wt (tons):** 0.48

Notes:

Widely Spaced Element Analysis: Girder

Start
→ Use Loads & Design Tool Palette
→ Select Second Floor/Lower Roof Horizontal Structural Plane
→ Material Steel
→ Load Combination D + L

→ Use Load Combination
  → Set Factors
    Dead: 1.0
    Live: 1.0
  → Add
  → OK Button To Close Dialog Window
  → Highlight D+L In List

→ Select Element To Analyze & Design
  → Linear Widely Spaced Rolled Section
  → Select Widely Spaced Element A3-B3
  → Review Element Attributes & Guidelines
Preliminary Analysis → Use Preliminary

Analysis
Units: Feet & Kips
☐ Use Actual Properties
☐ DL=Deck+Self Weight

Connectivity
Left: Hinge
Right: Roller

Self Weight
Estimated Self Weight: 73 plf
☐ Update Area Structure Loads
☒ Add Self Weight

Analysis
-analysis File Name: Optional
Yrs. The Loads & Connectivity Are Correct

View Shear, Moment & Deflection Diagrams

Excel Data
☒ Execute Excel

End
Widely Spaced Element Analysis: Girder

1.00 Dead (kif)

1.00 Superimposed Dead (kif)

1.00 Live (kif)

Shear (k)

Moment (kft)

Deflection

Total Combined Load
Steel Beam Design

Start

Review Depth Limits, Deflection Limits & Steel Strength

Review Calculations & Selections

Use Scratch Pad To Explore Support Conditions, Span, Spacing, And Loading Alternatives

Select Member

Print Spreadsheet

Return To Preliminary

Select Member

Send Member Size To CASM

Print Spreadsheet

Return To CASM

Restore CASM

Double Click On CASM Icon

Cancel Selected Element

End
Steel Beam Design

Steel Beam Selection

STEEL BEAM PRELIMINARY SELECTION

<table>
<thead>
<tr>
<th>Project: Office Building - Scheme A</th>
<th>Data: Feb 26, 1992</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: Radford AAP</td>
<td>Engr:</td>
</tr>
</tbody>
</table>

CASM Load & Analysis Data:

Method: Analysis

<table>
<thead>
<tr>
<th>Member ID:</th>
<th>Load Type</th>
<th>Factored Moments (k-ft)</th>
<th>Fact. Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connectivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hinge (Left)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roller (Right)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sup Dead</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fb=.66*Fy=</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roller (Right)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summary</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load Type</th>
<th>D</th>
<th>L</th>
<th>( D + L )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead</td>
<td>13.7</td>
<td>1.9</td>
<td>2.0</td>
</tr>
<tr>
<td>Sup Dead</td>
<td>80.3</td>
<td>9.1</td>
<td>10.0</td>
</tr>
<tr>
<td>Live</td>
<td>179.2</td>
<td>20.8</td>
<td>22.4</td>
</tr>
</tbody>
</table>

\( \text{Member ID: FACTORED MOMENTS} \)

<table>
<thead>
<tr>
<th>Load Type</th>
<th>Left</th>
<th>Mid</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead</td>
<td>13.7</td>
<td>-</td>
<td>1.9</td>
</tr>
<tr>
<td>Sup Dead</td>
<td>80.3</td>
<td>-</td>
<td>9.1</td>
</tr>
<tr>
<td>Live</td>
<td>179.2</td>
<td>-</td>
<td>20.8</td>
</tr>
</tbody>
</table>

\( \text{Member ID: FACT. REACTIONS} \)

<table>
<thead>
<tr>
<th>Load Type</th>
<th>Left</th>
<th>Mid</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead</td>
<td>13.7</td>
<td>-</td>
<td>1.9</td>
</tr>
<tr>
<td>Sup Dead</td>
<td>80.3</td>
<td>-</td>
<td>9.1</td>
</tr>
<tr>
<td>Live</td>
<td>179.2</td>
<td>-</td>
<td>20.8</td>
</tr>
</tbody>
</table>

**E = 29,000 ksi**

\( \text{Live Ld Defl= } \frac{L}{360} = 0.30 \) in

\( \text{Total Defl= } \frac{L}{240} = 1.20 \) in

\( \text{Summary} \)

\( \text{Max: } M = 272.9 \text{ k-ft} \)

\( \text{R= 34.4 kips} \)

\( \text{Sx(req)= 136.5 in}^3 \)

\( \text{ix(req)= 769.4 in}^4 \)

CASM Beam Selection Table:

<table>
<thead>
<tr>
<th>Beam</th>
<th>Depth (in)</th>
<th>Width (bf in)</th>
<th>Lx (in^4)</th>
<th>Sx (in^3)</th>
<th>Live Ld Defl (in)</th>
<th>Total Ld Defl (in)</th>
<th>Shear (kcal)</th>
<th>Bending (kcal)</th>
<th>Beam Wt (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W 21 x 68</td>
<td>21.1</td>
<td>8.27</td>
<td>1,480</td>
<td>140</td>
<td>-0.43</td>
<td>-0.65</td>
<td>3.8</td>
<td>23.4</td>
<td>1,632</td>
</tr>
<tr>
<td>W 14 x 90</td>
<td>14.0</td>
<td>14.52</td>
<td>999</td>
<td>143</td>
<td>-0.63</td>
<td>-0.96</td>
<td>5.6</td>
<td>22.9</td>
<td>2,160</td>
</tr>
<tr>
<td>W 12 x 106</td>
<td>12.9</td>
<td>12.22</td>
<td>933</td>
<td>145</td>
<td>-0.68</td>
<td>-1.03</td>
<td>4.4</td>
<td>22.6</td>
<td>2,544</td>
</tr>
<tr>
<td>W 18 x 76</td>
<td>18.2</td>
<td>11.04</td>
<td>1,330</td>
<td>146</td>
<td>-0.47</td>
<td>-0.72</td>
<td>4.4</td>
<td>22.4</td>
<td>1,824</td>
</tr>
<tr>
<td>W 21 x 73</td>
<td>21.2</td>
<td>8.30</td>
<td>1,600</td>
<td>151</td>
<td>-0.39</td>
<td>-0.60</td>
<td>3.6</td>
<td>21.7</td>
<td>1,752</td>
</tr>
</tbody>
</table>

CASM Steel Beam Selection:

<table>
<thead>
<tr>
<th>Beam</th>
<th>Span= 24.0 ft</th>
<th>Lx= 1,480</th>
<th>Sx= 140</th>
<th>Defl(in): -0.43</th>
<th>-0.65</th>
<th>fv= 3.8</th>
<th>fb= 2.7</th>
<th>Beam Wt(tons)= 0.82</th>
</tr>
</thead>
</table>

Notes:

Truss Element Analysis

Start

Use Loads & Design Tool Palette

Select Second Floor/ Lower Roof Horizontal Structural Plane

Material Steel

Load Combination D+S

Use Load Combination

Set Factors
- Dead: 1.0
- Snow: 1.0

Add

OK Button To Close Dialog Window

Highlight D+S In List

Select Element To Analyze & Design

Linear Truss-Custom

Select A Truss

Review Element Attributes & Guidelines

Preliminary Analysis

Use Preliminary
### Truss Element Analysis

#### Total Combined Load — Axial (k)

#### Total Combined Load — Deflection

#### Total Combined Load — Reactions (k)
Column Load Run Down

Start

Use Loads & Design Tool Palette

Material Steel

Load Combination D + L + S

Use Load Combination

Set Factors
Dead: 1.0
Live: 1.0
Snow: 1.0

Add

OK Button To Close Dialog Window

Highlight D+L+S In List

Live Load Reduction

Occupancy (LL)

Apply Live Load Reduction

Select Element To Analyze & Design

Column Rolled Section

Select Column B3

Review Element Attributes & Guidelines
Column Load Run Down

- Live Load Reduction
- Occupancy (LL)
  - Apply Live Load Reduction
- End
<table>
<thead>
<tr>
<th>Column</th>
<th>Load</th>
<th>Run</th>
<th>Down</th>
</tr>
</thead>
</table>
## Column Load Run Down

<table>
<thead>
<tr>
<th>Tributary Area</th>
<th>Self Weight</th>
<th>DL</th>
<th>LLR</th>
<th>LLR Sum</th>
<th>S</th>
<th>TL Sum</th>
<th>DL Sum</th>
<th>LLR Sum</th>
<th>S Sum</th>
<th>TL Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upper Roof</strong></td>
<td></td>
<td>578.0</td>
<td>8.3</td>
<td>0.0</td>
<td>0.0</td>
<td>14.4</td>
<td>22.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Second Floor/Lower Roof</strong></td>
<td></td>
<td>578.0</td>
<td>38.4</td>
<td>37.8</td>
<td>0.0</td>
<td>74.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Column B-3 Load Run Down (k)*
Column Load Run Down

Project : Office Building - Scheme A
Location : Radford AAF
Design Load : TM 5-809=1 1991
Time : Sun Jan 26, 1992 1:13 PM

************************ Live Load Reduction ************************

Second Floor/Lower Roof
Office: Offices (Lo) : 50.0 psf
Tributary area (TA) : 576.0 sf
Area of influence (Ai) = 4*TA for columns.
Ai = 2304.0 sf
Ai >= 400.0 sf
Lo <= 100.0 psf
L = Lo*{0.25+15/sqrt(Ai)}
L = 28.1 psf
Member supports only one floor.
L >= 0.5*Lo
0.5*Lo = 25.0 psf
-------
| L = 28.13 psf |
-------

************************ Live Load Reduction ************************

Second Floor/Lower Roof
Office: Corridor (main) (Lo) : 100.0 psf
Tributary area (TA) : 576.0 sf
Area of influence (Ai) = 4*TA for columns.
Ai = 2304.0 sf
Ai >= 400.0 sf
Lo <= 100.0 psf
L = Lo*{0.25+15/sqrt(Ai)}
L = 56.3 psf
Member supports only one floor.
L >= 0.5*Lo
0.5*Lo = 50.0 psf
-------
| L = 56.25 psf |
-------

************************ Live Load Reduction ************************

Second Floor/Lower Roof
Office: Files & Storage (Lo) : 150.0 psf
Tributary area (TA) : 576.0 sf
Area of influence (Ai) = 4*TA for columns.
Ai = 2304.0 sf
Ai >= 400.0 sf
Lo > 100.0 psf
Member supports only one floor.
No live load reduction taken.
L = Lo
-------
| L = 150.00 psf |
-------
Steel Column Design

1. Start
2. Review Shape/Strength, K Value & Size Limit
3. Review Load & Analysis Data
4. Review Selections For Level 1
5. Select Member
   - Send Member Size To CASM
6. Review Selections For Level 2
7. Select Member
   - Send Member Size To CASM
8. Print Spreadsheet
9. Return To CASM
10. Restore CASM
11. Cancel Selected Column
12. End
# Steel Column Preliminary Selection

## CASM Load & Analysis Data:

**Method:** Analysis  
**Load Combination:** D + L + S  
**Steel Fy:** 36.0 ksi

<table>
<thead>
<tr>
<th>Member ID: B-3</th>
<th>Size Limit: 16.0 in. max</th>
<th>E = 29000 ksi</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Level</th>
<th>Flt to Flt Ht</th>
<th>Trib Area</th>
<th>Floor Level Load Totals (kips)</th>
<th>Load Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Roof</td>
<td>6</td>
<td>14.0</td>
<td>576</td>
<td>8.8</td>
<td>14.4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second Floor/L</td>
<td>1</td>
<td>14.0</td>
<td>576</td>
<td>45.7</td>
<td>97.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## CASM Column Selection Table

<table>
<thead>
<tr>
<th>Level</th>
<th>Preq: 23.2 kips</th>
<th>K-value: 1.0</th>
<th>Cc = 126.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Col Shape: W</td>
<td>Length: 14.0 ft</td>
<td>kl: 14.0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Column Size</th>
<th>Depth (in)</th>
<th>Width (bf-in)</th>
<th>Area (sq in)</th>
<th>ry (in)</th>
<th>k/r</th>
<th>Fa (ksi)</th>
<th>fa (ksi)</th>
<th>Pallow (kip)</th>
<th>Weight (ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W 6 x 15</td>
<td>5.99</td>
<td>5.99</td>
<td>4.43</td>
<td>1.46</td>
<td>115.07</td>
<td>10.98</td>
<td>5.24</td>
<td>48.6</td>
<td>0.11</td>
</tr>
<tr>
<td>W 5 x 16</td>
<td>5.01</td>
<td>5.00</td>
<td>4.68</td>
<td>1.27</td>
<td>132.28</td>
<td>8.45</td>
<td>4.96</td>
<td>39.6</td>
<td>0.11</td>
</tr>
<tr>
<td>W 8 x 18</td>
<td>8.14</td>
<td>5.25</td>
<td>5.26</td>
<td>1.23</td>
<td>136.59</td>
<td>7.78</td>
<td>4.41</td>
<td>40.9</td>
<td>0.13</td>
</tr>
<tr>
<td>W 5 x 19</td>
<td>5.15</td>
<td>5.03</td>
<td>5.54</td>
<td>1.28</td>
<td>131.25</td>
<td>8.61</td>
<td>4.19</td>
<td>47.7</td>
<td>0.13</td>
</tr>
<tr>
<td>W 8 x 28</td>
<td>8.06</td>
<td>6.54</td>
<td>8.25</td>
<td>1.62</td>
<td>103.70</td>
<td>12.50</td>
<td>2.81</td>
<td>103.2</td>
<td>0.20</td>
</tr>
</tbody>
</table>

## CASM Steel Column Selection

<table>
<thead>
<tr>
<th>Column Size</th>
<th>Level</th>
<th>Depth (in)</th>
<th>Width (bf-in)</th>
<th>Area (sq in)</th>
<th>ry (in)</th>
<th>k/r</th>
<th>Fa (ksi)</th>
<th>Pallow (kip)</th>
<th>Weight (ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W 8 x 28</td>
<td>2</td>
<td>8.06</td>
<td>6.54</td>
<td>8.25</td>
<td>1.62</td>
<td>103.70</td>
<td>12.50</td>
<td>103.2</td>
<td>0.20</td>
</tr>
<tr>
<td>W 8 x 28</td>
<td>1</td>
<td>8.06</td>
<td>6.54</td>
<td>8.25</td>
<td>1.62</td>
<td>103.70</td>
<td>12.50</td>
<td>103.2</td>
<td>0.20</td>
</tr>
</tbody>
</table>

**Total Column Weight:** 0.20

### Notes:
Lateral Resistance Philosophy

Steps Required

1. Create building volume
2. Define a structural grid
3. Layout structural framing on ALL levels
4. Assign gravity load on ALL levels
   Calculate wind and/or seismic loads
5. Select a load combination including wind or seismic loads
6. Define N-S & E-W vertical resistance system

Options:

1. Unbraced Frames

2. Braced Frames
   A. Trussing

B. Shear Walls

7. Define horizontal diaphragm systems

   All flexible
   All rigid
   Floors rigid & roof flexible
Lateral Resistance Philosophy

**Flexible Diaphragms**

Simple Beam Model
(tributary area)

*No Torsion*

Continuous Beam Model

**Rigid Diaphragms**

Symmetrical

Torsion
(even accidental minimum required)

Non-Symmetrical

\[ M = P \times \theta \]
Monolithic Perpendicular Shear Walls

For N-S

or

For E-W

or
Define Lateral Resistance

1. Start
2. Use Draw Structure Tool Palette
3. Select Second Floor/ Lower Roof Horizontal Structural Plane
4. Define Second Floor/ Lower Roof Diaphragm Type
5. Diaphragm Guidelines
6. Lateral Horizontal Rigid Diaphragm
7. Define N-S Lateral Resistance
8. Define Location
9. Vertical Define Location
10. Select Beam On Grid Line A
11. Define Bracing & Connectivity
12. Vertical Define Elements
13. Select NS-1
14. Define All Rigid Frame Connections
15. Close Lateral Resistance Dialog Window
16. Repeat For Grid Lines C & E
Define Lateral Resistance

1. Define E-W Lateral Resistance
2. Define Location
3. Vertical Define Location
   - Select Beam On Grid Line 1
4. Define Bracing & Connectivity
   - Vertical Define Elements
   - Select EW-1
   - Define All Rigid Frame Connections
   - Close Lateral Resistance Dialog
5. Repeat For Grid Line 4
6. Define Upper Roof Diaphragm Type
7. Select Upper Roof Horizontal Structural Plane
8. Lateral Horizontal Flexible Diaphragm
9. Display Lateral Resistance Locations
10. Show Structure
    - NS Lateral Resistance
    - EW Lateral Resistance
11. End
Define Lateral Resistance

Rigid Diaphragm

Second Floor / Lower Roof
Define Lateral Resistance

NS-3

EW-1 & EW-2
Wind Lateral Analysis

Start

Use Loads & Design Tool Palette

Load Combination D + W

Use Load Combination

Set Factors
Dead: 1.0
Wind: 1.0

Add

OK Button To Close Dialog Window

Highlight D+W In List

Define Member Properties

Select Second Floor/ Lower Roof Horizontal Structural Plane

Beam Properties

Use Modify Design

Select Beam On NS-1

Design
Material: Steel
Description: W 14 x 48
Weight: 48.0 plf
Modulus Of Elasticity: 29000 ksi
Moment Of Inertia: 1485.0 in4
Cross Sectional Area: 14.1 in2
Number Of Shear Studs: 0
Wind Lateral Analysis

- Define Properties
- Beam Properties
- Use Copy Design
  - Select Beam With Properties
  - Select All Other Beams Used For NS-1, NS-2, NS-3, EW-1, EW-2
  - Double Click Right Mouse Key To End Copying Designs
- Column Properties
- Use Modify Design
  - Select Column On NS-1
  - Design
    - Material: Steel
    - Description: W 8 x 48
    - Weight: 48.0 plf
    - Modulus Of Elasticity: 29000 ksi
    - Moment Of Inertia: 184.0 in4
    - Cross Sectional Area: 14.1 in2
    - Number Of Shear Studs: 0
  - Use Copy Design
  - Select Column With Properties
  - Select All Other Columns Used For NS-1, NS-2, NS-3, EW-1, EW-2
  - Double Click Right Mouse Key To End Copying Designs
Wind Lateral Analysis

- Define Properties
  - Select Upper Roof Horizontal Structural Plane
    - Beam Properties
      - Use Modify Design
        - Select Beam On NS-1
          - Design
            - Material: Steel
            - Description: W 12 x 22
            - Weight: 22.0 plf
            - Modulus Of Elasticity: 29000 ksi
            - Moment Of Inertia: 156.0 in^4
            - Cross Sectional Area: 6.48 in^2
            - Number Of Shear Studs: 0
          - Use Copy Design
          - Select Beam With Properties
          - Select All Other Beams Used For NS-1, NS-2, EW-1, EW-2
            - Double Click Right Mouse Key To End Copying Designs
          - Column Properties
            - Use Modify Design
              - Select Column On NS-1
Wind Lateral Analysis

Define Properties

Column Properties

Design

| Material:   | Steel       |
| Description: | W 8 x 48 |
| Weight:     | 48.0 plf  |
| Modulus Of Elasticity: | 29000 ksi |
| Moment Of Inertia: | 184.0 in4 |
| Cross Sectional Area: | 14.1 in2 |
| Number Of Shear Studs: | 0        |

Use Copy Design

Select Column With Properties

Select All Other Columns Used For NS-1, NS-2, EW-1, EW 2

Double Click Right Mouse Key To End Copying Designs

Select Second Floor/ Lower Roof Horizontal Structural Plane

Lateral Analysis

Use Lateral Resistance Design

Select NS-1

Analysis

Units: Feet & Kips
☑ Use Actual Properties
☐ DL=Deck+Self Weight
Wind Lateral Analysis

Lateral Analysis

Connectivity @ Hinge

Repeat For All Supports

Lateral Resistance Verify All Rigid Connections

Yes, Properties Are All Correct

Wind Load Options

Wind Direction: South
When 2 Wind Loads: Max. Suction
Wind Load: GCPi = 0

Flexible Diaphragm @ Simple Beam Model

Rigid Horizontal Diaphragm Calculations
File Name: Rigidout.txt
Consider Perpendicular Wall...

View Loads

Analysis

Analysis File Name: Optional
Yes, The Loads & Connectivity Are Correct

View Shear, Moment, Deflection & Reaction Diagrams

View Output

Print Data
- Rigid Diaphragm
- All Other
- Print To File
- Execute Notepad
Wind Lateral Analysis

Properties: \( w \) (plf), \( A \) (in²), \( E \) (ksi), \( I \) (in⁴)

1.00 Wind (kt) -- NS-1 -- \( r = 32\% \)
Wind Lateral Analysis

1.00 Superimposed dead (kif)

1.00 Dead (kif)
Wind Lateral Analysis

Total Combined Load -- Axial (k)

Total Combined Load -- Shear (k)

Total Combined Load -- Moment (kft)
Wind Lateral Analysis

Total Combined Load -- Deflection

Total Combined Load -- Loads & Reactions (k)
### Rigid Horizontal Diaphragm Calculations

**Center of Rigidity**

<table>
<thead>
<tr>
<th>Name</th>
<th>h (ft)</th>
<th>I (ft^4)</th>
<th>Av Deflection Rigidity R/ (ft)</th>
<th>x (in)</th>
<th>R^x (ft)</th>
<th>sum(R) (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS-1</td>
<td>14.0</td>
<td>0</td>
<td>0</td>
<td>0.101</td>
<td>9.917</td>
<td>32.48%</td>
</tr>
<tr>
<td>NS-2</td>
<td>14.0</td>
<td>0</td>
<td>0</td>
<td>0.101</td>
<td>9.917</td>
<td>32.48%</td>
</tr>
<tr>
<td>NS-3</td>
<td>14.0</td>
<td>0</td>
<td>0</td>
<td>0.093</td>
<td>10.697</td>
<td>35.04%</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Centroid from lower left = \( \frac{\text{sum}(R^x)}{\text{sum}(R)} \) : 45.85 ft

Maximum dimension : 85.67 ft

Eccentricity (e) = centroid-(max dimension)/2 : 3.02 ft

\( e_{\text{min}} = 0.05 \times \text{max. dimension} \) : 4.28 ft

Eccentricity (e) used for torsional analysis : 3.02 ft

\( e_{\text{min}} \) considered only for seismic analysis.

<table>
<thead>
<tr>
<th>Name</th>
<th>h (ft)</th>
<th>I (ft^4)</th>
<th>Av Deflection Rigidity R/ (ft)</th>
<th>x (in)</th>
<th>R^x (ft)</th>
<th>sum(R) (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EW-1</td>
<td>14.0</td>
<td>0</td>
<td>0</td>
<td>0.078</td>
<td>12.795</td>
<td>50.00%</td>
</tr>
<tr>
<td>EW-2</td>
<td>14.0</td>
<td>0</td>
<td>0</td>
<td>0.078</td>
<td>12.793</td>
<td>50.00%</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Centroid from lower left = \( \frac{\text{sum}(R^x)}{\text{sum}(R)} \) : 36.03 ft

Maximum dimension : 73.67 ft

Eccentricity (e) = centroid-(max dimension)/2 : 0.00 ft

\( e_{\text{min}} = 0.05 \times \text{max. dimension} \) : 3.68 ft

Eccentricity (e) used for torsional analysis : 0.00 ft

\( e_{\text{min}} \) considered only for seismic analysis.

### Assumptions used:

Deflections calculated by applying a 1 kip load.

<table>
<thead>
<tr>
<th>Name</th>
<th>h (ft)</th>
<th>Rigidity</th>
<th>dx (ft)</th>
<th>R^*dx</th>
<th>R^<em>dx</em>dx</th>
<th>R^*dx/ (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS-1</td>
<td>14.0</td>
<td>9.917</td>
<td>45.0</td>
<td>466.487</td>
<td>20101.310</td>
<td>0.00641</td>
</tr>
<tr>
<td>NS-2</td>
<td>14.0</td>
<td>9.917</td>
<td>3.0</td>
<td>29.543</td>
<td>88.007</td>
<td>0.00042</td>
</tr>
<tr>
<td>NS-3</td>
<td>14.0</td>
<td>10.697</td>
<td>39.0</td>
<td>416.944</td>
<td>16252.029</td>
<td>0.00599</td>
</tr>
<tr>
<td>EW-1</td>
<td>14.0</td>
<td>12.793</td>
<td>36.0</td>
<td>460.545</td>
<td>16579.613</td>
<td>0.00662</td>
</tr>
<tr>
<td>EW-2</td>
<td>14.0</td>
<td>12.793</td>
<td>36.0</td>
<td>460.545</td>
<td>16579.613</td>
<td>0.00662</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>69600.573</td>
</tr>
</tbody>
</table>

Shear distribution : \( F_v = \frac{V \times R}{\text{sum}(R)} \)

Torsional moment : \( M_t = V \times e \)

Torsional component : \( F_t = M_t \times R^x / \text{sum}(R^x \times dx) \)

Total shear to element: \( F_{\text{total}} = F_v + F_t \)
Calculate Seismic Loads

View Spectral Plots

Print Screen

Close Spectral Plots Dialog Window

Calculate

Review Plan Structural Irregularities

Review Vertical Structural Irregularities

α

Ct=0.035 For Steel Moment Resisting Frames

Beam Self Weight
Estimated Self Weight: 45 plf

Column Self Weight
Estimated Self Weight: 45 plf

Center Of Mass
File Name: Centmass.txt

Seismic
Yes, All The Loads Have Been Applied To The Structure And The Correct Load Combination Selected

View Output

Print Data

- Seismic
- Center Of Mass
- All Other
- Print To File
- Execute Notepad
Seismic Loads

- View Output
- Scroll Output
- Page Setup
  - Left Margin: 0.5 in
  - Right Margin: 0.0 in
- Print File
- Exit Notepad
- End
Seismic Loads
Seismic Loads

Zone: 2A  Z=0.150
Soil Factor: S3  S=1.5
C1  : 0.035
hn  : 28.0 ft

\[ T = C \left( \frac{\ln(t)}{3/4} \right) \]

\[ C = 1.25 \left( \frac{S}{T+2/3} \right) \]

Design Base Shear Coefficient Spectrum
Seismic Loads

Project: Office Building - Scheme A
Location: Radford AAP
Seismic Code: TH S-809-10 1991
Time: Sun Jan 26, 1992 1:40 PM

**************************** Seismic Analysis ****************************

3. Upper Roof: 194.9 k
2. Second Floor/Lower Roof: 686.9 k

Total Building Weight (W): 881.7 k

******************************************************************************* N - S and E - W ***********************************************

Zone: 2A: I = 0.150
Importance Category: IV: I = 1.00
Soil Factor: 63: S = 1.5
System: C3a: Rw = 6
Ct = 0.035
hn = 28.0 ft
T = Ct*hn^3/4 = 0.43 sec
C = 1.25*S/T^2/3 = 3.79 > 2.75
C/Rw = 0.458 > 0.375
W = 881.7 k
V = Z*I*C*V/Rw

\[
V = 60.6 \text{ k}
\]

T < F \text{ / sec}

\[
x^2 = 0.0 \text{ k}
\]

V-Ft = 60.6 k

<table>
<thead>
<tr>
<th>Floor to Sum(F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

Sum 882 15073 1.000 60.6

<table>
<thead>
<tr>
<th>Floor to Sum(F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

Sum 882 1156
**Seismic Loads**

**Project** : Office Building - Scheme A  
**Location** : Radford AAP  
**Time** : Sun Jan 26, 1992 1:40 PM

-----------------------------  
**Center Of Mass**  
-----------------------------

### Upper Roof -- 28.00 ft

<table>
<thead>
<tr>
<th>Name</th>
<th>Weight (k)</th>
<th>NS (ft)</th>
<th>NS*Weight (kft)</th>
<th>EW (ft)</th>
<th>EW*Weight (kft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior Wall</td>
<td>36.9</td>
<td>36.8</td>
<td>1358.9</td>
<td>0.8</td>
<td>30.7</td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>24.6</td>
<td>0.8</td>
<td>20.5</td>
<td>24.8</td>
<td>610.0</td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>36.9</td>
<td>36.8</td>
<td>1358.9</td>
<td>48.8</td>
<td>1801.6</td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>24.6</td>
<td>72.8</td>
<td>1791.4</td>
<td>24.8</td>
<td>446.4</td>
</tr>
<tr>
<td>Upper Roof</td>
<td>49.8</td>
<td>36.8</td>
<td>1033.1</td>
<td>24.8</td>
<td>1235.9</td>
</tr>
<tr>
<td>Beam Self Weight</td>
<td>18.4</td>
<td>36.8</td>
<td>676.3</td>
<td>24.8</td>
<td>455.9</td>
</tr>
<tr>
<td>Column Self Weight</td>
<td>3.8</td>
<td>36.8</td>
<td>139.2</td>
<td>24.8</td>
<td>93.9</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>194.9</td>
<td>7178.2</td>
<td>4839.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N-S Center Of Mass: 36.83 ft  
E-W Center Of Mass: 24.83 ft

### Second Floor/Lower Roof -- 14.00 ft

<table>
<thead>
<tr>
<th>Name</th>
<th>Weight (k)</th>
<th>NS (ft)</th>
<th>NS*Weight (kft)</th>
<th>EW (ft)</th>
<th>EW*Weight (kft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second Floor</td>
<td>72.9</td>
<td>12.8</td>
<td>935.1</td>
<td>24.8</td>
<td>1809.5</td>
</tr>
<tr>
<td>Second Floor</td>
<td>90.7</td>
<td>36.8</td>
<td>2436.5</td>
<td>28.8</td>
<td>7060.8</td>
</tr>
<tr>
<td>Second Floor</td>
<td>72.9</td>
<td>60.8</td>
<td>4522.6</td>
<td>44.8</td>
<td>2029.5</td>
</tr>
<tr>
<td>Lower Roof</td>
<td>123.6</td>
<td>36.8</td>
<td>4554.0</td>
<td>66.8</td>
<td>2042.2</td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>73.8</td>
<td>36.8</td>
<td>2717.8</td>
<td>0.8</td>
<td>65.0</td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>24.6</td>
<td>0.8</td>
<td>20.5</td>
<td>24.8</td>
<td>610.0</td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>36.9</td>
<td>36.8</td>
<td>1358.9</td>
<td>48.8</td>
<td>1801.6</td>
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<td>Exterior Wall</td>
<td>24.6</td>
<td>72.8</td>
<td>1791.4</td>
<td>24.8</td>
<td>446.4</td>
</tr>
<tr>
<td>Parapet</td>
<td>9.9</td>
<td>0.8</td>
<td>8.3</td>
<td>66.8</td>
<td>662.1</td>
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<td>Parapet</td>
<td>19.8</td>
<td>36.8</td>
<td>729.8</td>
<td>84.8</td>
<td>1680.9</td>
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<td>72.8</td>
<td>722.6</td>
<td>66.8</td>
<td>662.1</td>
</tr>
<tr>
<td>Beam Self Weight</td>
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<td>36.8</td>
<td>914.9</td>
<td>36.2</td>
<td>899.9</td>
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<td>Column Self Weight</td>
<td>5.7</td>
<td>36.8</td>
<td>208.8</td>
<td>36.2</td>
<td>2054.4</td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>43.0</td>
<td>0.8</td>
<td>35.9</td>
<td>42.8</td>
<td>1843.6</td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>36.9</td>
<td>36.8</td>
<td>1358.9</td>
<td>84.8</td>
<td>3129.7</td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>43.0</td>
<td>72.8</td>
<td>3134.9</td>
<td>42.8</td>
<td>1843.6</td>
</tr>
<tr>
<td>Column Self Weight</td>
<td>3.8</td>
<td>36.8</td>
<td>139.2</td>
<td>24.8</td>
<td>93.9</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>686.9</td>
<td>25299.0</td>
<td>27738.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N-S Center Of Mass: 36.83 ft  
E-W Center Of Mass: 40.39 ft
Seismic Lateral Analysis

- Start
  - Use Loads & Design Tool Palette
    - Load Combination D+E
      - Use Load Combination
        - Set Factors
          - Dead: 1.0
          - Seismic: 1.0
        - OK Button To Close Dialog Window
          - Highlight D+E in List
    - Define Member Properties
    - Select Second Floor/Lower Roof Horizontal Structural Plane
      - Lateral Analysis
        - Use Lateral Resistance Design
          - Select NS-1
            - Analysis
              - Units: Feet & Kips
              - Use Actual Properties
              - DL=Deck+Self Weight

- OK Button To Close Dialog Window
  - Highlight D+E in List
Draw Structure

1. Draw Upper Roof framing
2. Draw Surface in Bay A1-B2
   - Select Handle On Grid Line B1-B2
   - Double Click Right Mouse Key To End Defining Area
   - Save Surface Element Orientation: E-W
4. Copy Beams & One-Way Surface To Other Bays
   - Copy Structure
   - Select Third Point Beams
   - Select One-Way Surface
   - Double Click Right Mouse Key To End Selecting Structure
   - Select Grid Location A1 As The Base Point
   - Paste Structure
   - Select Grid Locations B1, A2, B2, A3, B3
   - Double Click Right Mouse Key To End
Seismic Lateral Analysis

Properties: w (psf), A (in²), E (ksi), I (in⁴)

1.00 Seismic (kip) -- NS-1 -- F, 32%
Seismic Lateral Analysis

Total Combined Load -- Deflection

Total Combined Load -- Loads & Reactions (k)
Project: Office Building - Scheme A
Location: Radford AAP
Seismic Code: TN 5-609-10 1991
Time: Sun Jan 26, 1992 1:43 PM

Seismic Lateral Resistance Locations

<table>
<thead>
<tr>
<th>Level</th>
<th>F (ft)</th>
<th>Fh (ft)</th>
<th>F (k)</th>
<th>V (k)</th>
<th>OTM (k)</th>
<th>sum(OTM) (kft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>28.0</td>
<td>21.9</td>
<td>21.9</td>
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<th>F (k)</th>
<th>V (k)</th>
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<th>F (ft)</th>
<th>Fh (ft)</th>
<th>F (k)</th>
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</table>
Quantity Take-Off Philosophy

3 Considerations

1. One typical interior bay (exterior side bay, corner bay)

2. One typical floor level and roof level

3. The entire building structural system

Estimated weights are not used for quantity take-offs

Elements designed by Excel spreadsheets are used

Use Modify Design and Copy Design to manually enter element sizes

Calculated square footage can be overridden
Quantity Take-Off

Start

Use Loads & Design Tool Palette

Select Second Floor/Lower Roof Horizontal Structural Plane

Design All Elements To Include In Quantity Take-Off

Design Surface Elements

Use Modify Design

Select A Surface Element On The Second Floor

Design

Material: Steel
Description: Mtl Dk 2"-20ga/NL,W/T 2.5" Weight: 1.99 psf
Concrete Weight: 145.0 pcf
Concrete Weight: 42.0 psf
Depth: 4.5 in

Use Copy Design

Select Surface With Properties

Select All Other Surface Elements On The Second Floor

Double Click Right Mouse Key To End Copying Designs

Design Beam Elements

Use Copy Design
Quantity Take-Off

Design All Elements To Include In Quantity Take-Off

Design Beam Elements

Select Third Point Beam With Properties

Select All Other Third Point Beams

Double Click Right Mouse Key To End Copying Designs

Use Copy Design

Select Girder With Properties

Select All Other Girder

Double Click Right Mouse Key To End Copying Designs

Use Copy Design

Select Interior Column With Properties

Select Other Interior Column

Double Click Right Mouse Key To End Copying Designs
Quantity Take-Off

- Design All Elements To Include In Quantity Take-Off
- Use Modify Design
  - Select Beam C4-D4
  - Delete
  - Repeat For All Elements Supporting Lower Roof

- Override Calculated Square Footage
  - NS: 72'
  - EW: 48'

- View Output
- Scroll Output
- Page Setup
  - Left Margin: 0.5 in
  - Right Margin: 0.0 in
- Print File
- Exit Notepad

End
**Project**: Office Building - Scheme A  
**Location**: Radford AAP  
**Time**: Sun Jan 26, 1992 1:57 PM

---

**Quantity Take-off**

---

**Second Floor/Lower Roof**

Plan Area: 72.0 ft x 48.0 ft: 3456.0 sqft

**STEEL: Narrowly Spaced Elements**

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<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Weight</th>
<th>Element No.</th>
<th>Total Weight</th>
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<tr>
<td></td>
<td>(ft)</td>
<td>(plf)</td>
<td></td>
<td>(lbs)</td>
</tr>
<tr>
<td>W 14 x 48</td>
<td>24.0</td>
<td>48.0</td>
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<td>W 21 x 48</td>
<td>24.0</td>
<td>68.0</td>
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<td>1632.0</td>
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<td>W 16 x 40</td>
<td>24.0</td>
<td>48.0</td>
<td>15</td>
<td>1662.0</td>
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**Total Weight**: 3244.0 lbs

**Weight Per Square Foot**: 9.4 psf

---

**STEEL: Widely Spaced Elements**

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<th>Length</th>
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</tr>
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<tbody>
<tr>
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<td>(ft)</td>
<td>(plf)</td>
<td></td>
<td>(lbs)</td>
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<td>145.0</td>
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<tr>
<td>Mtl Dk 2&quot;-20ga/HLMT 2.5&quot;</td>
<td>4.5</td>
<td>384</td>
<td>2.0</td>
<td>145.0</td>
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**Total Weight**: 5731 lbs

**Concrete Cubic Yards**: 35.0

**Total Weight**: 3.2 tons
## STEEL: Column Elements

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<thead>
<tr>
<th>Description</th>
<th>Weight/Length (ft)</th>
<th>Weight/Element (plf)</th>
<th>Element No. (lbs)</th>
<th>Total Weight (lbs)</th>
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<tbody>
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<td>14.0</td>
<td>48.0</td>
<td>48.0</td>
<td>672.0 10</td>
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<td>W 8 x 28</td>
<td>14.0</td>
<td>28.0</td>
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<tr>
<td></td>
<td>14.0</td>
<td>0.0</td>
<td>0.0</td>
<td>6</td>
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<tr>
<td>Sum</td>
<td></td>
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</table>

Total Weight: 3.8 tons

Weight Per Square Foot: 2.2 psf
Concluding Remarks

Schemes A, B and C were developed to permit exploration and instruction of the broadest possible range of CASM capabilities. The schemes should not be viewed as completely logical structural framing solutions to the given design parameters, nor as necessarily economical. Each of the three schemes contain a variety of elements, which if properly combined and interchanged might produce "real" schemes for consideration at a 35% review.

Examples of unlikely components assembled in schemes A, B and C include: (1) concrete as a decking for the low roof, (2) custom made trusses for the low roof framing, (3) prefabricated limestone wall panels mixed with cast-in-place concrete shear walls, and (4) non-composite steel beam framing for the second floor.

A logical steel framed beam/column solution for "real" consideration would include open web steel joists spanning 48 feet for the upper roof to eliminate a central column in the second floor space. The lower roof would be framed with 36 foot span open web steel joists (without inclusion of custom trusses) as in scheme B. Both roofs would be sheathed with a metal roof deck without concrete and both would become flexible diaphragms. The second floor would be framed with composite steel beams as in scheme B and remain a rigid diaphragm. Two lateral load resistance system options could be compared. One scheme could include a moment resistant frame approach similar to scheme A, while a second approach might incorporate trussing similar to scheme B. The non-loadbearing exterior envelope is open to a variety of possibilities. The Architects will likely dictate the aesthetic expression. The foundation system would be a combination of isolated and linear spread footings.

A third logical solution would be a masonry bearing wall system to support the steel open-web joist roof planes described above. The second floor plane might be constructed of pre-cast pre-stressed hollow cored planks, which would also bear on the walls and a central steel girder line. Some of these walls could become shear walls for lateral load resistance. Thus the exterior envelope and the interior partition provide a structural function, eliminating costly moment connections and columns within the exterior wall layout. Footings are now all linear spread footings with only one isolated footing.

It is unlikely that a reinforced concrete frame would present an economical solution for a 1-2 story office building.

The structural engineers that become proficient with the use of CASM will be able to explore many other ideas to arrive at the most structurally efficient and economical solution for this hypothetical project.
Concluding Remarks

Scheme 1: Moment connections for lateral load resistance

Scheme 2: Trussing for lateral load resistance
Concluding Remarks

24.0 --- 24.0

Resistance Locations

1

Typical Lateral Resistance Locations

2

Typical Lateral Resistance Locations

2

Second Floor

Lower Roof

Upper Roof

Scheme 3. Shear walls for lateral load resistance

8" CMU walls can be used as shear walls

4" Brick Veneer
1" Air Space
1" Rigid Insulation
8" Bearing Wall CMU
Wood Furring & 1/2" Dry Wall
This is one in a series of three manuals designed to instruct in the use of the Computer Aided Structural Modeling (CASM) computer program. The manuals are composed of flowcharts which show step-by-step procedures for executing a broad range of CASM capabilities. CASM is a computer program designed to aid the structural engineer in the preliminary design and evaluation of structural building systems by the use of three-dimensional (3-D) interactive graphics. This manual contains one of three different framing schemes for the same 1-2 story office building. The examples contain a complete range of capabilities to permit framing comparisons, including 3-D geometry modeling, criteria specifications, development of loads (snow, wind, seismic, dead, and live), drawing structural elements, preliminary analysis and design of structural elements, and quantity take-offs.
Concept design example, computer aided structural modeling (CASM) / by David Wickersheimer ... [et al] ; prepared for Department of the Army, US Army Corps of Engineers.

181 p. ; ill. ; 28 cm. — (Instruction report ; ITL-92-3 rept. 1)


TA7 W341 no.ITL-92-3 rept.1
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<td>A Three-Dimensional Finite Element Data Edit Program</td>
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| Instruction Report ITL-87-4 | User's Guide: 2-D Frame Analysis Link Program (LINK2D) | Jun 1987 |
| Technical Report ITL-87-4 | Finite Element Studies of a Horizontally Framed Miter Gate | Aug 1987 |
| Report 1: Initial and Refined Finite Element Models (Phases A, B, and C), Volumes I and II | | |
| Report 2: Simplified Frame Model (Phase D) | | |
| Report 3: Alternate Configuration Miter Gate Finite Element Studies—Open Section | | |
| Report 4: Alternate Configuration Miter Gate Finite Element Studies—Closed Sections | | |
| Report 5: Alternate Configuration Miter Gate Finite Element Studies—Additional Closed Sections | | |
| Report 6: Elastic Buckling of Girders in Horizontally Framed Miter Gates | | |
| Report 7: Application and Summary | | |
| Instruction Report ITL-87-5 | Sliding Stability of Concrete Structures (CSLIDE) | Oct 1987 |
| Instruction Report ITL-87-6 | Criteria Specifications for and Validation of a Computer Program for the Design or Investigation of Horizontally Framed Miter Gates (CMITER) | Dec 1987 |

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