StructurePoint’s Productivity Suite of powerful software tools for reinforced concrete analysis & design

**SPWall**
Finite element analysis & design of reinforced, precast IGF & tilt-up concrete walls

**SPColumn**
Design & investigation of rectangular, round & irregularly shaped concrete column sections

**SPMats**
Finite element analysis & design of reinforced concrete foundations, combined footings or slabs on grade

**SPBeam**
Analysis, design & investigation of reinforced concrete beams & one-way slab systems

**SPSlab**
Analysis, design & investigation of reinforced concrete beams & slab systems
The Industry Standard
Design and investigation of rectangular, round, or irregular concrete sections including slenderness effects
Options

- **Codes:** ACI 318-11/08/05/02  
  CSA A23.3-04/94

- **Units:** English or Metric

- **Run Axis:** X, Y or Biaxial

- **Run Options:** Design or Investigation

- **Slenderness:** Yes or No
Slenderness

**Design Column**
Slenderness related to the column being considered

**Beams**
Slenderness related to beams

**Columns Above and Below**
Slenderness related to columns above and below the design column

**Factors**
Factors that affect slenderness calculations
Reinforcement Options

- Confinement

- Design Criteria

**Confinement**

- Capacity Reduction Factors, $\Phi$
  - Axial compression ($a$): 0.8
  - Tension-controlled failure ($b$): 0.9
  - Compression-controlled failure ($c$): 0.65

**Design Criteria**

- Column Type
  - Structural
  - Architectural
  - User-defined

- Reinforcement Ratio
  - Minimum: 1%
  - Maximum: 8%

- Bar Selection
  - Minimum number of bars
  - Minimum area of steel

- Minimum clear spacing between bars: 1.5 in

- Design/Required ratio: 1
Material Properties

- **Concrete**: $f'_c$, $E_c$, $f_c$, $\beta_1$, and $\varepsilon_c$
- **Steel**: $f_y$ and $E_s$

Precast (CSA only)
Section

Design

- Rectangular:

- Circular:

- Irregular:

Investigation

- Irregular Section Editor
- Import Geometry
Irregular Sections
Irregular Sections
Irregular Sections

Geometry Data:
No_Of_Section_Nodes
Xs1  Ys1
Xs2  Ys2
.
.
Xsn  Ysn
No_Of_Opening_Nodes
Xo1  Yo1
Xo2  Yo2
.
.
Xon  Yon
Reinforcement Design Investigation

- All Sides Equal:
- Equal Spacing:
- Sides Different:
- Irregular:
Irregular Reinforcement
Irregular Reinforcement

Reinforcement Data:
- No. Of. Bars
- A1 X1 Y1
- .
- .
- An Xn Yn
Loads

Factored Loads
Import Data (from text file)
- Geometry
- Reinforcement
- Service loads
- Factored loads

Service Loads
Mandatory for slenderness
Import Data (from text file)
- Geometry
- Reinforcement
- Service loads
- Factored loads

Axial Loads
Uniaxial, short column investigation only

Load Factors
For service loads only

Control Point
Investigation Only
\[
\begin{align*}
\phi P_{n,\text{max}} / 0.85 & \quad \phi P_{n,\text{ma}} \\
f_s & = 0.0 \\
f_s & = f_y / 2 \\
\varepsilon_s & = f_y / E_s \\
\varepsilon_s & = 0.005 \\
P & = 0 \\
\phi P_{n,\text{min}} &
\end{align*}
\]
Factored Loads

Import Data (from text file)
- Geometry
- Reinforcement
- Service loads
- Factored loads

Factored Loads

<table>
<thead>
<tr>
<th>Load</th>
<th>X-Moment</th>
<th>Y-Moment</th>
</tr>
</thead>
<tbody>
<tr>
<td>-120</td>
<td>582</td>
<td>0</td>
</tr>
<tr>
<td>(kip)</td>
<td>(k-ft)</td>
<td>(k-ft)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>P</th>
<th>Mx</th>
<th>My</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
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<td>790</td>
<td>885</td>
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<td>468</td>
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<td>480</td>
<td>-942</td>
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<td>129</td>
<td>0</td>
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<td>190</td>
<td>-132</td>
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<td>-120</td>
<td>-288</td>
<td>0</td>
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<tr>
<td>26</td>
<td>-120</td>
<td>502</td>
<td>0</td>
</tr>
</tbody>
</table>

Insert | Modify | Delete | OK | Cancel
Service Loads
Axial Loads

For non-slender uniaxial loading only
Graphical Results

- **P-M Diagram**
  - $P_{n,max}$
  - $\phi P_{n,max}$
  - $\epsilon_s = \frac{f_y}{E_s}$

- **Mx-My Diagram**
  - $\epsilon_s = 0.005$
  - $P = 0$
  - $P = 500$ kip
Graphical Results

- Nominal Interaction Diagram

**Material:**
- $f_c = 4\, \text{ksi}$
- $f_{cc} = 3605\, \text{ksi}$
- $f_s = 3.4\, \text{ksi}$
- $f_{et} = 0.35$
- $f_y = 60\, \text{ksi}$
- $f_{ys} = 29000\, \text{ksi}$

**Section:**
- $A_g = 3000\, \text{in}^2$
- $I_x = 2.29557\times10^7\, \text{in}^4$
- $I_y = 3.80995\times10^6\, \text{in}^4$
- $X_o = 21.3158\, \text{in}$
- $Y_o = 0\, \text{in}$

**Reinforcement:**
- 50\% bars @ 0.037%
- $A_s = 17.4201\, \text{in}^2$
- Confinement: Tied
- Clear Cover: N/A
- Wrapping Factor: 0.33
Superimposing Diagrams
Text Results

Factored Loads and Moments with Corresponding Capacities:

No. Combo Fk kip Mx Muy PhilMax PhilMuy WA VA depth Dc, depth, sp, t, Phi

1 1 U1 230.00 60.00 61.60 244.60 207.47 4.991 11.75 24.38 0.00326 0.751
2 230.00 -218.40 -67.60 -201.63 -58.70 1.880 14.89 27.22 0.00280 0.698
3 1 U2 640.00 78.00 124.80 136.96 216.90 1.750 19.64 25.51 0.00090 0.650
4 640.00 -264.40 -60.00 -226.00 -58.67 0.828 23.64 27.28 0.00216 0.680
5 1 U3 490.00 66.00 97.00 162.02 209.78 2.490 16.99 26.18 0.00161 0.650
6 490.00 -229.20 -52.80 -264.31 -60.89 1.183 17.41 27.21 0.00169 0.650
7 1 U4 430.00 62.00 122.40 130.12 253.63 2.072 27.13 26.80 0.00171 0.650
8 430.00 -233.30 -55.40 -260.08 -59.78 1.145 17.25 27.13 0.00172 0.650
9 1 U5 970.00 106.50 257.00 --- Pu > Pmax ---
10 970.00 -301.20 -142.40 --- Pu > Pmax ---
11 1 U6 600.00 78.00 137.00 191.76 242.43 1.266 20.22 26.80 0.00096 0.650
12 600.00 -213.40 -120.20 -218.58 -132.02 1.015 20.13 25.80 0.00085 0.650
13 0.00 21.20 1.60 206.46 -242.05 14.466 7.10 23.67 0.00080 0.900
14 0.00 -181.30 6.00 -246.78 9.44 0.940 10.44 25.05 0.00443 0.878
15 1 U8 10.00 23.40 41.40 192.49 -240.56 8.226 9.82 25.44 0.00584 0.900
16 10.00 -267.20 56.90 -255.94 39.66 2.272 20.48 27.09 0.00090 0.888

STRUCTURE Point - spColumn v4.6.0 (TM)
Licensed to: StructurePoint, License ID: 000000-000000-0-000000-20151-20151
C:\Program Files (x86)\StructurePoint\spColumn\Examples\Example11.cel

17 1 U9 -300.00 -10.10 -59.60 -26.22 -250.59 2.596 6.14 26.54 0.01038 0.900
18 -300.00 -88.40 89.00 -173.78 149.87 2.840 4.21 23.28 0.01338 0.900
19 1 U10 720.00 -59.00 154.60 136.31 185.60 1.377 20.61 24.06 0.00050 0.650
20 720.00 -260.20 -17.00 -206.40 -129.25 0.724 23.63 26.28 0.00066 0.650 #
21 1 U11 410.00 65.50 76.60 211.57 247.42 5.280 14.49 24.28 0.00203 0.650
22 410.00 -196.40 -95.60 -262.86 -129.43 1.243 16.20 26.93 0.00199 0.650
23 240.00 -51.00 40.80 158.09 310.06 5.100 13.83 24.89 0.00245 0.728
24 240.00 -175.20 12.20 -206.70 21.61 1.771 14.51 27.07 0.00267 0.702
25 1 U3 -80.00 -2.60 2.40 -263.86 264.02 102.845 6.08 23.28 0.00777 0.900
26 -80.00 -84.40 34.40 -357.08 137.35 3.594 8.80 26.15 0.00595 0.900

# Section capacity exceeded. Revise column!

Pmax = 893.83 kip

*** End of output ***
Batch Mode
CTI Files

Example of a CTI file:

```
#spColumn Text Input (CTI) File
[spColumn Version]
4.600
[Project]
spColumn Manual Example 1
[Column ID]
PCANotes 6.4
[Engineer]
SP
[Investigation Run Flag]
15
[Design Run Flag]
3
[Slenderness Flag]
0
[User options]
0,0,0,0,0,0,0,0,0,0,0,0,1,0,1,1,2,0,5,0,0,0.000000,0,0,12
[Irregular Options]
-2,0,0,1,0.790000,50.000000,50.000000,-50.000000,-50.000000,0.000000,0.000000,5.000000,5.000000
[Files]
0.17
[Investigation Reinforcement]
4,2,0,0,5,0,5,5,1.500000,1.500000,1.500000,1.500000
[Design Reinforcement]
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
```
Options

Two-way systems

One-way systems
Span Data

- Defining Spans
- Span Manipulation

![Span Data Image](image1.png)

![General Information Image](image2.png)
Support Data

- Defining Supports
- Boundary Conditions
Reinforcement

- Design
- Investigation
Loads

Load Combinations

Support Loads and Displacements

Span Loads

StructurePoint

Concrete Software Solutions
Graphical Output

- Loads
- Internal Forces
- Moment Capacity
- Shear Capacity
- Deflections
- Reinforcement

Internal Force Diagrams
Graphical Output

- Loads
- Internal Forces
- Moment Capacity
- Shear Capacity
- Deflections
- Reinforcement

Moment Capacity Diagrams
Graphical Output

- Loads
- Internal Forces
- Moment Capacity
- Shear Capacity
- Deflections
- Reinforcement

Shear Capacity Diagrams
Graphical Output

- Loads
- Internal Forces
- Moment Capacity
- Shear Capacity
- Deflections
- Reinforcement

Deflection Diagram
Text Output

- Input Echo
- Design Results
- Column Forces
- Internal Forces
- Deflections
Analysis, design, and investigation of R/C beams and one-way slab systems
Options

The figure shows screenshots of the General Information window with different tabs and options. The left screenshot has tabs for General Information, Span Control, and Solve Options. The selected tab is General Information. The right screenshot also shows General Information with additional options for Design Options, Span Control, and Solve Options.

- **Design Options**:
  - Live load pattern ratio: 100%
  - Compression Reinforcement:
  - Decremental Rein. Design:
  - Rigid beam-column joint:
  - Moment Redistribution

- **Torsion Analysis and Design**:
  - Torque type: Stirrups in Flanges
  - Equilibrium: No
  - Compatibility: Yes

- **Deflection calculation options**:
  - Sections to use in deflection calculations are:
    - Gross (uncracked)
    - Effective (cracked)
  - In negative moment regions, to calculate & use:
    - Rectangular Section
    - T-Section
  - Calculate long-term deflections:
    - Duration of load: 60 months
    - Sustained part of live load: 0 %

- **Frame**:
  - No. of Supports: 4
  - Left cantilever
  - Right cantilever
  - One-Way/Beam

- **Other**:
  - Distance location as ratio of span

- **Options**:
  - Design code: ACI 318-08
  - Reinforcement: ASTM A615

- **Run mode**:
  - Design
  - Investigation
Moment Redistribution

For ACI 318-08, 05, and 02

\[ \delta = \frac{0, \text{ if } z_{le} < 0.0075}{1000z_{le}, \text{ if } z_{le} \geq 0.0075} \text{ or} \]

For ACI 318-99

\[ \delta = 20 \left( \frac{q - p}{\rho_{pl}} \right), \text{ if } (q - p) > 0.5\rho_{pl} \text{ or} \]

For CSA A23.3

\[ \delta = 30 - 50 \frac{e}{d} \]

Top Reinforcement

<table>
<thead>
<tr>
<th>Span Zone</th>
<th>Width</th>
<th>Max</th>
<th>Max</th>
<th>AxPrime</th>
<th>AdMin</th>
<th>AxMin</th>
<th>SpMin</th>
<th>SpMax</th>
<th>SpSeg</th>
<th>AnSeg</th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>2.08</td>
<td>0.00</td>
<td>0.667</td>
<td>0.000</td>
<td>1.035</td>
<td>0.73</td>
<td>0.000</td>
<td>3-95</td>
<td>*5</td>
<td>*5</td>
<td></td>
</tr>
<tr>
<td>Middle</td>
<td>2.08</td>
<td>2.79</td>
<td>16.450</td>
<td>0.000</td>
<td>1.034</td>
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<td>0.071</td>
<td>3-95</td>
<td>*5</td>
<td>*5</td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>2.08</td>
<td>30.18</td>
<td>28.039</td>
<td>0.000</td>
<td>1.086</td>
<td>9.79</td>
<td>0.706</td>
<td>3-95</td>
<td>*5</td>
<td>*5</td>
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<tr>
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<td>8.79</td>
<td>8.699</td>
<td>0.000</td>
<td>0.984</td>
<td>1.084</td>
<td>9.79</td>
<td>0.071</td>
<td>3-95</td>
<td>*5</td>
<td>*6</td>
</tr>
<tr>
<td>Middle</td>
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<td>8.79</td>
<td>8.699</td>
<td>0.000</td>
<td>0.984</td>
<td>1.084</td>
<td>9.79</td>
<td>0.071</td>
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<td>*5</td>
<td>*6</td>
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<td>1.035</td>
<td>9.79</td>
<td>0.600</td>
<td>3-95</td>
<td>*5</td>
<td>*5</td>
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</tr>
</tbody>
</table>

Notes:
- *5 - Design governed by minimum reinforcement.
- *6 - Number of bars governed by maximum allowable spacing.

Moment Redistribution Factors

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<tr>
<th>Supp</th>
<th>Side</th>
<th>Org.Nr</th>
<th>Iter</th>
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<th>SpMax%</th>
<th>SpMinF</th>
<th>SpMaxF</th>
<th>User</th>
<th>Applied</th>
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</thead>
<tbody>
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Top Reinforcement

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<tr>
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Notes:
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Shear and Torsion
Meshing
Define Properties
Restraints
Defining Loads
Assign
Solution
Contours
Define
Solution
General purpose structural analysis of 2-D and 3-D structures subject to static loads
Creating the Model

![Software Interface]
Applying the Forces
Viewing Results
Call: +1-847-966-4357
Email: info@StructurePoint.org