**123 Engineering**
123 Main Street
Suite 123
My city, My state 12345

# Reduced Beam Section Connection (SMRF)

**Based on FEMA 350 (July 2000)** Serial #: 12345

*Sample Calculation*

**Beam Properties of: W 16x57**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *d:* | 16.4 in. | *Tf:* | 0.715 in. | *Sx:* | 92.2 in³ | *Ix:* | 758 in4 | *Zx:* | 105 in³ | *Rx:* | 6.72 in. |
| *b:* | 7.12 in. | *Tw:* | 0.43 in. | *Sy:* | 12.1 in³ | *Iy:* | 43.1 in4 | *Zy:* | 18.9 in³ | *Ry:* | 1.6 in. |
| *w:* | 57 lb. | | | | | | | | | | |

**Column Properties of: W 14x53**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *d:* | 13.9 in. | *Tf:* | 0.66 in. | *Sx:* | 77.8 in³ | *Ix:* | 541 in4 | *Zx:* | 87.1 in³ | *Rx:* | 5.89 in. |
| *b:* | 8.06 in. | *Tw:* | 0.37 in. | *Sy:* | 14.3 in³ | *Iy:* | 57.7 in4 | *Zy:* | 22 in³ | *Ry:* | 1.92 in. |
| *w:* | 53 lb. | | | | | | | | | | |

**Steel Properties:**

*Steel Grade* **A992 Fy=50 ksi Fu=65 ksi**
*Cpr* **1.15**
*Ry* **1.1**

**Frame Dimensions:**

*Beam Length (Column C/C)* **20.00 ft.**
*Avg. Floor Height* **12.00 ft.**

**RBS Geometry of the Beam:**

a=Beam Flange x 0.60 = **4.25 in.** From 4.272 in.
b=Beam Depth x 0.75 = **12.25 in.** From 12.300 in.
c=Beam Flange x 0.20 = **1.50 in.** From 1.424 in.
*Cutout Radius* = **13.255 in.**
*X (Col. Face to RBS Dimension)* = **10.38 in.**
*L' (RBS-RBS Dimension)* = **17.11 ft.**
*RBS Section Modulus* **59.22 in³**
*RBS Plastic Modulus* **71.36 in³**

**Beam and column parameters**

| | | |
|---|---|---|
| *Beam depth less than 36 inches ?* | *16.4 in.* | **OK** |
| *Beam weight less than 300 pounds ?* | *57 pounds* | **OK** |
| *Beam's span to depth ratio greater than 7 ?* | *13.79* | **OK** |
| *Beam's flange less than 1-3/4 inches thick ?* | *0.715* | **OK** |
| *Mom. capacity of BM's flange less than 0.7xMplastic ?* | *0.76xMplastic* | **OK** |
| *Flange reduction less than 50% of flange width ?* | *57.9% remaining* | **OK** |
| *Column's size W12x or W14x ?* | *W 14x53* | **OK** |
| *Column width less than beam width ?* | *8.06in. vs. 7.12in.* | **OK** |

## Code Checks

*Calculated Values*

| | | | |
|---|---|---|---|
| *Vg* | *25.71 kip* | Shear at the column face from factored gravity loads | (Occurs at the Right side) |
| *Vf* | *71.87 kip* | Shear at the column face | |
| *Vp* | *68.02 kip* | Shear at the RBS | (Occurs at the Right side) |
| *Mf* | *434.9 ft-kip* | Probable plastic moment at the face of the column | |
| *Mc* | *474.3 ft-kip* | Probable plastic moment at the center of the column | |
| *Mpr* | *376.1 ft-kip* | Probable peak plastic hinge moment at RBS | |
| *ds* | *7.58%* | Frame's drift increase factor due to RBS | |

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*Sample Calculation*

*Mf*

| | | | |
|---|---|---|---|
| *Mf* | 434.9 | ft-kip | |
| *Ry Zb Fy* | 481.25 | ft-kip | |
| *Ratio* | 0.904 | | **OK** |

*Doubler Plates*

| | | | |
|---|---|---|---|
| *Srbs* | 59.22 | $in^3$ | |
| *Cy* | 0.72 | | |
| *Ry* | 1.1 | | |
| *t* | 0.561 | in | **FAIL- Doubler plates required** |

*Continuity Plates*

| | | | |
|---|---|---|---|
| *Tcf1* | 1.211 | in | |
| *Tcf2* | 1.187 | in | |
| *Tcf* | 1.187 | in | **FAIL - Continuity plates required** |

*Beam Flange*

| | | |
|---|---|---|
| *bf/2tf* | 3.18 | |
| *52/sqrt(Fy)* | 7.35 | |
| *Ratio* | 0.43 | **OK** |

*Beam Web*

| | | |
|---|---|---|
| *hc/tw* | 34.81 | |
| *418/sq(fy)* | 59.11 | |
| *Ratio* | 0.59 | **OK** |

*Shear capacity of the beam*

| | | | |
|---|---|---|---|
| *Vf* | 71.87 | kip | |
| *Allow. Shear* | 190.40 | kip | |
| *Unity Check* | 0.38 | | **OK** |

*Moment capacity of the beam*

| | | | |
|---|---|---|---|
| *Allow. Moment* | 393.75 | ft-kip | *Actual moment to be less than this amount.* **Check with your frame analysis software.** |

*Moment capacity of the beam at RBS*

| | | | |
|---|---|---|---|
| *Allow. Moment* | 267.60 | ft-kip | *Actual moment at RBS to be less than this amount.* **Check with your frame analysis software.** |

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# Reduced Beam Section Connection (SMRF)

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*Sample Calculation*

## Gravity Loads at Beam

*Distributed Loads*

| *Dead Load* | *Live Load* |
|---|---|
| 1.500 kip/ft | 1.000 kip/ft |
| 0.000 kip/ft | 0.000 kip/ft |
| 0.000 kip/ft | 0.000 kip/ft |

*Point Loads*

| *Dead Load* | *Live Load* | *Location* |
|---|---|---|
| 1.200 kip | 2.300 kip | 13.00 ft |
| 1.500 kip | 2.100 kip | 16.00 ft |
| 0.000 kip | 0.000 kip | 0.00 ft |

## Notes and Assumptions

1- Flexural demand on the girder due to gravity loads is less than about 30% of the girder's capacity.
2- Strong Column - Weak Beam action is not checked.
3- For bracing and other requirements see FEMA 350.