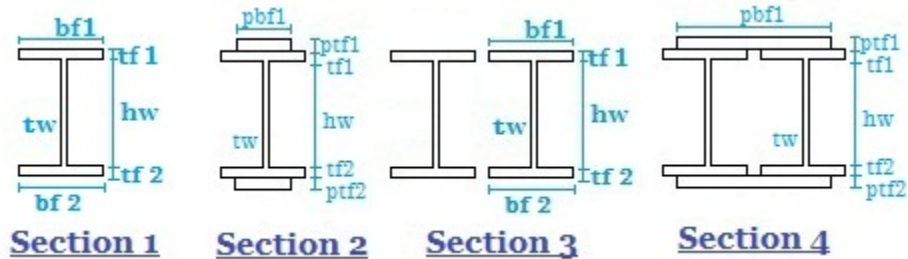


>> IN THE NAME OF GOD <<

Moment-Curvature Analysis Of Four Steel Sections With MATLAB.

This program is written by salar delavar ghashghaei-2015.05.12

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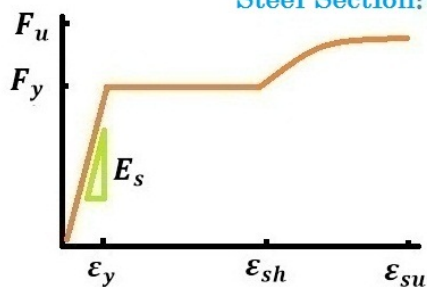
#### Section Properties:

```
tf1=9.2;% [mm] I section thickness on Top flange
bf1=110;% [mm] I section width on Top flange
tw=5.9;% [mm] I section thickness of Web
hw=201.6;% [mm] Height of web
tf2=9.2;% [mm] I section thickness on Bottom flange
bf2=110;% [mm] I section width on Bottom flange
ptf1=10;% [mm] Plate section thickness on Top flange [section 2]
pbf1=90;% [mm] Plate section width on Top flange [section 2]
ptf2=10;% [mm] Plate section thickness on Bottom flange [section 2]
pbf2=90;% [mm] Plate section width on Bottom flange [section 2]
ptf41=10;% [mm] Plate section thickness on Top flange [section 4]
pbf41=150;% [mm] Plate section width on Top flange [section 4]
ptf42=10;% [mm] Plate section thickness on Bottom flange [section 4]
pbf42=150;% [mm] Plate section width on Bottom flange [section 4]
```

#### Steel Section Properties:

### Stress-Strain of materials

Steel Section: Stress-Strain Relationship (Curve strain hardening)



$$\begin{cases} \epsilon_s \leq \epsilon_y & f_s = E_s \epsilon_s \\ \epsilon_y < \epsilon_s \leq \epsilon_{sh} & f_s = F_y \\ \epsilon_{sh} < \epsilon_s \leq \epsilon_{su} & f_s = F_u + (F_u - F_y) \left( \frac{\epsilon_{su} - \epsilon_s}{\epsilon_{su} - \epsilon_{sh}} \right)^2 \end{cases}$$

```
fy =240;% [N/mm^2] Yield strength of steel section
Es =2e5;% [N/mm^2] Modulus of elasticity of steel section
fu=1.5*fy;% Ultimate steel stress
ey=fy/Es;% Yeild steel strain
esh=0.025;% Strain at steel strain-hardening
esu=0.35;% Ultimate steel strain
Esh=(fu-fy)/(esu-esh);
```

#### Analysis Report:

```
#####
# SECTION 1 #
#####
```

(+)Increment 1 : It is converged in 7 iterations - strain: 0.00024 - x: 110.00 - Phi: 0.00218 - Moment: 11.58  
 (+)Increment 2 : It is converged in 1 iterations - strain: 0.00048 - x: 110.00 - Phi: 0.00436 - Moment: 23.15  
 (+)Increment 3 : It is converged in 1 iterations - strain: 0.00072 - x: 110.00 - Phi: 0.00655 - Moment: 34.73  
 (+)Increment 4 : It is converged in 1 iterations - strain: 0.00096 - x: 110.00 - Phi: 0.00873 - Moment: 46.30  
 (+)Increment 5 : It is converged in 1 iterations - strain: 0.00120 - x: 110.00 - Phi: 0.01091 - Moment: 57.88  
 (+)Increment 6 : It is converged in 1 iterations - strain: 0.00500 - x: 110.00 - Phi: 0.04545 - Moment: 65.26  
 (+)Increment 7 : It is converged in 1 iterations - strain: 0.01000 - x: 110.00 - Phi: 0.09091 - Moment: 65.50  
 (+)Increment 8 : It is converged in 1 iterations - strain: 0.01500 - x: 110.00 - Phi: 0.13636 - Moment: 65.55  
 (+)Increment 9 : It is converged in 1 iterations - strain: 0.02000 - x: 110.00 - Phi: 0.18182 - Moment: 65.57  
 (+)Increment 10 : It is converged in 1 iterations - strain: 0.02500 - x: 110.00 - Phi: 0.22727 - Moment: 65.57  
 (+)Increment 11 : It is converged in 1 iterations - strain: 0.07000 - x: 110.00 - Phi: 0.63636 - Moment: 72.60  
 (+)Increment 12 : It is converged in 1 iterations - strain: 0.14000 - x: 110.00 - Phi: 1.27273 - Moment: 82.28  
 (+)Increment 13 : It is converged in 1 iterations - strain: 0.21000 - x: 110.00 - Phi: 1.90909 - Moment: 89.54  
 (+)Increment 14 : It is converged in 1 iterations - strain: 0.28000 - x: 110.00 - Phi: 2.54545 - Moment: 94.33  
 (+)Increment 15 : It is converged in 1 iterations - strain: 0.35000 - x: 110.00 - Phi: 3.18182 - Moment: 96.66

+=====+

= Section 1 curve fitted =

Curvature Moment  
 (1/m) (kN.m)

```
-----
0      0
0.0134 70.8411
3.1818 96.6621
```

+=====+

#####

# SECTION 2 #

#####

(+)Increment 1 : It is converged in 7 iterations - strain: 0.00024 - x: 120.00 - Phi: 0.00200 - Moment: 20.14  
 (+)Increment 2 : It is converged in 1 iterations - strain: 0.00048 - x: 120.00 - Phi: 0.00400 - Moment: 40.28  
 (+)Increment 3 : It is converged in 1 iterations - strain: 0.00072 - x: 120.00 - Phi: 0.00600 - Moment: 60.42  
 (+)Increment 4 : It is converged in 1 iterations - strain: 0.00096 - x: 120.00 - Phi: 0.00800 - Moment: 80.56  
 (+)Increment 5 : It is converged in 1 iterations - strain: 0.00120 - x: 120.00 - Phi: 0.01000 - Moment: 100.70  
 (+)Increment 6 : It is converged in 1 iterations - strain: 0.00500 - x: 120.00 - Phi: 0.04167 - Moment: 114.88  
 (+)Increment 7 : It is converged in 1 iterations - strain: 0.01000 - x: 120.00 - Phi: 0.08333 - Moment: 115.17  
 (+)Increment 8 : It is converged in 1 iterations - strain: 0.01500 - x: 120.00 - Phi: 0.12500 - Moment: 115.22  
 (+)Increment 9 : It is converged in 1 iterations - strain: 0.02000 - x: 120.00 - Phi: 0.16667 - Moment: 115.24  
 (+)Increment 10 : It is converged in 1 iterations - strain: 0.02500 - x: 120.00 - Phi: 0.20833 - Moment: 115.25  
 (+)Increment 11 : It is converged in 1 iterations - strain: 0.07000 - x: 120.00 - Phi: 0.58333 - Moment: 127.39  
 (+)Increment 12 : It is converged in 1 iterations - strain: 0.14000 - x: 120.00 - Phi: 1.16667 - Moment: 144.40  
 (+)Increment 13 : It is converged in 1 iterations - strain: 0.21000 - x: 120.00 - Phi: 1.75000 - Moment: 157.27  
 (+)Increment 14 : It is converged in 1 iterations - strain: 0.28000 - x: 120.00 - Phi: 2.33333 - Moment: 165.95  
 (+)Increment 15 : It is converged in 1 iterations - strain: 0.35000 - x: 120.00 - Phi: 2.91667 - Moment: 170.44

+=====+

= Section 2 curve fitted =

Curvature Moment  
 (1/m) (kN.m)

```
-----
0      0
0.0123 123.9371
2.9167 170.4450
```

+=====+

#####

# SECTION 3 #

#####

(+)Increment 1 : It is converged in 7 iterations - strain: 0.00024 - x: 110.00 - Phi: 0.00218 - Moment: 23.15  
 (+)Increment 2 : It is converged in 1 iterations - strain: 0.00048 - x: 110.00 - Phi: 0.00436 - Moment: 46.30  
 (+)Increment 3 : It is converged in 1 iterations - strain: 0.00072 - x: 110.00 - Phi: 0.00655 - Moment: 69.45  
 (+)Increment 4 : It is converged in 1 iterations - strain: 0.00096 - x: 110.00 - Phi: 0.00873 - Moment: 92.61  
 (+)Increment 5 : It is converged in 1 iterations - strain: 0.00120 - x: 110.00 - Phi: 0.01091 - Moment: 115.76  
 (+)Increment 6 : It is converged in 1 iterations - strain: 0.00500 - x: 110.00 - Phi: 0.04545 - Moment: 130.52  
 (+)Increment 7 : It is converged in 1 iterations - strain: 0.01000 - x: 110.00 - Phi: 0.09091 - Moment: 131.01  
 (+)Increment 8 : It is converged in 1 iterations - strain: 0.01500 - x: 110.00 - Phi: 0.13636 - Moment: 131.10

(+)Increment 9 : It is converged in 1 iterations - strain: 0.02000 - x: 110.00 - Phi: 0.18182 - Moment: 131.13  
 (+)Increment 10 : It is converged in 1 iterations - strain: 0.02500 - x: 110.00 - Phi: 0.22727 - Moment: 131.15  
 (+)Increment 11 : It is converged in 1 iterations - strain: 0.07000 - x: 110.00 - Phi: 0.63636 - Moment: 145.19  
 (+)Increment 12 : It is converged in 1 iterations - strain: 0.14000 - x: 110.00 - Phi: 1.27273 - Moment: 164.56  
 (+)Increment 13 : It is converged in 1 iterations - strain: 0.21000 - x: 110.00 - Phi: 1.90909 - Moment: 179.07  
 (+)Increment 14 : It is converged in 1 iterations - strain: 0.28000 - x: 110.00 - Phi: 2.54545 - Moment: 188.66  
 (+)Increment 15 : It is converged in 1 iterations - strain: 0.35000 - x: 110.00 - Phi: 3.18182 - Moment: 193.32

+=====+

= Section 3 curve fitted =

Curvature (1/m)	Moment (kN.m)
0	0
0.0134	141.6822
3.1818	193.3242

0	0
0.0134	141.6822
3.1818	193.3242

+=====+

#####

# SECTION 4 #

#####

(+)Increment 1 : It is converged in 7 iterations - strain: 0.00024 - x: 120.00 - Phi: 0.00200 - Moment: 37.10  
 (+)Increment 2 : It is converged in 1 iterations - strain: 0.00048 - x: 120.00 - Phi: 0.00400 - Moment: 74.20  
 (+)Increment 3 : It is converged in 1 iterations - strain: 0.00072 - x: 120.00 - Phi: 0.00600 - Moment: 111.31  
 (+)Increment 4 : It is converged in 1 iterations - strain: 0.00096 - x: 120.00 - Phi: 0.00800 - Moment: 148.41  
 (+)Increment 5 : It is converged in 1 iterations - strain: 0.00120 - x: 120.00 - Phi: 0.01000 - Moment: 185.51  
 (+)Increment 6 : It is converged in 1 iterations - strain: 0.00500 - x: 120.00 - Phi: 0.04167 - Moment: 213.19  
 (+)Increment 7 : It is converged in 1 iterations - strain: 0.01000 - x: 120.00 - Phi: 0.08333 - Moment: 213.78  
 (+)Increment 8 : It is converged in 1 iterations - strain: 0.01500 - x: 120.00 - Phi: 0.12500 - Moment: 213.89  
 (+)Increment 9 : It is converged in 1 iterations - strain: 0.02000 - x: 120.00 - Phi: 0.16667 - Moment: 213.92  
 (+)Increment 10 : It is converged in 1 iterations - strain: 0.02500 - x: 120.00 - Phi: 0.20833 - Moment: 213.94  
 (+)Increment 11 : It is converged in 1 iterations - strain: 0.07000 - x: 120.00 - Phi: 0.58333 - Moment: 236.20  
 (+)Increment 12 : It is converged in 1 iterations - strain: 0.14000 - x: 120.00 - Phi: 1.16667 - Moment: 267.62  
 (+)Increment 13 : It is converged in 1 iterations - strain: 0.21000 - x: 120.00 - Phi: 1.75000 - Moment: 291.44  
 (+)Increment 14 : It is converged in 1 iterations - strain: 0.28000 - x: 120.00 - Phi: 2.33333 - Moment: 307.59  
 (+)Increment 15 : It is converged in 1 iterations - strain: 0.35000 - x: 120.00 - Phi: 2.91667 - Moment: 316.07

+=====+

= Section 2 curve fitted =

Curvature (1/m)	Moment (kN.m)
0	0
0.0124	229.6579
2.9167	316.0717

0	0
0.0124	229.6579
2.9167	316.0717

+=====+

+-----+

SECTION 1 - Elastic EI : 5305.54 (kN.m^2)  
 SECTION 1 - Plastic EI : 8.15 (kN.m^2)  
 SECTION 2 - Elastic EI : 10069.54 (kN.m^2)  
 SECTION 2 - Plastic EI : 16.01 (kN.m^2)  
 SECTION 3 - Elastic EI : 10611.08 (kN.m^2)  
 SECTION 3 - Plastic EI : 16.30 (kN.m^2)  
 SECTION 4 - Elastic EI : 18551.08 (kN.m^2)  
 SECTION 4 - Plastic EI : 29.75 (kN.m^2)  
 Steel Material Ductility Rito : 14.00  
 SECTION 1 - Steel Section Ductility Rito : 238.30  
 SECTION 1 - Steel Section Over Strength Factor : 1.36  
 SECTION 2 - Steel Section Ductility Rito : 236.97  
 SECTION 2 - Steel Section Over Strength Factor : 1.38  
 SECTION 3 - Steel Section Ductility Rito : 238.30  
 SECTION 3 - Steel Section Over Strength Factor : 1.36  
 SECTION 4 - Steel Section Ductility Rito : 235.60  
 SECTION 4 - Steel Section Over Strength Factor : 1.38

+-----+

Plotting :

