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|--------------------|----------------------|-----------------|-------------|
| Client: | | Date: | Nov 9, 2020 |
| Author: | Thisuri Weerasinghe | Job #: | |
| Project: | AU Steel Column | Subject: | C1 |
| References: | AS 4100:1998 (R2016) | | |

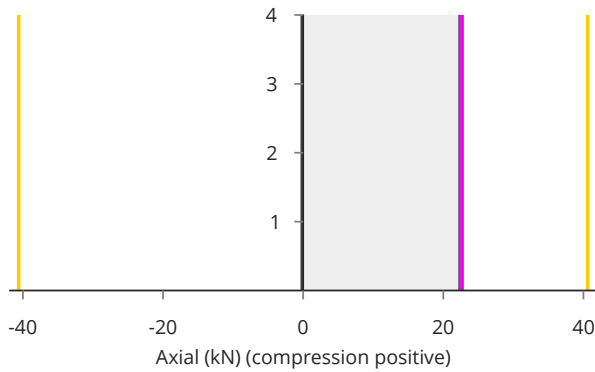
Summary

| | |
|-------------------------------|---------------------------------|
| Compression Demand | $N_c^* = 22.5 \text{ kN}$ |
| 55% Compression Capacity | $\phi N_c = 40.6 \text{ kN}$ |
| 2% Max Short-Term Extension | $\epsilon_s = 0.183 \text{ mm}$ |
| 1% Max Long-Term Extension | $\epsilon_l = 0.115 \text{ mm}$ |
| 1% Max Imposed Load Extension | $\epsilon_Q = 0.112 \text{ mm}$ |

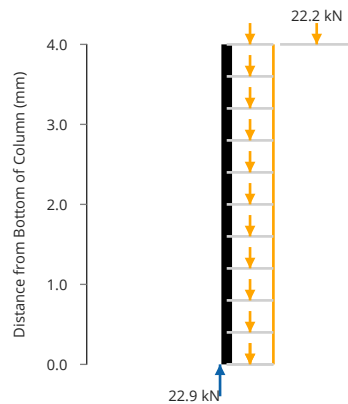
Graphs by Load Case

Graphed Load Case Strength: (1.2G, 1.5Q)
 Show Capacities on Graphs? Yes

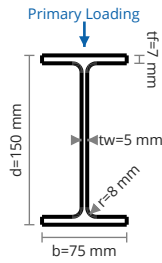
- Load Case: 1.2G, 1.5Q
- Envelope



- Reactions
- Axial Load
- Lateral Load



Key Properties



Member Type 150 UB 14.0 - Gr.300PLUS

Total Column Height $L = 4\,000$ mm

Lateral and Torsional Unbraced and Effective Lengths

$L_{eff} =$

AS 4100:1998, Cl 5.6.3.

| Bracing Type | Unbraced Length l_l (mm) | Effective Length Factor k_e | Effective Length l_e (mm) |
|----------------------------------|----------------------------|-------------------------------|-----------------------------|
| $l_{e,x}$ X-Axis Lateral Bracing | 4 000 | 1 | 4 000 |
| $l_{e,y}$ Y-Axis Lateral Bracing | 4 000 | 1 | 4 000 |
| $l_{e,z}$ Torsional Bracing | 4 000 | 1 | 4 000 |

Position of Supports from Bottom

$r =$

| Support Type | Position z (mm) | Restraint Type |
|---------------------|-------------------|-------------------------------|
| Fixed (Base) | 0 | F: Full (Lateral + Torsional) |
| Roller (Axial Free) | 4 000 | F: Full (Lateral + Torsional) |

Frame Type

Braced

Design Criteria

Deflection Limit Absolute Criterion $\Delta_{max} = 8$ mm

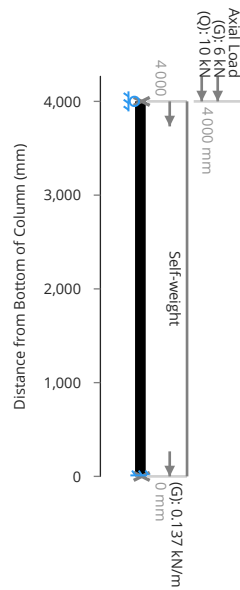
Deflection Limit Span Criterion $D_{lim} =$

| Span Type (Interior or Cantilever) | Short-Term Service $\Delta_{s,lim}$ (L/) | Long-Term Service $\Delta_{l,lim}$ (L/) | Imposed Load Q $\Delta_{Q,lim}$ (L/) |
|------------------------------------|--|---|--------------------------------------|
| Interior Spans | 250 | 250 | 250 |

Extension Limit Absolute Criterion $E_{max} = 10$ mm

Extension Limit Span Criterion $E_{lim} =$

| Span Type (Interior or Cantilever) | Short-Term Service $E_{s,lim}$ (L/) | Long-Term Service $E_{l,lim}$ (L/) | Imposed Load Q $E_{Q,lim}$ (L/) |
|------------------------------------|-------------------------------------|------------------------------------|---------------------------------|
| Interior Spans | 500 | 500 | 500 |



Axial, Point, & Moment Loads

$$N, P, M =$$

| Label | Location z (mm) | Axial Eccentricity e (mm) | Load Magnitudes N, P, M |
|------------|-------------------|-----------------------------|---------------------------|
| Axial Load | 4 000 | 0 | G, Q |

Default Axial Load Eccentricity

Pure Compression

Include Self Weight

Yes

Character of Imposed Load

Floors: Residential and Domestic

AS1170.1, Cl 4.2.2

Wind Loads

Wind Tributary/Load Width

$$LW_{wind} = 450 \text{ mm}$$

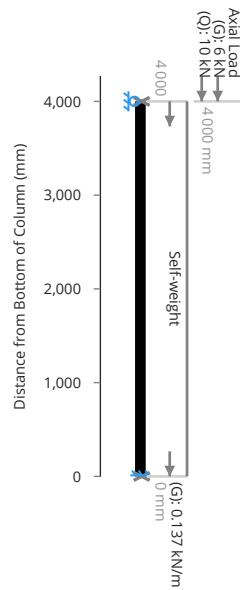
Ultimate Wind Pressure

$$p_u = 0.375 \text{ kN/m}^2$$

Service Wind Pressure

$$p_s = 0.25 \text{ kN/m}^2$$

Y-axis Lateral Design Loads



Member Properties

| | | |
|--|---------------------------------|---------------------------------------|
| Steel Type | Hot-Rolled or Hot-Finished (HR) | AS 4100:1994, Table 5.2 & Table 6.2.4 |
| Total Diameter of Penetrations and Unfilled Fastener Holes in WEB | $d_{h,w} = 35.6$ mm | AS 4100:1998, Cl 7.2 & Cl 9.1.10 |
| Total Diameter of Penetrations and Unfilled Fastener Holes in FLANGE | $d_{h,f} = 10.8$ mm | AS 4100:1998, Cl 7.2 & Cl 9.1.10 |

Load Case Analysis - Axial (AS1170.0)

Strength Load Cases - Vertical

$$LC_{str,V} =$$

| Load Case | Total Vertical Load $\Sigma w_N + \Sigma N$ (kN) | Compression N_c^* (kN) | Tension N_t^* (kN) | Max Vertical Reaction R_v^* (kN) |
|---------------------|--|--------------------------|----------------------|------------------------------------|
| 1.35G | 0 | 8.47 | 8.47 | 8.84 |
| 1.2G, 1.5Q | 0 | 22.5 | 22.5 | 22.9 |
| 1.2G, 1.5Q_lt | 0 | 13.5 | 13.5 | 13.9 |
| 1.2G, Wu_dn, Q_comb | 0 | 11.5 | 11.5 | 11.9 |
| 0.9G, Wu_up | 0 | 5.65 | 5.65 | 5.89 |
| G, Eu, Q_E | 0 | 9.27 | 9.27 | 9.55 |
| 1.2G, Su, Q_comb | 0 | 11.5 | 11.5 | 11.9 |

Short-term Service Load Cases - Vertical

$$LC_{sserv,V} =$$

| Load Case | Total Vertical Load $\Sigma w_N + \Sigma N$ (kN) | Extension E_s (mm) |
|----------------|--|----------------------|
| G, Ws_up | 6.55 | 0.0705 |
| G, Q_st | 16.5 | 0.183 |
| G, Ws_dn, Q_lt | 10.5 | 0.115 |
| G, Es, Q_lt | 10.5 | 0.115 |
| G, Ss, Q_lt | 10.5 | 0.115 |

Long-term Service Load Cases - Vertical $LC_{lserv,V} =$

| Load Case | Total Vertical Load $\Sigma w_n + \Sigma N$ (kN) | Extension E_l (mm) |
|-------------|--|----------------------|
| G | 6.55 | 0.0705 |
| G, Q_lt | 10.5 | 0.115 |
| G, Ss, Q_lt | 10.5 | 0.115 |

Unfactored Load Analysis (AS1170.0)

Unfactored Loads - Vertical $Loads_V =$

| Load Type | Total Vertical Load $\Sigma w_N + \Sigma N$ (kN) | Compression N_c^* (kN) | Tension N_t^* (kN) | Max Vertical Reaction R_z^* (kN) | Short-Term Extension E_s (mm) |
|-----------|--|--------------------------|----------------------|------------------------------------|---------------------------------|
| G | 6.55 | 6.27 | 6.27 | 6.55 | 0.0705 |
| Q | 10 | 10 | 10 | 10 | 0.112 |

Compression Section Capacity (AS 4100:1998, CI 6.2)

Compression Resistance Factor

$$\phi_c = 0.9$$

AS 4100:1998, Table 3.4

Nominal Compression Section Capacity

$$N_s = 570 \text{ kN}$$

AS 4100:1998, CI 6.2.1

Compression Member Capacity (AS 4100:1998, CI 6.3)

Member Capacity

$$N_{c,table} =$$

| Factor λ_n | Factor α_a | Factor λ | Factor η | Factor ξ | Slenderness Reduction Factor α_c | Member Capacity N_c (kN) | Member Utilisation $N_c^*/(\phi N_c)$ |
|--------------------|-------------------|------------------|---------------|--------------|---|----------------------------|---------------------------------------|
| 273 | 7.54 | 273 | 0.845 | 0.601 | 0.0989 | 56.3 | 0.444 |

Compression Member Capacity

$$N_{ce,table} =$$

AS 4600:2018, Eqn 7.2.1.2(1-4) (as referred from AS 4100:1998, CI 6.3.3)

| Span Length l (mm) | Flexural-Torsional Buckling Load N_{oc} (kN) | Slenderness Factor λ_c | Nominal Flexural-Torsional Capacity N_c (kN) | Flexural-Torsional Utilisation $N_c^*/\phi N_c$ | Overall Compression Capacity ϕN_c (kN) | Overall Compression Utilisation $N_c^*/\phi N_c$ |
|----------------------|--|--------------------------------|--|---|--|--|
| 4 000 | 60.5 | 3.07 | 45.1 | 0.555 | 40.6 | 0.555 |

Extension Analysis (AS 4600:2018, CI 2.2.1.3)

Short-Term Extension Per Span

$$\epsilon_{ST} =$$

| Span Length l (mm) | Short-Term Extension ϵ_{ST} (mm) | Short-term Extension Limit $\epsilon_{ST,max}$ (mm) | Extension Utilisation $\epsilon_{ST}/\epsilon_{ST,max}$ |
|----------------------|---|---|---|
| 4 000 | 0.183 | 8 | 0.0229 |
| TOTAL | 0.183 | 8 | 0.0229 |

Long-Term Extension Per Span

$$\epsilon_{LT} =$$

| Span Length l (mm) | Long-Term Extension ϵ_{LT} (mm) | Long-term Extension Limit $\epsilon_{LT,max}$ (mm) | Extension Utilisation $\epsilon_{LT}/\epsilon_{LT,max}$ |
|----------------------|--|--|---|
| 4 000 | 0.115 | 8 | 0.0144 |
| TOTAL | 0.115 | 8 | 0.0144 |

Imposed Load Extension Per Span

$$\epsilon_Q =$$

| Span Length l (mm) | Imposed Load Extension ϵ_{ST} (mm) | Imposed Load Extension Limit $\epsilon_{ST,max}$ (mm) | Extension Utilisation $\epsilon_Q/\epsilon_{Q,max}$ |
|----------------------|---|---|---|
| 4 000 | 0.112 | 8 | 0.014 |
| TOTAL | 0.112 | 8 | 0.014 |

Comments