UDL Beam

Example 1 - rivt Doc

Attn: User Example

proj. 0001

Contents

01.1 Summary

This rivt file example calculates the maximum stress and deflection in a simply supported, uniformly loaded beam. It also serves as an annotated example of a rivt doc with multiple sections that is not part of a report.

The example illustrates the use of some of the most common API functions, commands and tags. Further details are provided in the rivt user manual.

The file may be formatted as a text, PDF or HTML doc by changing the type parameter in the PUBLISH command at the end of each rivt file (Doc-API *rv.D*). Published files are found in the *_published* folder.

01.2 Load Combinations

Table 1: ASCE 7-05 Load Effects (stored: t001-1.csv)

Equation No.	Load Combination
16-1	1.4(D+F)
16-2	1.2(D+F+T) + 1.6(L+H) + 0.5(Lr or S or R)
16-3	1.2(D+F+T) + 1.6(Lr or S or R) + (f1L or 0.8W)

01.3 Loads and Geometry

Successive value definitions are formatted as a table. Variable values are defined with the define operator. The line tag [T] labels and numbers the table.

Table 2: Define Unit Loads

variable	value	[value]	description
D_1	3.80 psf	0.18 kPA	joists DL
D_2	2.10 psf	0.10 kPA	plywood DL
D_3	10.00 psf	0.48 kPA	partitions DL
D_4	3.00 klf	43.78 kN_m	fixed machinery DL
L_1	40.00 psf	1.92 kPA	ASCE7-O5 LL
b_1	10.00 inch	254.00 mm	beam width
h_1	18.00 inch	457.20 mm	beam depth
E_1	29000.00 ksi	199947.96 MPA	modulus of elasticity
Fb_1	20000.00 lb_in2	137.90 MPA	allowable stress

The VALTABLE command reads variable values from a file in the rvsrc folder. The description is used as the table title. The range specifies the starting and ending line to be read from the file (0:0 means all lines).

Table 3: Beam Geometry (rvsrc/beam1.csv)

variable	value	[value]	description
spc_1	2.00 ft	0.61 m	beam spacing

variable	value	[value]	description
spn_1	16.00 ft	4.88 m	beam span

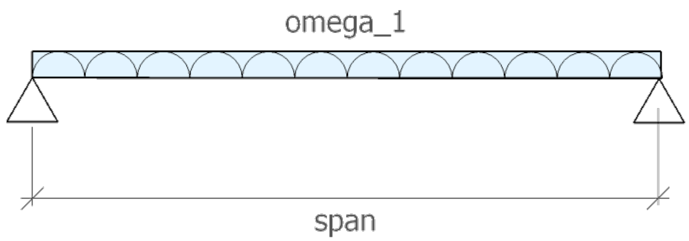

Fig. 1 - Beam Diagram

Uniform Distributed Loads

Eq. 1: Dead load [ASCE7-05 2.3.2]

$$dl_1 = 1.2 \cdot (D_4 + spc_1 \cdot (D_1 + D_2 + D_3))$$

dl_1 = 3.64 klf [dl_1] = 53.09 kN_m | Dead load [ASCE7-05 2.3.2]

D_2	D_1	D_4	D_3	spc_1
2.10 psf	3.80 psf	3.00 klf	10.00 psf	2.00 ft
plywood DL	joists DL	fixed machinery DL	partitions DL	beam spacing

Eq. 2: Live load [ASCE7-05 2.3.2]

$$ll_1 = 1.6 \cdot L_1 \cdot spc_1$$

ll_1 = 0.13 klf [ll_1] = 1.87 kN_m | Live load [ASCE7-05 2.3.2]

spc_1	L_1
2.00 ft	40.00 psf
beam spacing	ASCE7-05 LL

Eq. 3: Total load [ASCE7-05 2.3.2]

$\omega_1 = dl_1 + ll_1$

$\omega_1 = 3.77$ klf [ω_1] = 54.96 kN_m | Total load [ASCE7-05 2.3.2]

ll_1	dl_1
128.00 ft·psf	3.64 klf
Live load [ASCE7-05 2.3.2]	Dead load [ASCE7-05 2.3.2]

01.4 Beam Response

The following lines import the beam geometry from an external file, calculate section properties from imported functions and calculate the maximum moment, bending stress and mid-span deflection.

Table 4: Beam functions (rvsrc/sectprop.py)

Function	Docstring
rectsect(b, d)	section modulus of rectangle
rectinertia(b, d)	moment of inertia of rectangle
midspan_delta(ln, w, e, i)	mid-span deflection of simply supported beam with UDL

Eq. 4: rectangle - S (sectprop.py)

$section_1 = rectsect(b_1, h_1)$

$section_1 = 540.00$ in3 [$section_1$] = 8849.01 cm3 | rectangle - S (sectprop.py)

h_1	b_1
18.00 inch	10.00 inch
beam depth	beam width

Eq. 5: rectangle - I (sectprop.py)

$inertia_1 = rectinertia(b_1, h_1)$

$inertia_1 = 4860.0$ in4 [$inertia_1$] = 202288.5 cm4 | rectangle - I (sectprop.py)

h_1	b_1
18.0 inch	10.0 inch

beam depth	beam width

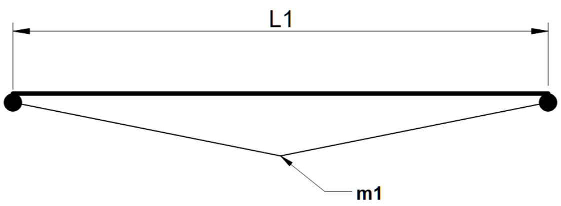

Fig. 2 - Moment diagram

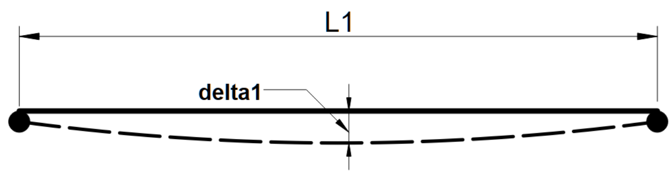

Fig. 3 - Deflection diagram

Eq.6: Maximum bending stress formula

$$\sigma_1 = \frac{M_1}{S_1}$$

Eq. 7: Mid-span UDL moment

$$m_1 = \frac{\omega_1 \cdot spn_1^{2}}{8}$$

m_1 = 120.52 ftkip   [m_1] = 163.40 mkN | Mid-span UDL moment

spn_1	ω_1
16.00 ft	3.77 klf
beam span	Total load [ASCE7-05 2.3.2]

Eq. 8: Bending stress

$$fb_1 = \frac{m_1}{section_1}$$

fb_1 = 2678.2 lb_in2   [fb_1] = 18.5 MPA | Bending stress

m_1	$section_1$
120.5 ft2·klf	540.0 inch3
Mid-span UDL moment	rectangle - S (sectprop.py)

Eq. 9: Stress ratio

$fb_1 < Fb_1$

fb_1	Fb_1	ratio L/R	check	reference
2.68 ksi	20.00 ksi	0.133908	OK	Stress ratio

Eq. 10: mid-span deflection (sectprop.py)

δ_1 = midspan_δ(spn_1, ω_1, E_1, ine ↪

↪ $rtia_1$)

$\delta_1 = 0.04$ inch   [δ_1] = 1.00 mm | mid-span deflection (sectprop.py)

$inertia_1$	spn_1	ω_1	E_1
4860.00 inch4	16.00 ft	3.77 klf	29000.00 ksi
rectangle - I (sectprop.py)	beam span	Total load [ASCE7-05 2.3.2]	modulus of elasticity