

Capacity of I-beam as a cantilever

In considering the capacity of a cantilever I-beam in bending, I looked at the following standards: **AS 4100, BS 5950-1:2000 & SCI publication P360.**

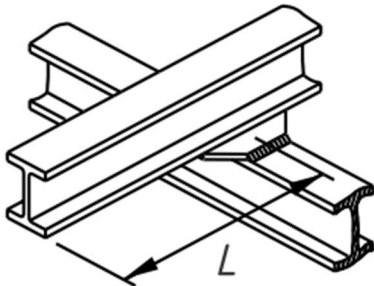
Could anyone shed light on the following questions. Assume case of a cantilever segment extending past another beam, with partial torsional restraint. Diagrams are shown in attachment.

Q1:
Comparing AS 4100 to BS 5950-1:2000 and SCI publication P360, the effective length inferred from AS 4100 is close to a value of 2.0L, whereas in BS it's 5.0L and in P360 it's also 5.0L (2.0 x 2.5). Have I missed something here?

Q2:
On the assumption that BS and P360 (which is supposed to be derived from BS) are the authority, I can't seem to get the same capacity when I crunch the numbers (for 310UC118 with an overhang of 5m) ... maybe an error with calculating slenderness.
Please refer to separate Excel workbook.

This may be of help:
<https://www.steelconstruction.info/images/9/99/AD-408.pdf>

b) Continuous, with partial torsional restraint



EXTRACT: AS 4100

5.6.3 Effective length

The effective length (l_e) of a segment or sub-segment shall be determined as follows:

$$l_e = k_t k_l k_r l$$

where

- k_t = a twist restraint factor given in Table 5.6.3(1)
- k_l = a load height factor given in Table 5.6.3(2)
- k_r = a lateral rotation restraint factor given in Table 5.6.3(3)

TABLE 5.6.3(1)
TWIST RESTRAINT FACTORS (k_t)

Restraint arrangement	Factor , k_t
FF, FL, LL, FU	1.0
FP, PL, PU	$1 + \frac{\left[\left(\frac{d_1}{l}\right)\left(\frac{t_f}{2t_w}\right)^3\right]}{n_w}$
PP	$1 + \frac{\left[2\left(\frac{d_1}{l}\right)\left(\frac{t_f}{2t_w}\right)^3\right]}{n_w}$

TABLE 5.6.3(2)
LOAD HEIGHT FACTORS (k_l) FOR GRAVITY LOADS

Longitudinal position of the load	Restraint arrangement	Load height position	
		Shear centre	Top flange
Within segment	FF, FP, FL, PP, PL, LL	1.0	1.4
	FU, PU	1.0	2.0
At segment end	FF, FP, FL, PP, PL, LL	1.0	1.0
	FU, PU	1.0	2.0

TABLE 5.6.3(3)
LATERAL ROTATION RESTRAINT FACTORS (k_r)

Restraint arrangement	Ends with lateral rotation restraints (see Clause 5.4.3.4)	Factor, k_r
FU, PU	Any	1.0
FF, FP, FL, PP, PL, LL	None	1.0
FF, FP, PP	One	0.85
FF, FP, PP	Both	0.70

EXTRACT: BS 5950-1:2000 & SCI publication P360

Table 14 — Effective length L_E for cantilevers without intermediate restraint

Restraint conditions		Loading conditions	
At support	At tip	Normal	Destabilizing
a) Continuous, with lateral restraint to top flange	1) Free	3.0L	7.5L
	2) Lateral restraint to top flange	2.7L	7.5L
	3) Torsional restraint	2.4L	4.5L
	4) Lateral and torsional restraint	2.1L	3.6L
b) Continuous, with partial torsional restraint	1) Free	2.0L	5.0L
	2) Lateral restraint to top flange	1.8L	5.0L
	3) Torsional restraint	1.6L	3.0L
	4) Lateral and torsional restraint	1.4L	2.4L

RESTRAINT CONDITIONS		k	D
AT SUPPORT	AT TIP*		
a) Continuous, with lateral restraint to top flange	1) Free	3.0	2.5
	2) Lateral restraint to top flange	2.7	2.8
	3) Torsional restraint	2.4	1.9
	4) Lateral and torsional restraint	2.1	1.7
b) Continuous, with partial torsional restraint	1) Free	2.0	2.5
	2) Lateral restraint to top flange	1.8	2.8
	3) Torsional restraint	1.6	1.9
	4) Lateral and torsional restraint	1.4	1.7