

Access Steel Document SX023a-EN-EU

Scia Engineer Version 10.0.86

Introduction

This benchmark concerns the example *SX023a-EN-EU Calculation of effective section properties for a cold-formed lipped channel section in compression* of Access Steel, <http://www.access-steel.com/>, 2005.

This example deals with the effective properties calculation of a cold-formed lipped channel section subjected to compression.



Reference Results

The reference gives following results:

Local Buckling calculation							
Part	\bar{b} [mm]	k_{σ}	$\bar{\lambda}_p$	ρ	b_{eff} [mm]	b_{e1} [mm]	b_{e2} [mm]
Upper Flange	72	4	0,789	0,914	65,8	32,9	32,9
Lower Flange	64	4	0,702	0,978	62,6	31,3	31,3
Upper Fold	19,8	0,5	0,614	1,00	19,8		
Lower Fold	19,8	0,5	0,614	1,00	19,8		
Web	198	4	2,171	0,414	82	41	41

Distortional Buckling calculation – Upper stiffener – Iteration 1	
A_s	103,3 mm ²
I_s	3663 mm ⁴
b_1	61,73 mm
b_2	54,41 mm
h_w	198 mm
k_f	0,97
K	0,331 N/mm ²
σ_{cr}	309 N/mm ²
$\bar{\lambda}_d$	1,064
χ_d	0,701

Distortional Buckling calculation – Lower stiffener – Iteration 1	
A_s	100,2 mm ²
I_s	3618 mm ⁴
K	0,406 N/mm ²
σ_{cr}	350,7 N/mm ²
$\bar{\lambda}_d$	0,999
χ_d	0,748

Distortional Buckling calculation – Upper stiffener – Iteration n	
b_{e1}	32,9 mm
$b_{e2,n}$	36 mm
$c_{eff,n}$	19,8 mm
$\chi_{d,n}$	0,683

Distortional Buckling calculation – Lower stiffener – Iteration n	
b_{e1}	31,3 mm
$b_{e2,n}$	32 mm
$c_{eff,n}$	19,8 mm
$\chi_{d,n}$	0,744

Effective section properties	
A_{eff}	436,8 mm ²

Scia Engineer Results

Result for the initial calculation i.e. without stiffener iterations:

Id	bp [mm]	f1 [N/mm ²]	f2 [N/mm ²]	psi [-]	k [-]	lambda,p [-]	lambda,p,red [-]	rho [-]	be [mm]	be1 [mm]	be2 [mm]	Effective shape
1	19,80	350,000	350,000	1,000	0,500	0,614		1,000	19,80			
2	84,00	350,000	350,000	1,000	4,000	0,702		0,978	82,82	31,31	31,31	
3	198,00	350,000	350,000	1,000	4,000	2,171		0,414	81,98	40,99	40,99	
4	72,00	350,000	350,000	1,000	4,000	0,789		0,914	68,80	32,90	32,90	
5	19,80	350,000	350,000	1,000	0,500	0,614		1,000	19,80			

Id	As [mm ²]	Is [mm ⁴]	b1 [mm]	b2 [mm]	hw [mm]	kf [-]	K [N/mm ²]	sigma,cr [N/mm ²]	lambda,d [-]	Chi,d [-]	As,red [mm ²]
1	100,17	3817,53	54,41	61,73	198,00	1,031	0,398	347,377	1,004	0,744	74,58
5	103,29	3682,97	61,73	54,41	198,00	0,970	0,331	308,986	1,064	0,701	72,35

Result using stiffener iterations:



Id	bp [mm]	f1 [N/mm ²]	f2 [N/mm ²]	psi [-]	k [-]	lambda,p [-]	lambda,p,red [-]	rho [-]	be [mm]	be1 [mm]	be2 [mm]	Effective shape
1	19,80	350,000	350,000	1,000	0,500	0,614	0,528	1,000	19,80			
2	84,00	350,000	350,000	1,000	4,000	0,702	0,604	1,000	84,00	32,00	31,31	
3	198,00	350,000	350,000	1,000	4,000	2,171		0,414	81,98	40,99	40,99	
4	72,00	350,000	350,000	1,000	4,000	0,789	0,857	1,000	72,00	32,90	36,00	
5	19,80	350,000	350,000	1,000	0,500	0,614	0,511	1,000	19,80			

Id	As [mm ²]	Is [mm ⁴]	b1 [mm]	b2 [mm]	hw [mm]	kf [-]	K [N/mm ²]	sigma,cr [N/mm ²]	lambda,d [-]	Chi,d [-]	As,red [mm ²]
1	101,53	3837,63	54,12	60,39	198,00	1,077	0,400	344,211	1,008	0,741	75,23
5	109,37	3744,36	60,39	54,12	198,00	0,928	0,350	303,195	1,074	0,693	75,81

A [mm ²]	Ay [mm ²]	Az [mm ²]	It [mm ⁴]	Iy [mm ⁴]	Iz [mm ⁴]	MLCS [mm ⁴]	ILCS [mm ⁴]	Iw [mm ⁴]	Wely [mm ³]	Welz [mm ³]	Wply [mm ³]	Wplz [mm ³]
437,56	182,57	239,70	486,43	3625147,02	298603,05	3624402,17	299347,91	0,00	38323,40	6297,45	39477,46	9833,94

Comments

- The results correspond to the benchmark results.
- For the distortional buckling calculation (iteration 1) of the lower stiffener, a value of **1,031** for **kf** should be used. The reference uses a value of **0,97**.