Table 5.12 Universal columns subject to axial load and bending, steel grade 43: compression resistance P_{cx}, P_{cy} (kN) and buckling resistance moment M_b (kN m) for effective length L_e (m), and reduced moment capacity M_{rx}, M_{ry} (kN m) for ratios of axial load to axial load capacity F/P_z (abstracted from the *Steelwork Design Guide to BS 5950 Part 1*, published by the Steel Construction Institute)

Designation and capacities	L_e(m) / F/P_z	1.5 / 0.05	2.0 / 0.10	2.5 / 0.15	3.0 / 0.20	3.5 / 0.25	4.0 / 0.30	5.0 / 0.35	6.0 / 0.40	7.0 / 0.45	8.0 / 0.50	9.0 / 0.55	10.0 / 0.60	11.0 / 0.65
203 × 203 × 86	P_{cx}	2920	2870	2810	2750	2680	2610	2450	2260	2040	1810	1580	1370	1190
$P_z = 2920$	P_{cy}	2740	2570	2400	2220	2030	1830	1460	1150	916	740	607	0	0
$M_{cx} = 259$	M_b	259	259	259	253	244	235	220	206	194	182	172	163	155
$M_{cy} = 95$	M_{bs}	259	259	259	259	259	254	233	211	190	168	148	130	115
$p_y Z_y = 79$	M_{rx}	258	253	245	235	221	207	194	180	166	152	138	123	108
	M_{ry}	95	95	95	95	95	95	95	95	95	95	95	90	82
203 × 203 × 71	P_{cx}	2410	2380	2330	2270	2220	2160	2020	1860	1680	1480	1290	1120	970
$P_z = 2410$	P_{cy}	2260	2130	1980	1830	1670	1510	1200	943	750	605	496	0	0
$M_{cx} = 213$	M_b	213	213	213	203	195	187	173	160	149	139	131	123	116
$M_{cy} = 78$	M_{bs}	213	213	213	213	213	207	190	172	154	137	120	106	93
$p_y Z_y = 65$	M_{rx}	211	207	200	191	181	170	158	147	135	124	112	100	88
	M_{ry}	78	78	78	78	78	78	78	78	78	78	78	73	67
203 × 203 × 60	P_{cx}	2080	2040	2000	1950	1900	1850	1730	1580	1400	1230	1060	914	789
$P_z = 2080$	P_{cy}	1940	1820	1700	1560	1410	1270	995	778	615	494	404	0	0
$M_{cx} = 179$	M_b	179	179	176	168	160	152	138	126	116	107	99	92	86
$M_{cy} = 65$	M_{bs}	179	179	179	179	179	173	158	143	127	112	98	85	75
$p_y Z_y = 54$	M_{rx}	178	175	170	162	153	144	134	124	114	105	94	84	74
	M_{ry}	65	65	65	65	65	65	65	65	65	65	65	62	57
203 × 203 × 52	P_{cx}	1830	1790	1750	1710	1670	1620	1510	1370	1220	1070	921	792	683
$P_z = 1830$	P_{cy}	1700	1600	1480	1360	1230	1100	865	676	534	429	351	0	0
$M_{cx} = 156$	M_b	156	156	152	144	137	130	117	106	96	87	80	74	69
$M_{cy} = 57$	M_{bs}	156	156	156	156	156	150	137	124	110	96	84	74	64
$p_y Z_y = 47$	M_{rx}	155	152	148	141	133	125	116	108	99	90	81	73	64
	M_{ry}	57	57	57	57	57	57	57	57	57	57	57	54	49
203 × 203 × 46	P_{cx}	1620	1580	1550	1510	1470	1430	1330	1210	1070	934	804	691	595
$P_z = 1620$	P_{cy}	1500	1410	1310	1200	1080	968	757	590	465	374	305	0	0
$M_{cx} = 137$	M_b	137	137	132	125	118	111	99	88	79	72	66	60	56
$M_{cy} = 49$	M_{bs}	137	137	137	137	137	131	120	108	95	83	73	64	55
$p_y Z_y = 41$	M_{rx}	136	133	129	124	116	109	102	94	86	79	71	63	55
	M_{ry}	49	49	49	49	49	49	49	49	49	49	49	47	43
152 × 152 × 37	P_{cx}	1280	1240	1210	1160	1110	1060	928	783	647	532	441	369	312
$P_z = 1300$	P_{cy}	1140	1030	910	787	671	568	411	306	0	0	0	0	0
$M_{cx} = 85$	M_b	85	82	77	72	68	64	57	52	47	43	39	36	34
$M_{cy} = 30$	M_{bs}	85	85	85	82	77	72	62	52	44	37	31	26	22
$p_y Z_y = 25$	M_{rx}	84	83	81	77	73	68	64	59	54	50	45	40	35
	M_{ry}	30	30	30	30	30	30	30	30	30	30	30	29	26
152 × 152 × 30	P_{cx}	1030	1000	969	933	893	847	740	622	512	420	347	290	246
$P_z = 1050$	P_{cy}	914	825	727	627	533	450	325	241	0	0	0	0	0
$M_{cx} = 67$	M_b	67	64	60	56	52	48	42	37	33	30	27	25	23
$M_{cy} = 24$	M_{bs}	67	67	67	65	61	57	49	41	34	28	24	20	17
$p_y Z_y = 20$	M_{rx}	67	66	64	61	58	54	51	47	43	39	35	32	28
	M_{ry}	24	24	24	24	24	24	24	24	24	24	24	23	21
152 × 152 × 23	P_{cx}	802	777	751	722	688	650	560	465	379	310	255	213	180
$P_z = 820$	P_{cy}	706	632	552	472	397	334	239	177	0	0	0	0	0
$M_{cx} = 45$	M_b	50	47	43	39	36	33	28	24	21	19	17	15	14
$M_{cy} = 14$	M_{bs}	50	50	50	47	44	41	35	29	24	20	17	14	12
$p_y Z_y = 14$	M_{rx}	50	49	48	46	44	41	38	35	33	30	27	24	21
	M_{ry}	17	17	17	17	17	17	17	17	17	17	17	17	16

F is factored axial load.

M_b is obtained using an equivalent slenderness $= nuvL_e/r$ with $n = 1.0$.

M_{bs} is obtained using an equivalent slenderness $= 0.5L/r$.

Values have not been given for P_{cx} and P_{cy} if the values of slenderness are greater than 180.

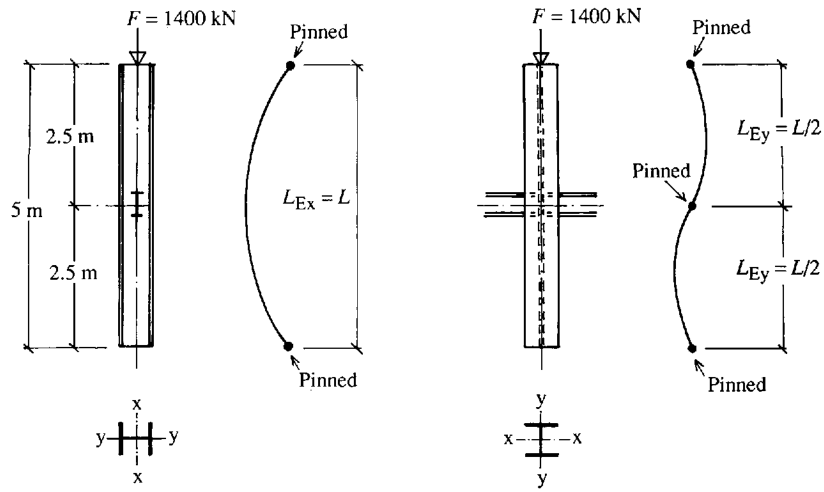

Figure 5.32 *Column load and effective lengths*

is halved. The effective height about the x–x axis will be unchanged. Thus

Effective length $L_{Ex} = 1.0L = 5000\,\text{mm}$

Effective length $L_{Ey} = \frac{L}{2} = \frac{5000}{2} = 2500\,\text{mm}$

It is again necessary to assume a trial section for checking: try 203 × 203 × 52 kg/m UC. The relevant properties from section tables are as follows:

Flange thickness $T = 12.5\,\text{mm}$
Area $A_g = 66.4\,\text{cm}^2 = 66.4 \times 10^2\,\text{mm}^2$
Radius of gyration $r_x = 8.9\,\text{cm} = 89\,\text{mm}$
Radius of gyration $r_y = 5.16\,\text{cm} = 51.6\,\text{mm}$

Here $T = 12.5\,\text{mm} < 16\,\text{mm}$, and therefore $p_y = 275\,\text{N/mm}^2$. The slenderness values are given by

$$\lambda_x = \frac{L_{Ex}}{r_x} = \frac{5000}{89} = 56 < 180$$