

quikEC3 is a unique program which addresses the need for simple, effective and low-cost software for steel design to EN-1993-1 (EC3). It is based on the popular MERLIN package which first introduced the concept of the 'electronic blue book'. Extensive research and development has produced an everyday practical tool which is also a powerful aid to learning the Eurocode. All the more difficult Eurocode concepts have been incorporated to ensure that it offers a comprehensive and versatile solution capable of addressing a wide range of section profiles.

Fundamental to the operation of quikEC3 is its set of steel tables (shown right). We provide UK, EC, USA and Japanese sections but the user can add simple and compound sections of his own. All relevant EC3 properties are calculated and presented in familiar looking tables. quikEC3 handles the widest range of section shapes you will find - a complete list is overleaf. Useful 'tool-tips' compare BS5950 and EC3 terminology aiding the transition to the new code.

But it doesn't stop there. Just click the 'Class' tab and input an axial force. The section classification and effective properties are immediately calculated. Click the 'Y capacity' tab, add shear and moment - the major axis capacity checks are carried out. Work through the remaining tabs adding any additional data and you will have a complete set of calculations. Loop backwards and forwards trying 'What if' scenarios - it's all very, very fast.

The output calculations are detailed, very clear and fully annotated with EC3 clause references. Ideally suited to the EC3 training environment, they're also very checking Engineer friendly.

- **Electronic steel tables to EN-1993-1**
Comprehensive and extendable steel tables including compound and custom sections. UK, EC, USA and Japanese sections included.
- **Ideal Training Tool for EN-1993-1 design**
Cross-references between BS5950 and EN-1993-1 terminology. Detailed section capacity checks with fully annotated calculations.
- **Section Classifications and effective properties**
Includes class3 (semi-compact) and class4 (slender) for a wide range of section shapes.
- **Detailed Section Checks**
Capacity, axial, moment, shear, buckling, LT buckling and combined checks
- **Very Clear Output**
Fully detailed calculations output showing equations used and EN1993-1 clause references.

To evaluate quikEC3, please visit our website at www.gtscad.com or call the number below for a free CD. The evaluation software is time limited but is otherwise fully functional. Take a look at the other programs in the QUIKSOFT library: QUIKFRAME xp - graphical frame analysis with optional steel and timber design, QUIKPORT xp - the ultimate portal program, QUIKJOINT - the most comprehensive connections program, QUIKBEAM - the project-based steel beam program and MERLIN - a BS5950 version of quikEC3.

GTS CADBUILD Limited

Woodbrook House, 30 Bridge Street, Loughborough, Leics LE11 1NH
Tel: 01509 260559 Fax: 01509 269221 Email: sales@gtscad.com

EN-1993-1 quik EC3

Serial	Type	Mass	Cost	h	b	Iw	If	Root r	Toe r	d
886x254x40UB	UB	140.1	112.06	683.5	253.7	12.4	19.0	15.2	0.0	615.1
886x254x25UB	UB	125.2	100.15	677.9	253.0	11.7	16.2	15.2	0.0	615.1
610x305x238UB	UB	238.1	190.49	635.6	311.4	18.4	31.4	16.5	0.0	540.0
610x305x179UB	UB	179.0	143.24	630.2	307.1	14.1	23.6	16.5	0.0	540.0
610x305x149UB	UB	149.2	119.35	612.4	304.8	11.8	19.7	16.5	0.0	540.0
610x229x400UB	UB	139.9	111.91	617.2	230.2	13.1	22.1	12.7	0.0	547.6
610x229x250UB	UB	125.1	100.07	612.2	229.0	11.9	19.6	12.7	0.0	547.6
610x229x113UB	UB	113.0	90.40	607.6	228.2	11.1	17.3	12.7	0.0	547.6
610x229x101UB	UB	101.2	80.96	602.6	227.6	10.5	14.8	12.7	0.0	547.6
533x210x220UB	UB	122.0	97.59	544.5	211.9	12.7	21.3	12.7	0.0	476.5
533x210x109UB	UB	109.0	87.21	539.5	210.8	11.6	18.8	12.7	0.0	476.5
533x210x101UB	UB	101.0	80.80	536.7	210.0	10.8	17.4	12.7	0.0	476.5

The steel tables

Input

Section : 457x191x82UB $f_y = 275 \text{ N/mm}^2$

$N_{Ed} = 2000.00 \text{ kN}$ Compression

$M_{Ed} = 25.00 \text{ kN.m}$ Y axis bending moment

$M_{Ed} = 0.00 \text{ kN.m}$ Z axis bending moment

$L_{cr} = 2.500$ Y axis buckling length

$L_{cr} = 2.500$ Z axis buckling length

$L_{cr} = 2.500$ Buckling length for torsional buckling

Flexural buckling - Y axis $\lambda = 1.3$

$N_{cr} = \pi^2 E I_{yy} / L_{cr}^2 = \pi^2 \cdot 210 \times 37050 \times 10^4 / 2500^2 = 122869.40 \text{ kN}$

$\lambda = \sqrt{N_{Ed} / N_{cr}} = \sqrt{2000 / 122869.40} = 0.15$

From Figure 6.4 using: $\lambda = 0.15$ and buckling curve 'b' (see Table 6.2)

$\chi = 1.000$

$N_{b,Ed} = \chi A_{eff} f_{yEd} = 1.000 \times 101 \times 275 \times 0.1 / \gamma_{M2} = 2781.68 \text{ kN}$

$N_{Ed} = 2000.00 \text{ kN}$

$N_{b,Ed} = 0.72 \text{ Pass}$ (6.46)

Strut capacity screen

Input

Section : 457x191x82UB $f_y = 275 \text{ N/mm}^2$

$N_{Ed} = 2000.00 \text{ kN}$ Compression

$M_{y,Ed} = 25.00 \text{ kN.m}$ Major axis bending moment

$M_{z,Ed} = 0.00 \text{ kN.m}$ Minor axis bending moment

Combined bending and axial compression

$$\frac{N_{Ed}}{\chi_y N_{b,Ed}} + K_{y1} \frac{M_{y,Ed} + \Delta M_{y,Ed}}{\chi_{T1} M_{y,Rd}} + K_{y2} \frac{M_{z,Ed} + \Delta M_{z,Ed}}{M_{z,Rd}} < 1.00 \quad (6.61)$$

$$\frac{N_{Ed}}{\chi_z N_{b,Ed}} + K_{z1} \frac{M_{y,Ed} + \Delta M_{y,Ed}}{\chi_{T1} M_{y,Rd}} + K_{z2} \frac{M_{z,Ed} + \Delta M_{z,Ed}}{M_{z,Rd}} < 1.00 \quad (6.62)$$

Combined buckling screen

Full Technical Details overleaf



Scope

quikEC3 is a program which calculates section properties of common structural steel shapes and presents these properties in conventional tabular form, i.e. as a set of steel tables. Using these properties and working in accordance with EN-1993-1 (EC3), it then carries out a series of section capacity checks (detailed below) thus forming a simple but effective steel design tool. Fully detailed calculation output makes the program eminently suitable for Engineers wishing to prepare for the imminent introduction of EC3 in the UK. The program will link to future EC3 versions of the QUIKFRAME, QUIKPORT, QUIKJOINT and QUIKBEAM programs.

Applicable Code

EN-1993-1, UK National Annex

Units

Metric SI only

Grades of Steel

S275, S355, S460, User defined

Types of Section



Supplied Steel Tables

British standard sections:

UB, UC, RSJ, UBP, HF-CHS, HF-SHS, HF-RHS, CF-CHS, CF-SHS, CF-RHS, RSA, TEE (from UB/UC), 2-RSC (compound channels), 2-RSA (compound angles), PFC, 2-PFC (compound PF channels), ASB (asymmetric beams), SFB (Slimflor beams), UB/PFC (Gantry Girders)

Euronorm parallel flange beams:

Euro HE, HL, HD, HP, IPE

American sections to ASTM specifications:

American W Shapes in accordance with ASTM A6/A6M

Japanese sections:

Japanese wide flange shapes

Custom Steel Tables

The user can create any number of custom sections and section table files. Sections can be totally new sections of the supported shapes (above) or based on existing sections. Sections can be combined to form compound/built-up sections.

Kickstart your EC3 transition now!

quikEC3 is only £65 per copy +vat (5x for £295, 10x for £550. Site licences on request)
 To order, call our Sales Hotline on 01509 260559 or download from www.gtscad.com.
 If you're not ready for EC3 yet, why not look at **MERLIN**, our BS5950 program

Section checks

Section classifications for axial, y bending, z bending: (for non-symmetrical sections, classification is carried out for either top, bottom, left or right of section in compression depending upon section orientation).

Calculation of effective section properties for class4 (slender) sections including any shift in neutral axis.

Section capacity checks: axial tension, axial compression, moment, low shear, high shear, moment and shear, moment with axial, moment axial and shear for both Y and Z axis bending. *Class 1, 2, 3 and 4 (slender) sections are covered.*

Combined axial, X moment and Y moment capacity checks.

Example Calculation Output

Compression	
$N_{c,Rd} = A_{eff} f / \gamma_{M0}$	= 2781.68 kN. (6.11)
$\frac{N_{Ed}}{N_{c,Rd}}$	= 0.72 Pass (6.9)
Moment capacity - Y axis	
$M_{y,Rd} = W_{el,y,lim} f_y / \gamma_{M0}$	(6.15)
	= 443.01 kN.m.
$\frac{M_{y,Ed}}{M_{y,Rd}}$	= 0.06 Pass (6.12)
Combined capacity 6.2.3.2) (6.44)	
$\frac{N_{Ed}}{A_{eff} f / \gamma_{M0}} + \frac{M_{y,Ed} + N_{Ed} e_{Ny}}{W_{el,y,lim} f_y / \gamma_{M0}} + \frac{M_{z,Ed} + N_{Ed} e_{Nz}}{W_{el,z,lim} f_y / \gamma_{M0}} < 1.00$	
$\frac{2000.00}{101.2 \times 275 \times 0.1 / 1.00} + \frac{25.00 + 2000.00 \times 0.00}{1611 \times 275 \times 0.1 / 1.00} + \frac{0.00 + 2000.00 \times 0.00}{195.6 \times 275 \times 0.00}$	= 0.72
Flexural buckling - Z axis 6.3.1.3	
$N_{b,Rd} = \pi^2 E I_{zz} / \lambda^2 = \pi^2 210 \times 1871 \times 10^4 / 2500^2$	= 6204.02 kN.
$\bar{\lambda} = \sqrt{(A_{eff} f_y / N_{b,Rd})} = \sqrt{(101 \times 275 \times 0.1 / 6204.02)}$	= 0.67
From Figure 6.4 using $\bar{\lambda} = 0.67$ and buckling curve 'c' (See Table 6.2)	
$\chi = 0.743$	
$N_{b,Rd} = \chi A_{eff} f_y / \gamma_{M0} = 0.743 \times 101 \times 275 \times 0.1 / \gamma_{M0}$	= 2067.93 kN
$\frac{N_{Ed}}{N_{b,Rd}}$	= 0.97 Pass (6.46)
Torsional and torsional-flexural buckling 6.3.1.4	
Torsional buckling	
$N_{b,T} = \pi^2 (G I_t + \pi^2 E I_w / L_{b,T}^2)$	
$I_t^2 = i_y^2 + i_z^2 + y_p^2 + z_p^2 = 188^2 + 42.3^2 + 0.000^2 + 0.000^2$	= 37253 mm ⁴
$N_{b,T} = \pi^2 / 37253 (81 \times 69.21 \times 10^4 + \pi^2 \times 210 \times 0.9220 \times 10^7 / 2500^2)$	= 9712.57 kN.
Torsional-flexural buckling	
$N_{b,T*} = \frac{N_{b,T}}{28} (1 + N_{b,T} / N_{Ed}) - \sqrt{(1 - N_{b,T} / N_{Ed})^2 + 4(y_p / i_y)^2 N_{b,T} / N_{Ed}}$	
$N_{b,T} / N_{Ed} = 9712.67 / 122889.40$	= 0.08
$(y_p / i_y)^2 = (0.000 / 122889.40)$	
$\beta = 1 - (y_p / i_y)^2$	= 2 x 1.00
$N_{b,T*} = 122889.40$	
$\frac{N_{Ed}}{N_{b,T*}}$	= 0.13 Pass (6.50)
Calculate the elastic critical moment for lateral-torsional buckling Use formula for doubly symmetrical sections. See Access Steel SMO03a-EN/EU	
L = 8.000 m.	Length between restraints
C ₁ = 1.000	Factor depending upon bending diagram shape
C ₂ = 1.000	Factor depending upon bending diagram shape
k _z = 1.00	Factor covering end rotation on plan
k _z = 1.00	Factor related to end warping
z _a = 0.0 mm.	Distance from load application to centroid +ve above, -ve below
i _z = 1871 cm ² .	Second moment of area about minor axis
I _w = 69.21 cm ⁴ .	Torsional constant
I _w = 0.9220 dm ⁴ .	Warping constant
z _p = 0.0 mm.	Distance from load application to shear centre +ve above, -ve below. Note: Shear centre and centroid coincide
$M_{cr} = C_1 \frac{\pi^2 E I_z}{(k_z L)^2} \left(\sqrt{(k_z I_w)^2 I_w / I_z + (k_z L)^2 G I_w / (\pi^2 E I_z)} + (C_2 z_p)^2 \right) - (C_2 z_p)$	
$M_{cr} = 228.16$ kN.m.	
Lateral torsional buckling	
W _{pl,y} = W _{el,y}	Class 4 cross section
$M_{b,Rd} = 228.16$ kN.m.	Access Steel SMO03a-EN/EU
$\bar{\lambda}_{LT} = \sqrt{(W_{pl,y} / M_{cr})} = \sqrt{(1611 \times 275 \times 0.001 / 228.16)}$	= 1.393
Using Equation (6.57) $\bar{\lambda}_{LT} = 1.393$ and buckling curve 'c' (Filled sections or equivalent welded)	
$\chi_{LT} = 0.432$	
$M_{b,Rd} = \chi_{LT} W_{pl,y} f_y / \gamma_{M0} = 0.432 \times 1611 \times 275 \times 0.001 / \gamma_{M0}$	= 191.48 kN.
$\frac{M_{y,Ed}}{M_{b,Rd}}$	= 0.13 Pass (6.50)
$\frac{M_{z,Ed}}{M_{b,Rd}}$	
Combined bending and axial compression Method 1 - Calculate interaction factors k ₀₁ Annex A	
Elastic cross-section properties class 3, class 4	
Equivalent uniform moment factor - C _{m1} Table A.2	



GTS CADBUILD Limited
 Woodbrook House, 30 Bridge Street, Loughborough, Leics LE11 1NH
 Tel: 01509 260559 Fax: 01509 269221 Email: sales@gtscad.com