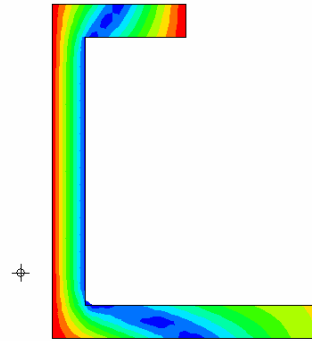
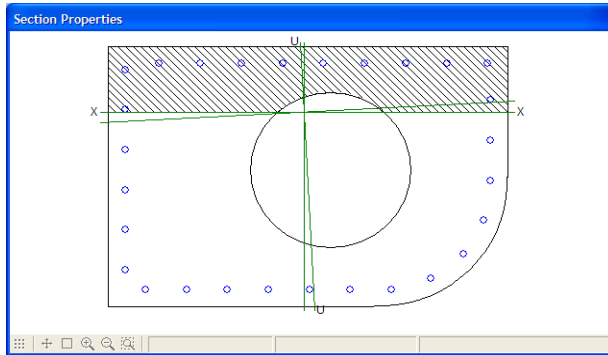


Section Property Modules for Eurocodes: S.01_{EN} and S.06_{EN}



This is a set of two modules for general calculation of section properties, with special emphasis on the properties required by civil engineering structures

S.01_{EN} – Section properties for any section

S.06_{EN} – Torsion & Shear properties for any section

The section outline, voids, reinforcement and material properties are all defined in module S.01_{EN}, which then calculates section properties necessary for civil engineering structures.

Module S.01_{EN} is the basic building block of the Sam suite, because the sections it defines are used for code checking of reinforced and prestressed concrete sections, and for defining cross sections of beams, which in turn are used to define longitudinal and transverse members of bridge decks.

Module S.06_{EN} calculates the torsion constant "C" using Prandtl's membrane analogy solved using finite difference equations. It is particularly powerful as it allows for continuous edges, as well as catering for any number of voids. It also calculates the shear properties.

National Annexes may be selected within the program. Alternatively the Nationally Determined Parameters can be altered by the user.

There are several benefits to these modules:

- ⇒ All numeric data is displayed graphically where possible, so that many errors of data entry are immediately obvious.
- ⇒ All results are displayed graphically, so that tables of numbers become meaningful pictures of results.
- ⇒ The modules use the same section data, so that changing between modules is completely seamless.
- ⇒ Wherever possible a mimic of an engineer's hand calculations are created, in order to allow the user to see why and how results are calculated. This allows the user to check the program, and to develop confidence in using it, as well as conforming to many quality standards that require a hard copy of the design calculations.

Module Specifications S.01_{EN} – Section properties for any section

Data Generation tools

- Graphical section generator containing shape libraries for:
 - Parametric shapes:
 - Rectangle, Circle, Annulus, Voided Slab, H, I, L, T, U, X, Z
 - Regular polygons
 - Standard pre-cast concrete beams:
 - Comprehensive libraries for UK, USA and Australian ranges.
 - Standard steel sections:
 - Comprehensive libraries for European (Arcelor) UK (BS4 and BS EN), USA (AISC), Australian (BHP) and Japanese ranges.
- Graphical section definer for sections comprising straight lines and arcs (no maximum number of nodes).
- Graphical section editor for building complex sections comprising unlimited number of individual shapes.
- Graphical reinforcement generator with unlimited number of reinforcing bars and pre-stressing strands and tendons.
- Definition of tendon forces for use in module S.04.
- Graphical material properties definition from the following libraries:
 - Concrete with stress-strain relationship parabola-rectangle, bi-linear, or rectangular as EN 1992-1-1 clause 3.1.7
 - Reinforcement with stress-strain relationship with horizontal top or inclined top as EN 1992-1-1 clause 3.2.7
 - Pre-stress tendons with stress-strain relationship with horizontal top or inclined top as EN 1992-1-1 clause 3.3.6
 - Includes facilities for user defined partial factors for materials, E values and stress limitations.
 - User defined stress/strain relationships
- Section, bar and tendon data may be imported and/or exported using ASCII text files.

Basic Calculations

- Section property calculations for:
 - area – cross section area
 - iyy, izz – second moments of area
 - iuu, ivv – ditto about principal axes
 - alpha – angle from global axes to principal axes
 - iyz – product moment of inertia
 - ybar, zbar – centroid coordinates
- (For torsion and shear properties see module S.06_{EN})
- The above properties are calculated for:
 - gross section
 - transformed section (to any E value)
 - cracked section with tension reinforcement only
 - cracked section with all reinforcement
 - plastic section
- Printer set-up for printing output for all modules
- Page heading set-up for printed and graphical output for all modules.
- Create user defined title block with user defined logo
- Add user notes to data file
- Option for changing units for input and output for all modules

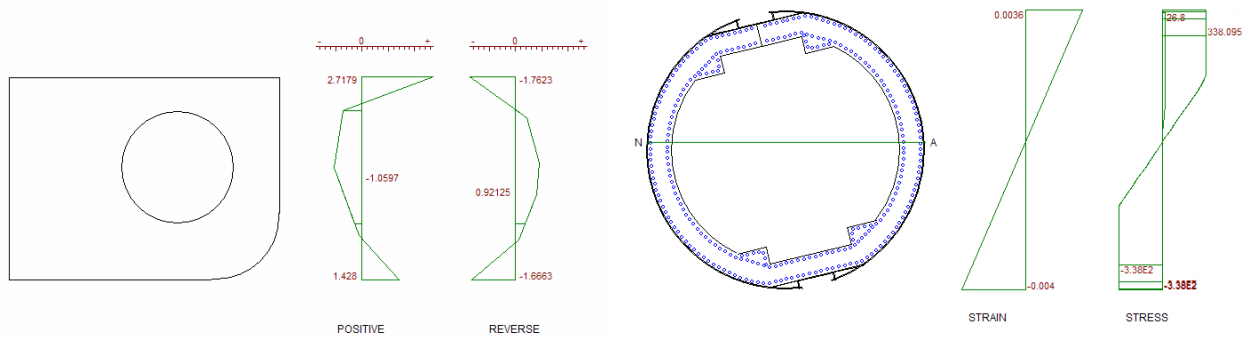
Beam Module Calculations

When used in conjunction with module B.01_{EN}, B.03_{EN}, B.04_{EN} or B.05_{EN} this module also includes the necessary section property calculations. Within the beam modules, the differential temperature analysis of module S.02_{EN} is also included as part of this module.

Module Specifications S.06_{EN} – Torsion and Shear properties for any section

- For sections defined using module S.01_{EN}:
 - Calculation of the torsion constant "C" using Prandtl's membrane analogy solved using finite difference equations.
 - Calculation of the maximum torsion stress.
 - Calculation of the shear centre, shear area and maximum shear stress.
 - For sections comprising more than one element, the same E value must be assumed for the whole of the section.
 - The section may include any number of voids subject to the limitations of module S.01_{EN}, except for shear calculations, where no voids are permitted.
- The defined section may have sides designated as "continuous", for example, break lines within a continuous slab.

Section Design Modules for Eurocodes: S.02_{EN} and S.04_{EN}



This is a set of two modules for code checking reinforced concrete sections

S.02_{EN} – Differential temperature analysis

S.04_{EN} – Design and assessment of concrete sections to EN 1992-1-1 & EN 1992-2

The section outline, voids, reinforcement and material properties are all defined in module S.01_{EN}.

These modules are used to enter actions (F), and to determine the effects of these actions (E) on the section.

S.02_{EN} uses differential temperature gradient profiles to calculate relaxing moments and forces and self-equilibrating stresses.

S.04_{EN} uses strain compatibility to calculate the stresses and strains in the section arising from moments applied about the Y and Z axes, and applied axial action. It also calculates the available moment or axial resistance. Crack width calculations are performed where appropriate.

National Annexes may be selected within the program. Alternatively the Nationally Determined Parameters can be altered by the user.

There are several benefits to these modules:

- ⇒ All numeric data is displayed graphically where possible, so that many errors of data entry are immediately obvious.
- ⇒ All results are displayed graphically, so that tables of numbers become meaningful pictures of results.
- ⇒ The graphical results for strain and stress profiles enable the engineering behaviour of sections to be more readily understood.
- ⇒ The modules use the same section data, so that changing between modules, changing actions and changing section outlines is completely seamless.
- ⇒ Interaction diagrams of moment and axial resistance are easily generated.
- ⇒ Wherever possible a mimic of an engineer's hand calculations are created, in order to allow the user to see why and how results are calculated. This allows the user to check the program, and to develop confidence in using it, as well as conforming to many quality standards that require a hard copy of the design calculations.

Module Specifications S.02_{EN} – Differential temperature analysis for any section

- For sections defined using module S.01_{EN}:
 - Differential Temperature action generated for:
 - EN 1991-1-5 Linear Temperature profile
 - EN 1991-1-5 Non-Linear Temperature profile
 - Any temperature profile that can be defined by up to 20 temperatures within the depth of the section.
 - Calculation of relaxing moments and self equilibrating stresses, using the method as described by Hambly ["Bridge Deck Behaviour", 2nd Edition, E & F N Spon, 1991].
- The calculations can be set to either ignore or include any reinforcement present

Module Specifications S.04_{EN} – Design and assessment of concrete sections

- For sections defined using module S.01_{EN} comprising concrete with reinforcement and/or pre-stressed tendons:
 - EN 1992-1-1 & EN 1992-2 Ultimate Limit state analysis to clause 6.1 for bending.
 - EN 1992-1-1 & EN 1992-2 Ultimate Limit state analysis to clause 6.2 for shear.
 - EN 1992-1-1 & EN 1992-2 Serviceability Limit state stress limitation analysis to clause 7.2 for the Characteristic, Frequent or Quasi-Permanent combination of actions.
 - EN 1992-1-1 & EN 1992-2 Serviceability Limit state crack control calculation to clause 7.3.
- Action definition for the stress analysis may be any combination of axial load, bending about the global Y axis, bending about the global Z axis, applied strain plane.
- Any number of loading cases may be defined for a single section data set.
- Action definition for the crack control calculation may be as for the stress limitation analysis, except that applied strains may only be included where they do not affect the neutral axis angle when combined with the other actions.
- The applied strain plane action may be applied to any individual element of the section, thus enabling staged construction to be analysed.
- Action definition options may be used to:
 - Specify M_y and/or M_z and/or N to calculate stresses and strains
 - Specify V_y and V_z to calculate shear reinforcement requirements in accordance with clause 6.2 and 9.2.2.
 - Find design resistance for section for
 - M_y or M_z or N; $-M_y$ or $-M_z$; M_z and M_y
 - N and M_y or N and M_z
 - Specify some actions as first option, and find additional actions as second option, which will load the section to its design resistance
- Fully detailed hand calculation style output is produced for the crack control and shear calculations.
- Interaction curves may be plotted for any combination of axial load N, and moments M_y , M_z
- Material stress/strain relationships, strengths and partial factors are user controlled parameters.