SCADA Pro™ 18
Structural Analysis & Design

User's Manual
COMPOSITE SLABS DESIGN

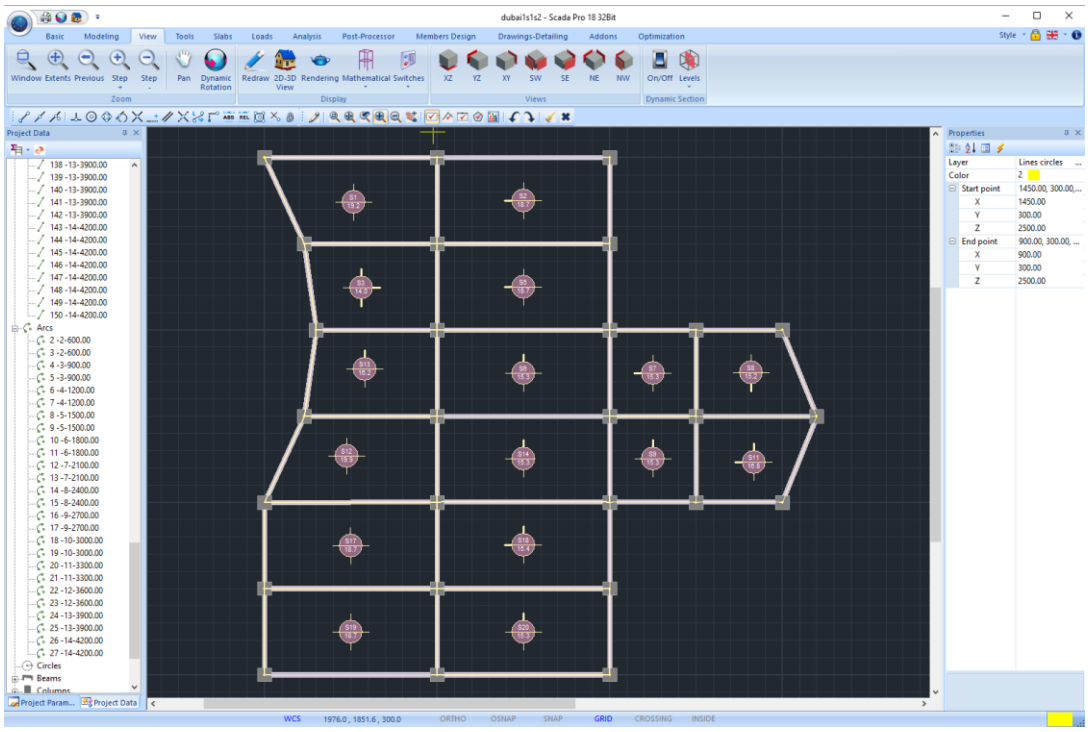
ACE HELLAS
INTEGRATED SOLUTIONS

CONTENTS

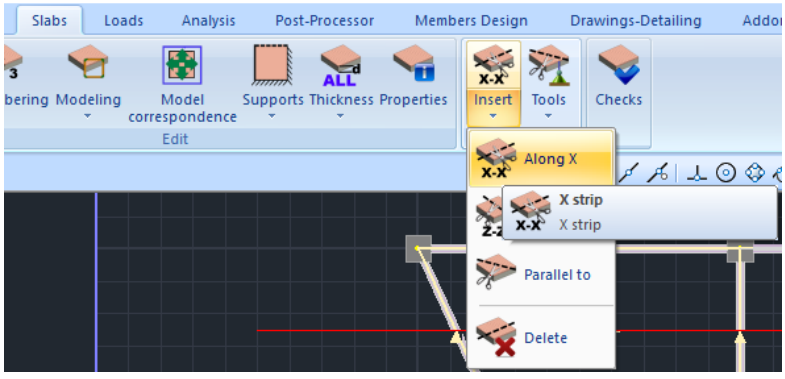
1. INTRODUCTION

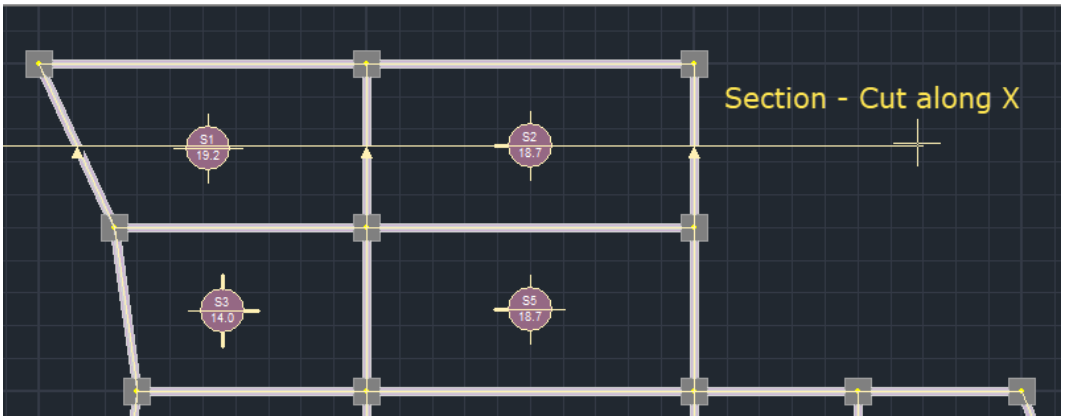
The design of composite slabs includes the design of the composite slab in the construction stage and the design of the composite slab in the operation stage after the concrete coagulation.
In the construction phase, the profiled steel sheeting act as a metal-type for the wet concrete and reinforcement of the slab. Sometimes it is necessary to use temporary support (propping), which is considered in the design as intermediate support. In this case, the profiled steel sheeting is designed to bear its own weight, the weight of the wet concrete and the construction loads associated with the slab manufacturing process.

In SCADA Pro, choose to view the project by level.

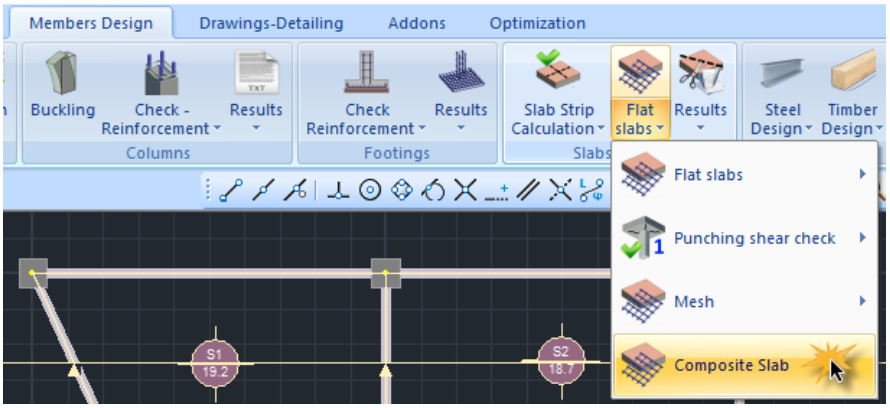


Select Tab “Slabs”, field “Strips”, button “Insert” and select the command “Insert Along X» and then draw the section cut of the slab.

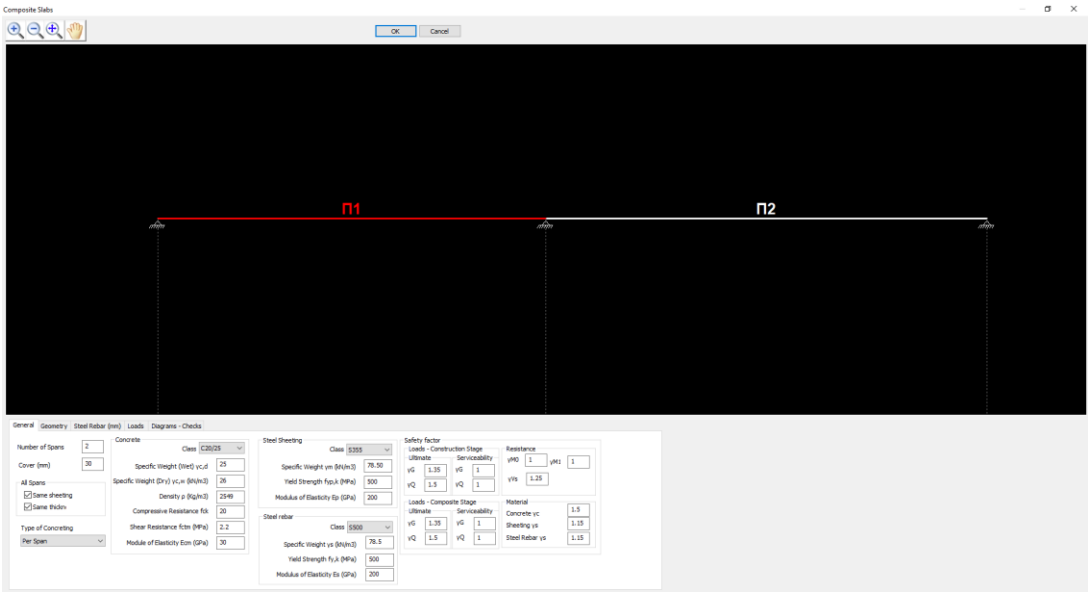




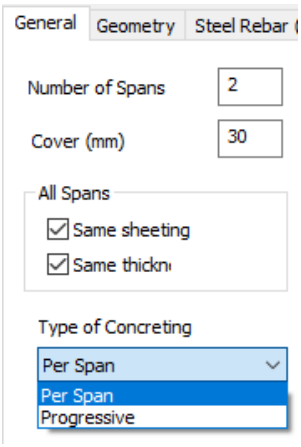
The section cut cuts the slab into two spans. To open the Composite Slab Editor, select the Tab "Members Design", "Slabs", "Flat Slabs", and "Composite Slabs".



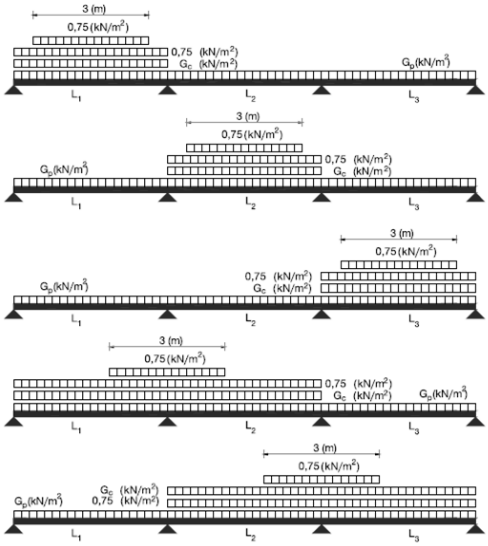
Then select the section cut and right click to open the Composite Slab Editor with 2-span display П1and П2.



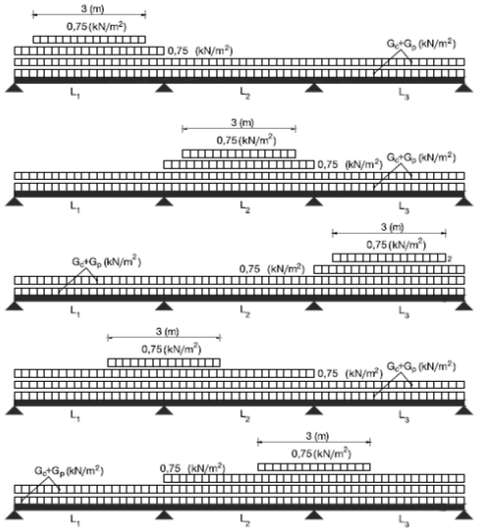
2. GENERAL PARAMETERS



The first form introduces general parameters such as the modification of the number of spans, the concrete cover and the choice that the type of profiled steel sheeting and the thickness of the concrete slab is common to each span. The way of concreting “Per Span” or “Progressive” is also specified.

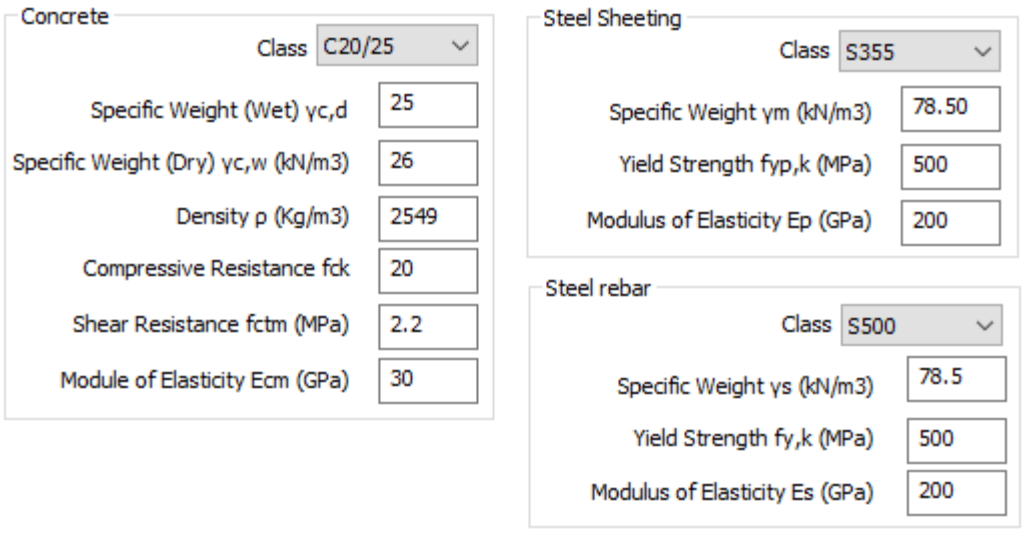


Concreting Per Span

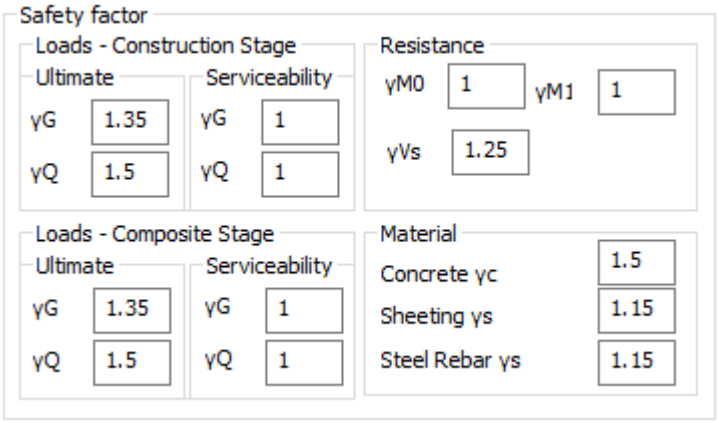


Progressive Concreting

In the rest form, the input is information about the materials used for the composite slab, such as wet and dry concrete, the structural steel of profiled steel sheeting and reinforcing steel.

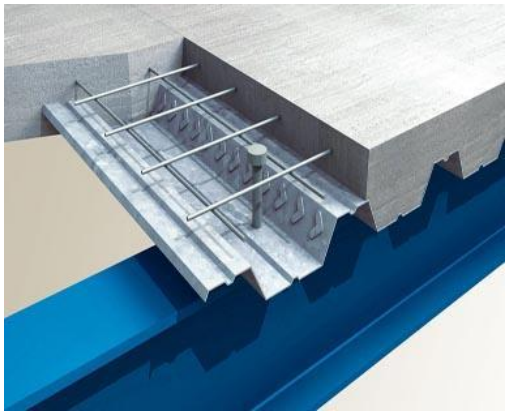


The last field of the form introduces the safety factors for actions and strengths in the construction stage and the composite stage as well as the safety factors of the materials.

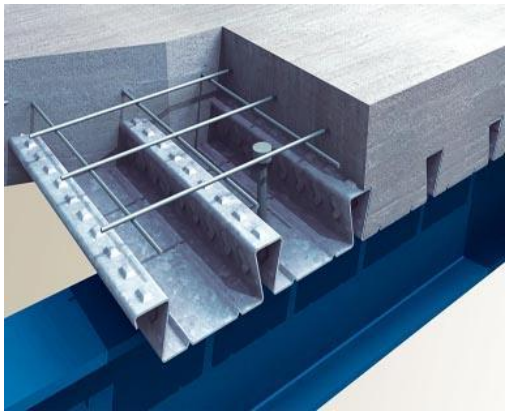


3. PROFILED STEEL SHEETING CROSS-SECTIONS

The types of profiled steel sheeting used for composite slabs are re-entrant sheetings with or without stiffeners, trapezoidal sheeting with embossments or stiffeners and deep decking sheeitngs. In the SCADA Pro, a library of 240 re-entrant and trapezoidal profiled steel sheetings has been integrated with and without embossments or stiffeners.

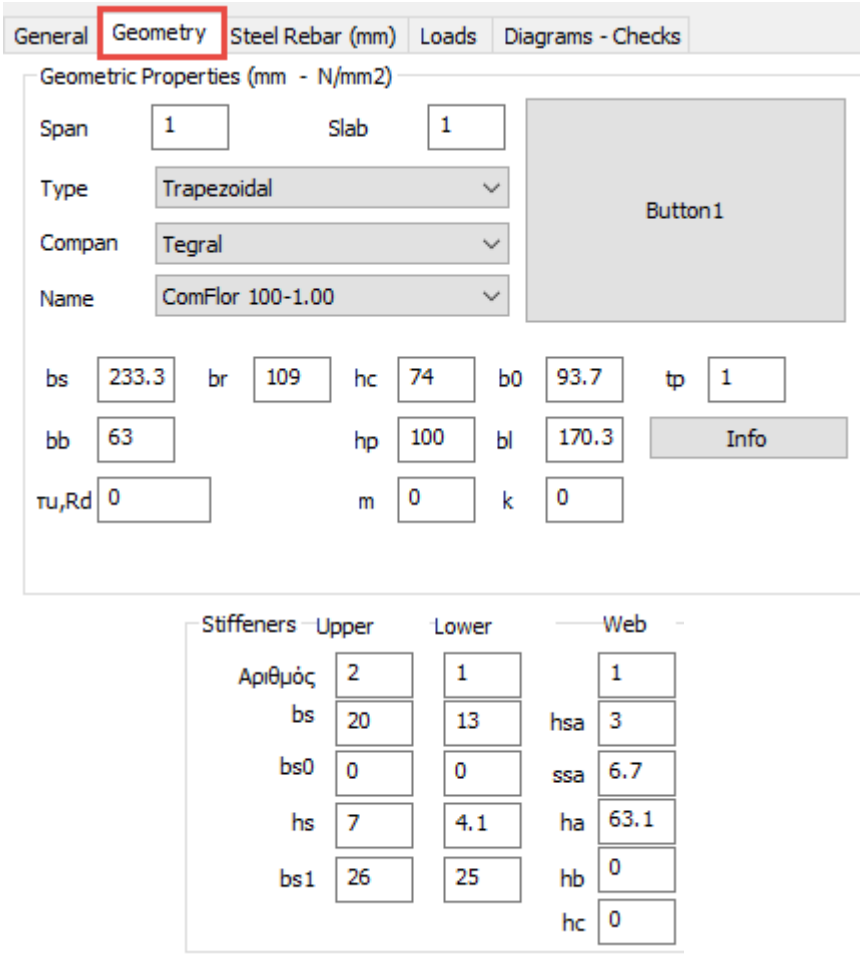


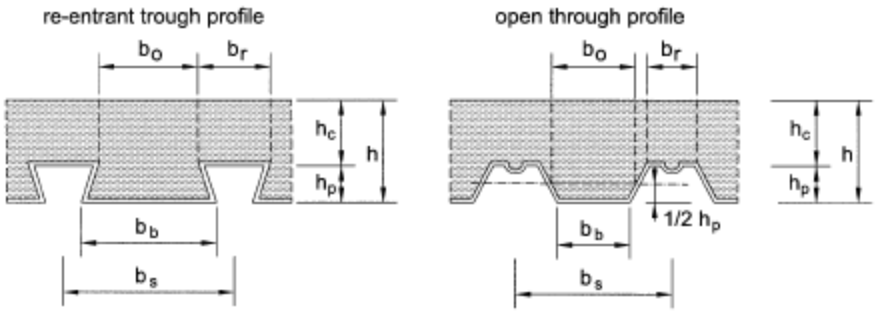
Trapezoidal Profile



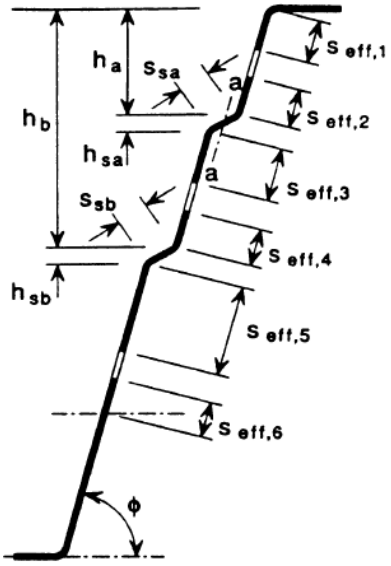
Re-entrant Profile

In the Geometry, form select the profiled steel sheeting from the library per span and modify the geometry if necessary. In particular, in the first field of the form, the dimensions of the profiled steel sheeting are introduced, as shown in the following figures for each type of steel sheeting, also the thickness of the concrete slab hc. Parameters m, k, $t_{u, RD\ was}$ given by the manufacturers are used in the longitudinal shear check of the composite slab and are characteristic of each steel sheeting.

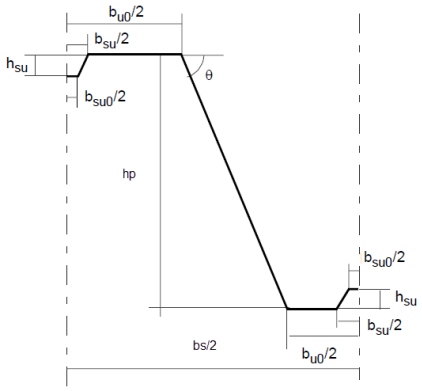




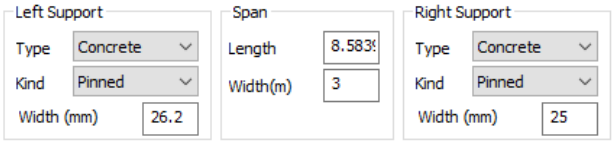
Re-entrant and trapezoidal sheeting dimensions



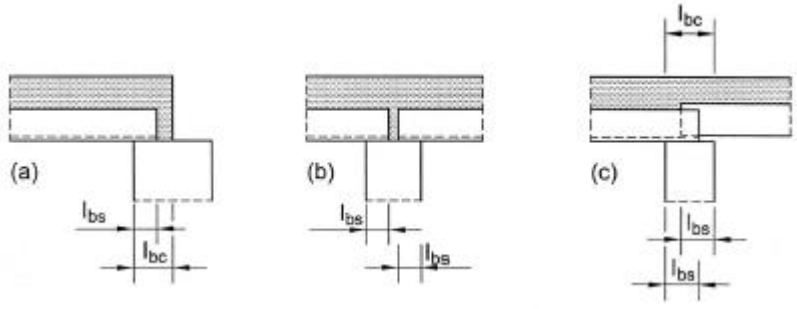
Dimensions of stiffeners in web

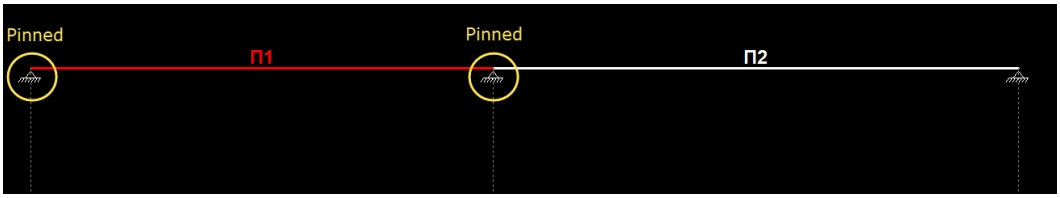


Dimensions of stiffeners in upper and lower flange



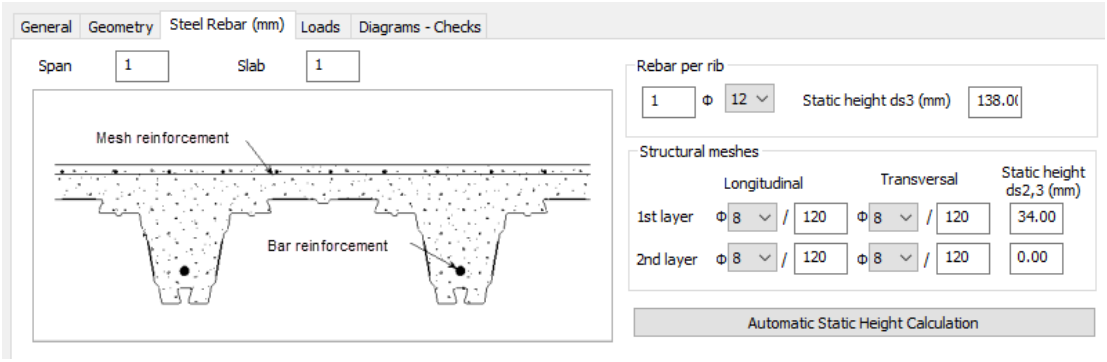
In the Geometry form, also, the support conditions and the width of the supports values are defined based on paragraph 9.2.3 of EN 1994-1-1.

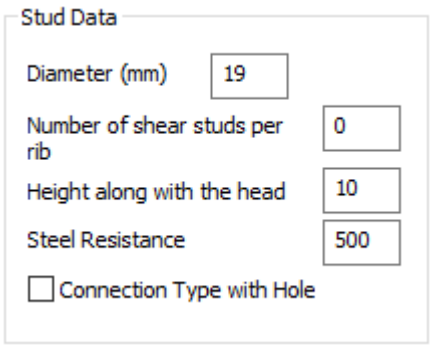




4. COMPOSITE SLAB STEEL REINFORCEMENT

In the Steel Rebar (mm) form, two structural meshes are defined in the concrete slab and the steel reinforcement per rib od the steel sheeting. Bar diameters and static heights are also specified.

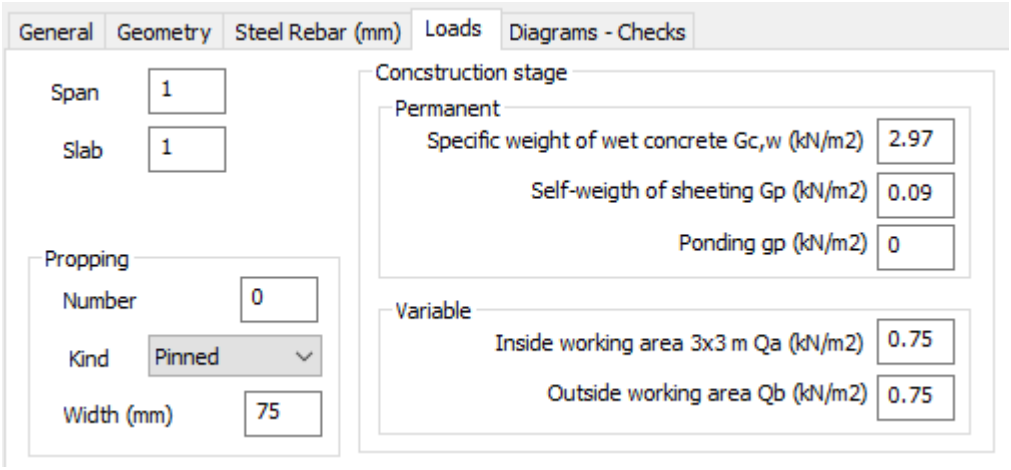




In the Stud Data field, the type and dimensions of the studs entered if they exist and are involved in the longitudinal shear check (i.e. with end anchorage) of the composite slab.

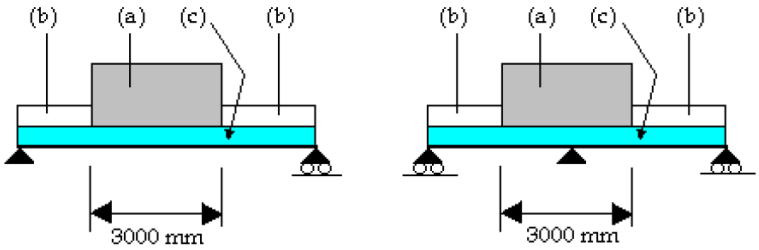
5. LOADS

The Loads form introduces the loads in the construction and composite stage.

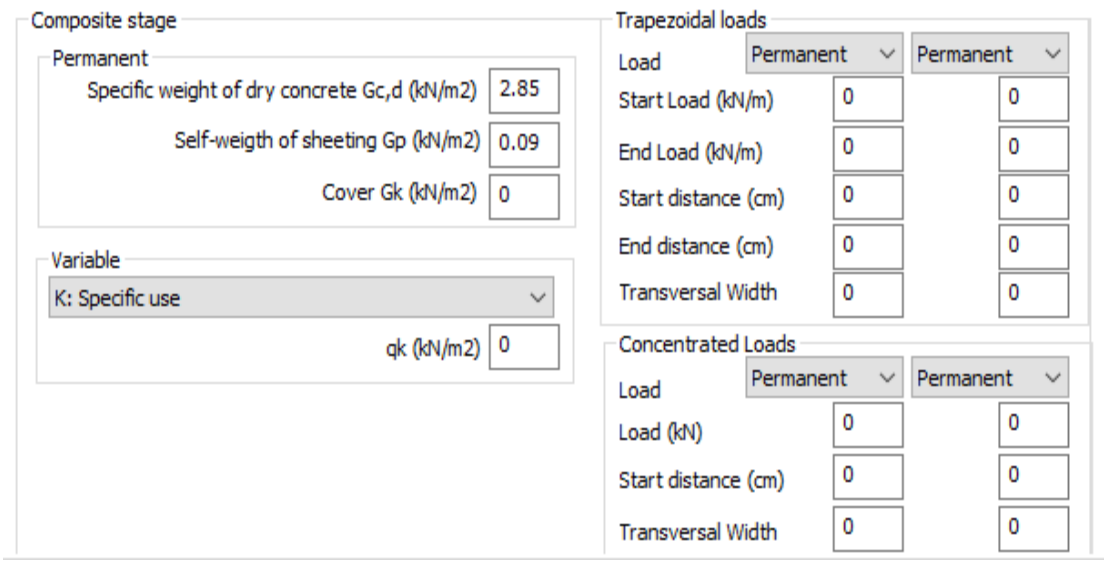


In the above field of the form is entered the number of temporary supports (Propping field), as well as, the permanent and variable construction loads Qa, Qb, Qc (EN 1991-1-6, §4.11.2).

Case	Loaded area	Load in kN/m^2
(a)	Inside the working area 3 m x 3 m (or the span length if less)	10% of the self-weight of the concrete but not less than 0,75 and not more than 1,5
(b)	Outside the working area	0,75
(c)	Actual area	Self-weight of the formwork, load-bearing element and the weight of the fresh concrete



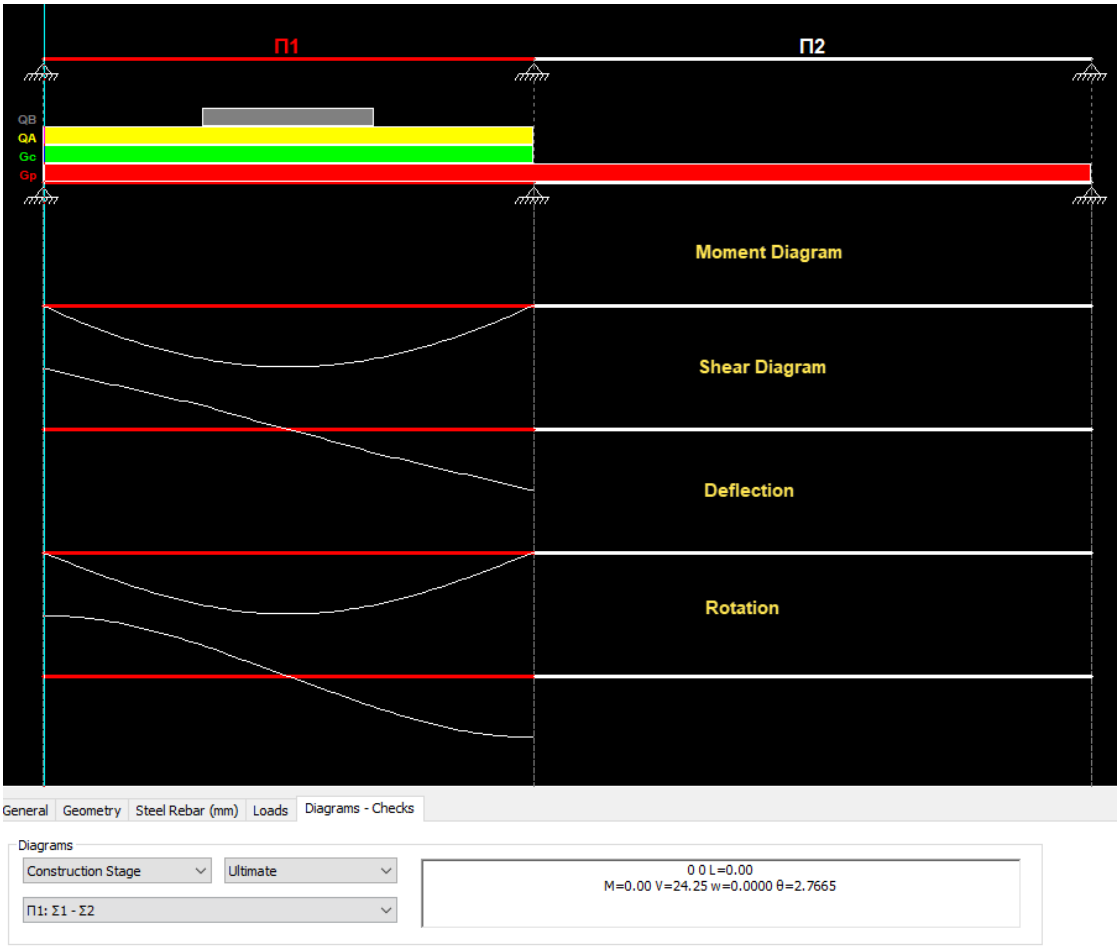
Also, the load value **Ponding gp (kN / m^2)** is entered after the slab design and if a problem with the deflection developed in accordance with paragraph 9.3.2 (2) of EN 1994-1-1 is encountered. In the other fields of the Loads form, the permanent and variable loads of the slab, distributed trapezoid, uniform and concentrated in the composite stage depending on its use and the judgment of the designer.



6. ANALYSIS

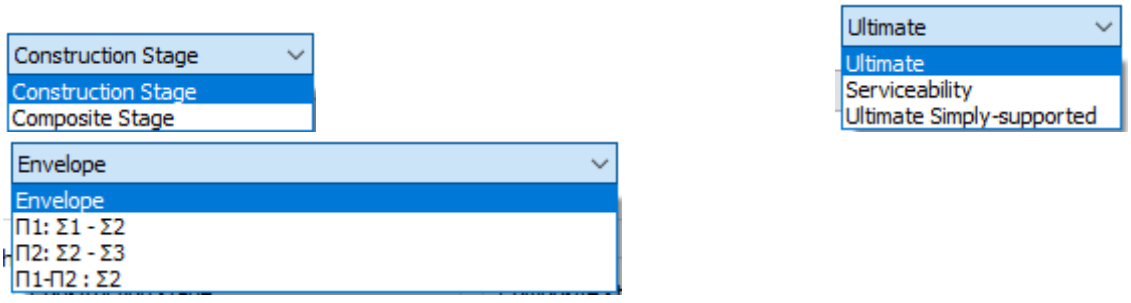
Στη φάση κατασκευής και σύμμικτης λειτουργίας εφαρμόζεται ο ελαστική ανάλυση χωρίς ανακατανομή. Το στατικό σύστημα της πλάκας καθορίζεται από τις συνθήκες στήριξης που ορίζονται στη φόρμα General. Τα αποτελέσματα της ανάλυσης περιλαμβάνουν τα διαγράμματα ροπών και τεμνουσών, το διάγραμμα του βέλους κάμψης και της γωνιακής παραμόρφωσης και απεικονίζονται γραφικά στη φόρμα Diagrams/Checks.

In the construction and composite stage, elastic analysis applied without redistribution. The static system is determined by the support conditions defined in the General form. The results of the analysis include the moment and shear diagram, the deflection and the angular deformation diagram and are displayed in the Diagrams / Checks form.



Η προβολή των αποτελεσμάτων γίνεται για τη φάση κατασκευής και τη φάση σύμμικτης λειτουργίας, για κάθε άνοιγμα και σε μορφή περιβάλλουσας για τις δυσμενέστερη εντατική κατάσταση, για οριακή κατάσταση αστοχίας και οριακή κατάσταση λειτουργικότητας. Η επιλογή “Ultimate Simply-supported” αφορά την εντατική κατάσταση της πλάκας μόνο για τον έλεγχο διαμήκους διάτμησης στη φάση κατασκευής στην οριακή κατάσταση αστοχίας.

The results are displayed for the construction stage and the composite stage, for each span and in the envelope format for the most adverse loading condition, for the ultimate and serviceability limit state. The option "Ultimate Simply-supported" refers to the slab's loading condition only for the longitudinal shear check in the composite stage in the ultimate limit state.



7. DESIGN

Για τη διαστασιολόγηση της πλάκας εφαρμόζεται ο κανονισμός EN 1993-1-3 για τη διαστασιολόγηση των χαλυβδόφυλλων στη φάση κατασκευής της σύμμικτης πλάκας. Βάσει του EN 1993-1-3 γίνεται υπολογισμός της ενεργούς διατομής του χαλυβδόφυλλου και όλων των μηχανικών ιδιοτήτων ανά μέτρο μήκους (§ 3.3, 4.2, 4.3.3, 4.3.4), καθώς και όλοι οι έλεγχοι επάρκειας που αφορούν τη διατομή του χαλυβδόφυλλου.

For the slab design, EN 1993-1-3 applies to the profiled steel sheeting design in the construction stage of the composite slab. According to EN 1993-1-3, the effective profiled steel sheeting and all its properties per meter of length (§ 3.3, 4.2, 4.3.3, 4.3.4) are calculated, as well as, all design checks about the cross section of the steel sheeting.

Design checks of the steel sheeting include:

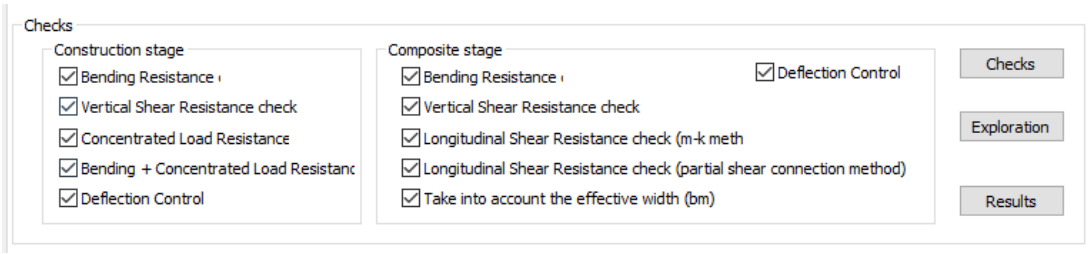
- Bending moment resistance (§5.4)
- Shear force resistance (§5.8)
- Resistance against local transverse forces (§5.8)
- Combined bending moment and shear force resistance (§5.10)
- Combined bending moment and local transverse force (§5.11)
- Deflection Control (§7.3)

Η διαστασιολόγηση της σύμμικτης πλάκας γίνεται σύμφωνα με τον EN 1994-1-1 και την Section 9 περιλαμβάνει τους παρακάτω ελέγχους επάρκειας:

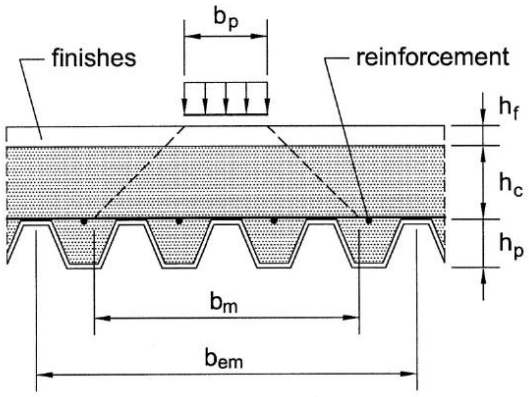
The composite slab design applied according to EN 1994-1-1 and Section 9 includes the following sufficiency checks:

- Bending moment resistance (§9.7.2)
- Longitudinal shear for slabs without end anchorage (§9.7.3)
- Longitudinal shear for slabs with end anchorage (§9.7.4)
- Vertical shear resistance (§9.7.5)
- Control of cracking of concrete (§9.8.1)
- Deflection Control (§9.8.2)

Checks form has the option to uncheck some design checks and not to implement them.



The selection ☑ Take into account the effective width (bm) is about paragraph 9.4.3 of EN 1994-1-1 for the calculation of the effective width bm of composite slab for concentrated point and line loads, for the composite slab design check.



8. REPORT / RESULTS

The results of the design are displayed either per span or per support. In the second and most general case the structure of the report is as follows:

1. **Page 0,1,2: Input parameters**
   Type of steel sheeting, loads, steel reinforcing, materials.
2. **Page 3: Effective cross section of the profiled steel sheeting**
   Effective cross section dimensions for the flanges, the web, and the mechanical properties of the gross and effective cross-section.
3. **Page 4: Profiled steel sheeting design - Construction stage (EN 1993-1-3)**
   Bending resistance check, vertical shear resistance check and deflection control per span.
4. **Page 5: Profiled steel sheeting design - Construction stage (EN 1993-1-3)**
   Design check in local transverse forces in each support, combined bending moment and local transverse force per support.
5. **Page 6, 7: Composite slab design - Composite stage (EN 1994-1-1)**
   Bending moment resistance check, vertical shear resistance check, deflection control, longitudinal shear resistance check – method m-k, longitudinal shear resistance check – partial connection method, per span.