ACE OCP

OPTIMIZATION COMPUTING PLATFORM

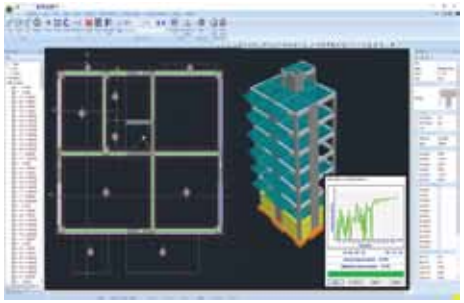
ACE HELLAS
INTEGRATED SOLUTIONS

ACE OCP is a module in SCADA Pro, representing an advanced real-world optimum design computing platform for civil structural systems. It also provides **a complete optimization approach in terms of final design stage for real-world civil engineering structures**. The main goal for the implementation of ACE OCP module is to help engineers to **design safer and economic structures within an affordable and reliable technological framework.**

- ACE OCP is a tool for sizing optimization; search for the optimum size of all cross-sections with respect to the design code provisions.
- ACE OCP provides a numerical procedure that can replace the traditional trial-and-error design approach with an automated one.
- ACE OCP provides the optimum design with reference to the lower material and construction cost.
- ACE OCP provides the optimum design with reference to the lower environmental impact.
- **Multiple state-of-the-art optimization algorithms** are available in this innovative SCADA Pro module all of which have been successfully tested in various challenging civil engineering problems.

Applicable in everyday practice, it has been implemented within an innovative computing framework, founded on the current state of the art of optimization. It supports all construction materials (reinforced concrete, steel, masonry) and design codes (EC2, EC3, EC6, EC8, Saudi Building Code) that SCADA Pro includes.

- Advanced and easy to use interface, makes structural optimization a single-click process.
- It offers the option to select multiple criteria, related to the construction cost, environmental impact, etc.; which can be used either as "Objective Functions" or "Additional Constraints", beyond those imposed by the design codes considered.



- Solution based on the selection of a powerful algorithm chosen from a list of state of the art numerical optimization algorithms.
- Numerous options to define the design bounds of the design variables; either at section or element level.
- Practical comparison of initial and optimized designs.

ACE OCP is the only commercially available solution on the global market for value engineering. ACE OCP harnesses technology to drive efficiency, increase performance and reduce cost while preserving safety excellence and lifecycle performance. It takes the power and skill of large consulting enterprises and the knowledge of the world's top universities and makes it available to every engineer with an intuitive interface that produces superior results. The module's advanced optimization techniques have been developed by the SCADA Pro R&D team in coordination with leading European academic institutions in order to reduce construction and/or material costs by at least 10%, consistent with the required performance, reliability, quality and safety. The methodologies integrated into **ACE OCP module have been approved** with the publication of the theoretical framework and indicative results in the official Journal (http://goo.gl/cZIbgB) of the **International Society for Structural and Multidisciplinary Optimization** (ISSMO, http://www.issmo.net).

www.scadapro.com

SBC in SCADA Pro

Saudi Building Code (SBC) is a set of legal, technical and administrative regulations and requirements that specify the minimum standards of buildings' construction in order to ensure public health and safety. The code takes into consideration the cultural and social environment, the climatic and natural conditions, as well as the soil types and materials' properties in the Kingdom.

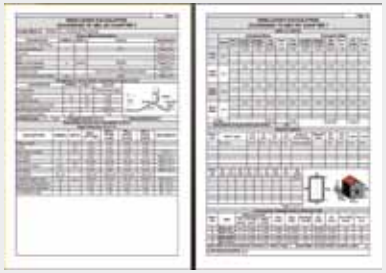
In SCADA Pro, SBC Parts 301, 303, 304 and 306 have been fully implemented.

Specifically:

1. 301 Structural – Loading and Forces

a. Load Requirements

SBC provides the minimum load requirements for the design of buildings and other structures. The loads and the appropriate load combinations are created simultaneously and automatically from the program.



b. Wind Loads Design

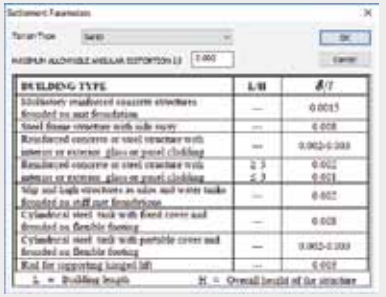
Both Methods, Simplified and Analytical, are included. A large set of tools guide the user in selecting correctly the various parameters.

The software calculates automatically all the necessary values and carries out all the checks. The input parameters and the results are presented in detail.

c. Seismic Design Criteria

Four Analyses Procedures (Index Force, Simplified, Static and Dynamic Analysis) are included. The Seismic Ground motion values (Ground Motion Acceleration, Site coefficients etc.) are defined automatically according to the Country Regions. The automatic calculation also applies for the Design Response Spectrum and the structural Plan and Vertical irregularities as well.

2. 303 Structural – Soil and Foundations



a. Design of Footings

All the required checks according to the Section 5.4 are performed.

b. Contact Pressure over total base area Calculation

3. 304 Structural – Concrete Structures

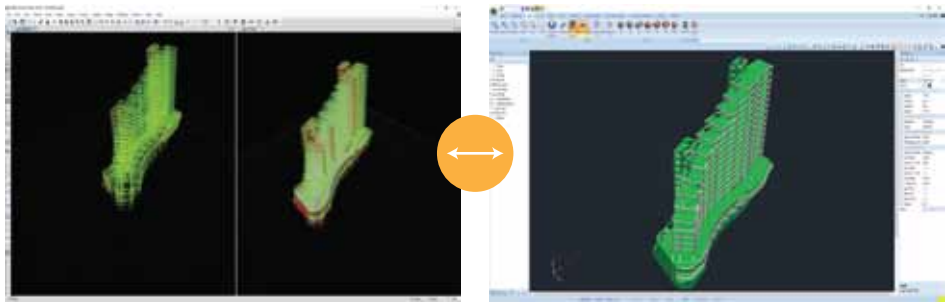
All the required checks are performed automatically for the following cases:

a. Flexure and Axial Loads, Magnified Moments for Sway and Non-Sway Frames
b. Shear and Torsion
c. Special Provisions for Seismic Design has also been implemented

4. 306 Structural – Steel Structures

a. Net and Gross Area Calculation. Effective Area of Tension members
b. Classification of Steel Sections
c. Tension Members check
d. Column and other Compression Members Design and checks
e. Flexural-Torsional Buckling check
f. Flexural members check
g. Design of members under Shear
h. Design of members under Combined Forces and Torsion
i. Complete library of all the types of steel connections

2-way communication between SCADA Pro & SAP2000 & ETABS



ETABS *SCADA Pro*

SCADA Pro, now, features bidirectional communication with SAP2000® and ETABS® software from Computers and Structures, Inc., allowing the import and export of any type of model created in SAP2000 or ETABS to SCADA Pro and vice versa. These modules provide engineers tremendous versatility and flexibility to meet challenging demands.

For example, engineers with projects analyzed in SAP2000/ETABS can take advantage of SCADA Pro's Eurocode and Saudi Building Code (SBC) implementation for full regulatory compliance.

Key benefits:

- Significant reduction of the modeling time through automation.
- Avoids errors and mismatches between architecture design and structural modeling.
- Building Information Modeling (BIM) compliance.

The two-way communication module supports:

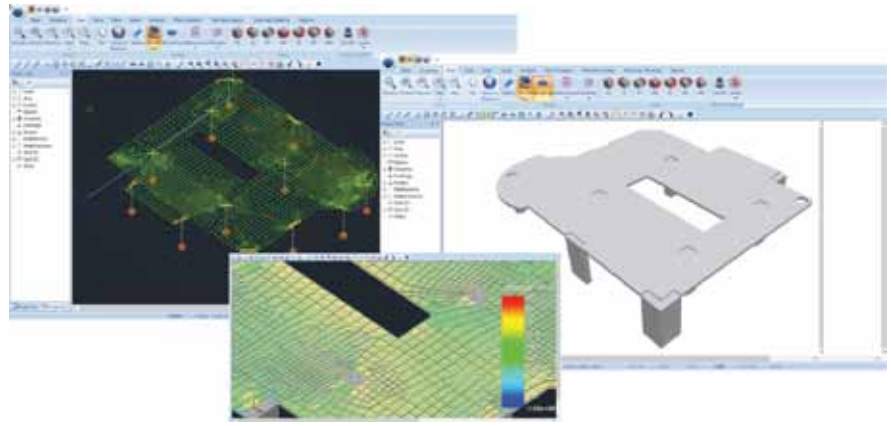
1. All types of materials, i.e. reinforced concrete, structural steel, masonry, wood
2. Frame and surface elements
3. Standard cross-sections, Sections Designer cross-sections, Libraries of standard steel sections.
4. Rigid offsets and insertion points
5. Multiple types of point, frame and shell loads and load patterns (e.g. quake/seismic load pattern, wind loads, snow loads)
6. Point and line springs for the simulation of the soil-structure interaction.
7. Analysis results (e.g. Static analysis, Response spectrum analysis) derived from SAP2000/ETABS can be imported in SCADA Pro and the corresponding P-M-V diagrams or the deformed shape to be displayed.

In SCADA Pro there are the following advanced features additional to those in SAP2000 and ETABS:

1. Automatic slab recognition, loads definition, design and detailing of reinforcement of slabs.
2. Design of a structure based on multiple design code provisions (i.e., EC2, EC3, EC5, EC6, EC8(3), SBC) by applying the analysis results derived from SAP2000 and ETABS.
3. Design checks that cannot be performed in SAP2000 or ETABS (e.g. Punching shear check, design checks of bearing masonry structures, timber connections).
4. Take advantage of the advanced analysis types that SAP2000 and ETABS support.
5. Using the editors of steel reinforcement in SCADA Pro for detailed modification of rebars.
6. Creating structural drawings and detailing designs, that can be modified, continuity of beams and columns and complete print out results of the project.
7. Report in any regional language (e.g. English, German, Italian, Polish, Turkish)

SCADA Pro® Flat Slab

SCADA Pro Flat Slab module for analysis and design is an advanced finite element solution that can operate independently or fully integrated with SCADA Pro Structural Analysis and Design software.



Key Features:

- Generates a true 3D model of an entire concrete building – accurate FEM analysis
- Supports import and export of various file and model formats (DWG/DXF file, ETABS/SAP2000 model, IFC file)
- Generates buildings with complex details such as elevated floors and foundations containing different slab regions, walls, beams, columns, drop panels and openings
- Easy to draw support lines anywhere on slab – even for complex geometries
- Automatically accounts for all critical design sections – different approach between column/middle strips
- Graphical display of total bending moment diagram for a design strip
- Performs code check and reports the location and amount of reinforcement needed for concrete design codes (Eurocode 2 and Saudi Building Code)
- Automatic generation of code based load combinations as well as user specified combinations
- Tabular and graphical display of design results
- Rebar calculations for any slab - Automatic enveloping and rebar detailing - DWG/DXF export
- Calculates and checks punching shear stresses and designs shear stud or stirrup reinforcing

Special Features of Flat Slab Flexural Analysis and Design:

- Self-weight of slabs is automatically calculated and may be optionally excluded in the analysis
- Special code considerations are taken into account:
  - **a.** How drop panels affect column strip width
  - **b.** Reinforcement concentration over a column
  - **c.** Difference in concentration width of side/corner columns to internal columns
  - **d.** Limitation of upper reinforcement over a side/corner column – simultaneous increase of span reinforcement
  - **e.** Strip width calculation for support lines even at the edge of a slab
- Allows user to modify typical top and bottom reinforcement mesh and rebar

Special Features of Punching Shear Design:

- Automatic computation of all the parameters important for the punching shear checks:
  - **a.** Type of column (i.e. internal column, side column, corner column or reentrant column)
  - **b.** Loading data of the most severe loading case and combination
  - **c.** Correct side of the slab concerning longitudinal reinforcement and slab cover (e.g. different choice for a floor slab vs. a foundation slab)
  - **d.** An equivalent rectangular shape for columns of arbitrary section shape
- User freedom to choose different values for all the parameters incorporated in the design – providing unlimited capabilities
- Two types of reinforcement arrangement compatible to the code proposed ones (radial arrangement vs. cruciform arrangement)
- Easy to interpret tabular format of results – fully compliant to the code regulations
- Graphical visualization of the rebar arrangement – can be interpreted both in stirrups or stud rails use
- Available for both 32-bit & 64-bit Windows