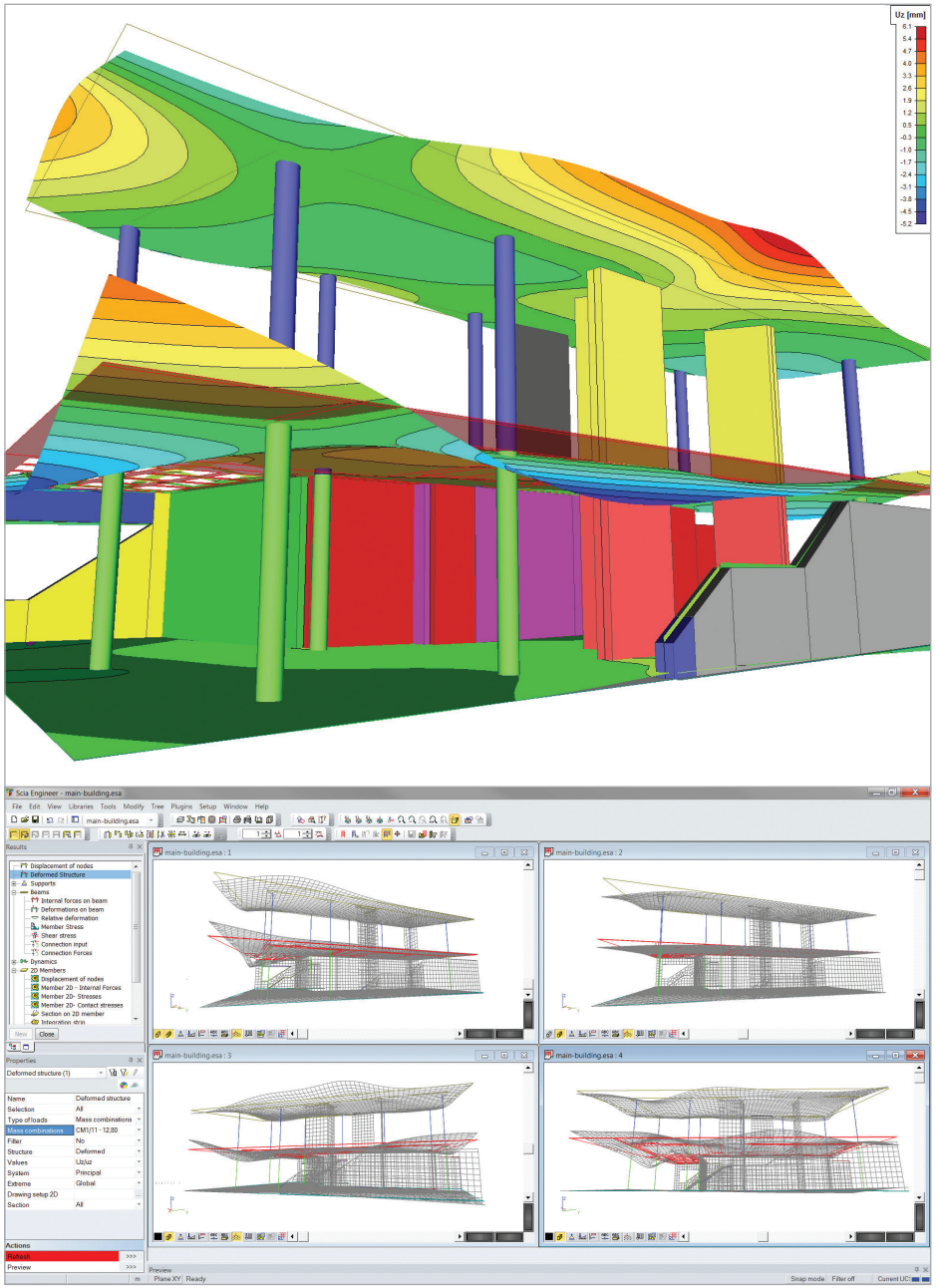
Summer House - Vourvourou-Halkidiki, Greece



Software: Scia Engineer

Project Description

The project centres on a two-storey summer house, located in the professors' quarter of the Aristotle University of Thessaloniki in Vourvourou, Halkidiki, Greece. The house is built on a hill right at the sea front, in the middle of a pine forest, and just a few steps from an almost-private magnificent beach.

The structural members consist of reinforced concrete. The vertical elements are walls and circular columns. The plates are rigid, having an area of about 180 m^2 and a thickness of 28 cm. The roof is inclined, while the middle plate is expanded as a cantilever outside the perimeter, creating the balconies and the external passageways. The mat foundation serves as the ground floor slab, with concrete walls along the longitudinal direction. Two secondary structures are attached to the main building; a pergola composed of concrete beams and a small underground warehouse (about 50 m^2).

Basic characteristics

The house has been built in an area with a high risk of substantial seismic activity. The strongest earthquake of the 20th century in the area was Ierissos earthquake in 1932, which had a magnitude of 7.0 on the Richter scale. On the other hand, the architectural concept demanded few columns, with the minimal dimensions possible, and no beams at all, so that the wonderful view could be enjoyed unhindered. Only some concrete walls were allowed, mainly in the middle and the rear side of the house. This type of construction is very common in non-seismic areas, but it is not recommended in general for areas with high seismicity, mainly because of the difficulty of having a credible calculation model for the transfer of the shearing forces directly from the plate to the concrete walls.

Using Scia Engineer & ECTools for modelling and structural design

The structure was modelled with Scia Engineer as a whole, including the surface elements (plates, walls, foundation, etc.) and the linear elements (mainly the columns). The foundation plate is considered to be supported on the elastic ground through unilateral contact conditions, in order to deal with the soil structure interaction.

For the design of the structural elements of the building, including the EC8 general checks (second order effects, seismic joint width, infills, torsional sensitivity, the exception of joint capacity design etc.) ECtools software was used. ECtools has the ability to distinguish complex wall sections (cores) and treat them as one section, recognising automatically the vertical walls that have been entered on Scia as 2D surface elements, and designing them as seismic walls, as required by EC8.

Shear punching on the plates and the foundation was resolved with the appropriate Scia algorithm which recognises the position of the column (inside, in the perimeter or in the corner position), and the possible existence of holes in the vicinity. The underground structure was modelled using 2D surface elements as well.

Conclusion

Although the presented building is rather small in size, the overall configuration of the structural members required the use of Finite Elements, in order to build a reliable model. Although this type of analysis is usually a laborious and complicated task, Scia Engineer, being a next generation program, brings the Finite Element technology to a level of convenience that allows the engineer to use it in all cases with the minimum effort, namely in cases ranging from simple conventional buildings to advanced cases with complex geometry, non-linear analyses etc.

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Our office is also active in the research area, producing scientific papers and participating in conferences and research programmes. The recent EU research programme HISTWIN (High-strength Steel Towers for WINd turbines) is one programme we have participated in.

Project information

Owner	Nicolas Mousiopoulos
Architect	A.Kotsiopoulos, E.Zoumboulidou, A.Panou
General Contractor	Domia SA - Chris Seroglou
Engineering Office	statika.gr, Consultant Civil Engineers
Location	Vourvourou-Halkidiki, Greece
Construction Period	04/2011 to 10/2011

Short description | **Summer house in Halkidiki**

The project concerns a summer house in Halkidiki. It is a two-storey building located just a few metres from the Aegean sea. The location is actually within an area prone to hazardous seismic activity. The strongest earthquake of the 20th century in this area was the Ierissos earthquake that struck in 1932, with a magnitude of 7.0 on the Richter scale. The building is concrete, with plates that are adjusted directly to the columns and walls without beams. For specifying the transfer of the horizontal seismic forces from the plates to the vertical elements, without the existence of beams, an FE modelisation was necessary. The structure was analysed and designed using Scia Engineer and ECTools software in order to describe the whole structure using surface and linear finite elements.