

## BESIX

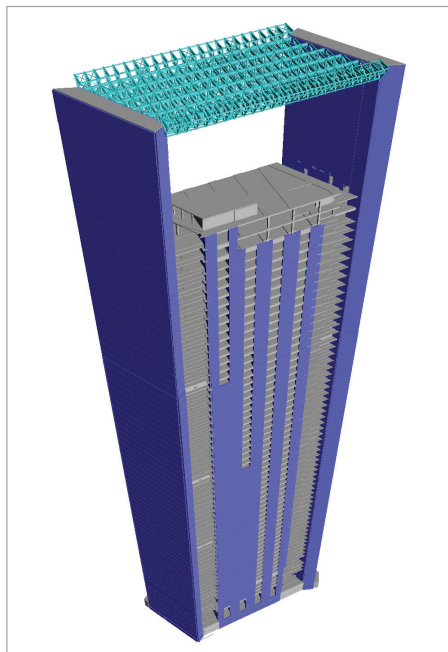
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## Nomination



BESIX is Belgium's largest construction group. It is a conglomerate of companies operating in the construction, engineering, environmental, real estate and concession sectors. The Group was founded in 1909 and since then has known impressive and regular growth. The company has become an important player in France and the Netherlands and has also entered the Egyptian and Libyan markets. In the Gulf the company has enjoyed huge success in the UAE, Qatar and Oman and has undertaken a large number of prestigious projects including the Burj Dubai Tower, currently the tallest building in the

world. In addition, it has undertaken impressive projects in countries such as the UK, India, Russia, Poland, the Czech Republic, Slovakia, Equatorial Guinea, Algeria and Morocco. BESIX and its subsidiaries cover practically all fields of the construction industry and are operating in Western Europe, Central and Eastern Europe, North and Central Africa, the Middle East, Central Asia and the Caribbean. The Group's annual turnover is of the order of EUR 1.6 billion and it has more than 20.000 employees in 19 countries and 4 continents.



Software: Scia Engineer

## Adnoc HQ Tower - Abu Dhabi, United Arab Emirates

The project is located at the Abu Dhabi Corniche and consists of a 75-storey office tower and two levels of basements. The overall building height is 343 m with a gross office area of 160.000 m<sup>2</sup> and a helipad on the roof.

### Challenges

BESIX Engineering - Dubai presented an alternative design which resulted in significant savings. Upon award of the project, the redesign had to proceed at a fast rate to enable the commencement of the construction activities within three months. With this difficult design, the choice of software became all the more important and BIM was applied for an effective verification of the alternative design.

The design is extremely complex due to the fact that the building is highly asymmetrical. The centre of mass is offset by 3 m due to the fact that the south core walls are only counterbalanced by six slender composite columns. Elastic shortening and long term creep causes the building to twist around its vertical axis and to lean forward towards the column line.

The original design relied heavily on structural steel inserts in the walls to provide adequate stiffness. In the alternative design all inserts were removed and additional stiffness was achieved by specifying high strength concrete with enhanced Young's modulus ( $E = 48\text{GPa}$  for grade 65/80 concrete instead of  $40\text{GPa}$  as per EC). The original columns were square composite with internal steel made-up sections and called for very elaborate fabrication and erection procedures. The BESIX design comprises 1.5 m diameter tubes ( $t_{\max} = 90\text{ mm}$ ) filled with high strength concrete and 20% of original steel. PT beam/ steel column connections are fully fixed for increased stiffness. The original design was as per ACI and IBC codes and the modelling was carried out using ETABS. BESIX applied the Eurocode suite and 3D modelling with Scia Engineer and Revit Structures.

### Foundations

The site is generally characterized by 8 m of sandy material overlaid by bedrock. The foundation system consists of a 3.5 m raft supported on a total of 364 bored piles 20 m long and diameter 1.0 m, 1.2 m and 1.5 m.

### Seismic and wind loads

A site specific study indicated that the project is located in an area of low seismicity, equivalent to Zone 1 UBC 1997 ( $Z = 0.075$ ). However, to comply with Abu Dhabi Municipality regulations, seismic zone 2a was adopted ( $Z = 0.15$ ).

The wind loading was based on tunnel testing, carried out by BMT. The reference wind speed for 50 year return was 38 m/s (thunderstorm).

### Structural 3D Modelling - BIM

From the very beginning of the tender BESIX opted to use BIM. As a first approach a Revit model was prepared and was then imported directly into Scia Engineer. The model interface works well both ways between the two software and any subsequent changes done in Scia Engineer were exported directly into Revit:

Revit - Detailed 3D model of all structural elements used in quantity take-off for concrete, reinforcement, and structural steel and for preparation of 2D drawings exported to Acad.

Scia Engineer - 3D model was imported from Revit and loads were introduced including wind and seismic. Scia Engineer was used to analyse the structural behaviour both in terms of global effects (sway and inter-storey drift) and detailed member design.

### Conclusion

The effective interface between Scia Engineer - Revit - Acad allowed BESIX to optimize both the geometry and the final quantities of the building to achieve an overall 20% saving. It also allowed a more comfortable construction schedule through simplified detailing. At the detailed design stage the same interface allows BESIX to maximize the production speed of drawings by using the 3D environment for the coordination between 3D models and 2D drawings. The construction of the ADNOC HQ Tower is currently into its ninth month. The first concrete for the raft was poured in September 2010 and the core walls are at Level 3 above ground level. The erection of the helipad roof is foreseen for May 2012. Once the building is completed it is earmarked to be one of the major landmarks along Abu Dhabi's Corniche.

## Project information

Owner Adnoc  
 Architect HOK  
 General Contractor Six Construct  
 Engineering Office Halcrow Yolles  
 Construction Period From May 2010 to April 2013  
 Location Abu Dhabi, United Arab Emirates



## Short project description

The Adnoc New Corporate Headquarters is an impressive 343 m tower. When completed in February 2013 it will become the tallest building in the Emirate with a total of 75 storeys and a gross floor area of 160.000 m<sup>2</sup>. BESIX is responsible for the alternative structural design. The Tower is a rhomboid with an angle of 60°, the height-to-base width ratio is 10 and it is topped - with a 66 m roof bridge and a private helipad. Other main features are the full-height glass façade front and back and the granite cladding along its sides. The front face is supported by slender columns spaced at wide intervals for maximum exposure.

