



# Precisely Set-out

by Konrad Saal

Architects' creativity in the design of fascinating modern buildings knows no bounds. State-of-the-art CAD programs, structural engineering software, and the visualization of 3D models allow almost any conceivable form of building to be designed to millimeter accuracy. However, these increasingly complex buildings must also be built to this fine level of detail, which is a

great challenge for surveying and construction engineers. The choice of the right instrument is crucial to achieving the required accuracies and to translating building geometry from a drawing into reality.

In the Algerian capital of Algiers the huge complex "Medina" is being created on the Mediterranean coast, on just one square kilometer (0.4mi<sup>2</sup>). An ambitious project, it is intended as a symbol of the

## Curtain wall façades

Curtain wall façades are lightweight and ensure the building envelope is sealed without affecting stability or structural engineering of the building. They withstand extreme temperatures and noise, while offering the building better protection in the event of earthquakes, explosions, and fire. Furthermore, curtain walls allow more efficient use of the internal space and flood the building with light. They consist of a frame, usually made of aluminum, fitted with glazed infill panels. Important elements of the façade are generally prefabricated and are always mounted

on brackets at the ends of the concrete floor slabs. The brackets must be very accurately positioned in a set pattern. They hold the façade elements in place and provide very little scope for adjustment during installation. Therefore checking the building geometry is one of the most important surveying tasks on these projects – it involves the precise surveying of level differences on concrete floor slabs, their evenness, and vertical alignment. The actual values in these projects must not deviate from the design values by more than 2 cm in any direction.

country's modernity. In middle of this site two 97 m (318 ft) high buildings with curtain wall façades will soon be soaring skywards.

The decision to have a curtain wall façade on the building – particularly a prefabricated one – commits the contractor to on-going surveying during construction. Ideally this should be done from the start, since displacements or distortions of the building shell can cause the installation to impose stresses or distortions on the façade. This could entail higher costs for rework, additional tailor-made brackets, or cutting back of concrete slabs.

To ensure the façade bracket positions were precisely set out, the façade contractor called on the expertise of Upgrade Topographie, a small engineering consultancy headquartered in Capbreton in southwest France. Since its founding ten years ago, the consultancy has concentrated on engineering and industrial surveying and has successfully provided the same service on several projects of this type. For this project Upgrade Topographie first established a highly accurate network of points around the two towers. Surveying engineer Julie Deléglise opted to use a high-precision Leica TS30 total station, which can achieve an angular accuracy of 0.5" and 0.6 mm (0.02 in) distance accuracy, for all measurements, taking due account of barometric pressure, relative humidity, and temperature. While surveying for the network, she captured points on the building's basic shell to compare the survey results of the existing structure with the design. After calculation of the

network coordinates, they were transformed into the local tower site coordinate system.

Upgrade Topographie relied on Leica Geosystems original accessories for the surveys. "We avoid the risks associated with using third-party accessories. Millimeters matter for the positioning of the curtain wall façade and therefore we have to transfer distances and levels precisely." For the Medina project, as with many projects of this kind, the client required Upgrade Topographie to submit current test and calibration certificates for the Leica TS30, which the consultant requested from its authorized Leica Geosystems Service Center.

On many previous projects based on networks of points, Upgrade Topographie had also used the Leica ScanStation C10 to check floors, as the task of modeling is simpler in Leica Cyclone software and differences to design coordinates can be superbly visualized. "This 3D laser scanner considerably improved our method of working and increased our efficiency, principally in the capture of building geometry," says Julie Deléglise. However, in this project the Leica TS30 was used to survey 1,500 points in reflectorless mode over the course of two days to check the building geometry.

After installation the curtain wall façade brackets had very little play left for readjustment to achieve the design positions. The plans specify that the brackets be attached to the edges of the concrete decks. The prefabricated frames have to be installed precisely



## About Upgrade Topographie

Vincent Hubert, the founder of Upgrade Topographie, and his team are specialized in precision surveying for construction and industrial engineering, including precision leveling. The company's projects are extremely diverse and extend from industrial surveying in the production halls of Airbus and precision surveying of railway tracks to controlling tunnel boring machines and load testing. Although the

consultancy was established only ten years ago, it is already well regarded for the reliability of its precision surveying. Its projects have taken Upgrade Topographie all over the world, from Algeria and Morocco to Angola, the Dominican Republic, and Qatar. An area of specialization is precision surveying for the installation of curtain wall façades.

on the brackets to later accept the glazed elements without causing distortion or imposing stress.

"When we transferred the survey data into the digital design models, we found differences in the verticals of the building of up to five centimeters (2 in). Furthermore, we discovered that the concrete slabs were not level enough. On one floor slab, the height differences between the highest and lowest points were up to six centimeters (2.4 in)!" said Julie Deléglise. Discussions then took place with the site manager on the measures to be taken to set out the brackets within the permitted tolerances.

The coordinates of the instrument station for the stakeout were calculated for each story using free

stationing. Further auxiliary points were set out using tripods with forced centering. These points were surveyed using automatic target recognition. Experience has proven to Julie Deléglise that this method is more accurate than manually targeting points.

With the Leica TS30 and a mini prism, points were set out in two locations on each story using the Stakeout program in the SmartWorx on-board software package. This program allows the user to choose whether the instrument automatically positions to the next stakeout point. "This function is very useful because it saves considerable time. We were able to set out 200 points per day." ■



■ Precision stakeout of the curtain wall façades: surveying engineer Julie Deléglise with the Leica TS30.