Virtual 3D Urban Design from Laser Scan Data

by Konrad Saal

The Inselhalle in Lindau, Germany, a conference center on an island in Lake Constance, was to be refurbished and extended to meet modern requirements. Since only incomplete records of the original building existed, project organizers decided to capture the existing features of this old conference hall and its surroundings using laser scanning. The acquired data is now available to architectural consultants for their designs and for virtual “tours”.

Consulting engineers Zimmermann & Meixner Z&M 3D Welt GmbH, from nearby Amtzell, won the contract for the building inventory documentation and 3D visualization. Their task was to capture the details of the whole hall (interior and exterior) and the adjacent features including the bank of the lake in the vicinity of the conference hall.

Survey of Existing Features Using 3D Laser Scanning
Surveying technician Viola Leibold and graduate engineer Benjamin Sattes arrived on the island with a Leica ScanStation 2 to produce as-built recordings of the original buildings and surrounding features. This versatile 3D laser scanner captures up to 50,000 points per second and has a range of up to 300 m. “Laser scanning provides surveyors with a way to overcome the hurdle of capturing the features of existing objects at an adequate level of detail precisely and cost-effectively,” explains Benjamin Sattes.

“The 3D laser scanner is linked to a laptop and controlled using the Leica Cyclone software package, which consists of several different modules. This arrangement allows the user to define the required scan window and point density and store the captured point data. Targets are set up and scanned at the same time as the object to permit subsequent geo-referencing, the linking of all captured point clouds into a single, consistent system. We captured an area of about 73,000 m² from 38 stations in five days. The interior, for which we needed about 21 stations over three days, involved a total area of 5,000 m²,” says Viola Leibold. The Lindau fire brigade even made a turntable ladder available to capture the roofscape.
To edit the point clouds Leica Geosystems offers modules that can interface with a number of engineering CAD programs, allowing users to work in their familiar software environment. The expanded and partially automated functions in Leica CloudWorx for AutoCAD allowed Benjamin Sattes to generate a 3D model of the whole object from the point clouds. “Any section or view can be generated from the model once complete.” Two cross-sections; layout plans of the basement, ground, and first floors; as well as four views were generated for the Inselhalle. The 25 architectural consultancies selected for the design competition used the model as the basis for their designs. With a maximum deviation of one centimeter from the actual dimensions of the building, the data is considered equivalent to surveys of the highest quality.

3D Visualization and Virtual Tours
“The particular aim of the exercise was to capture the features of the Inselhalle at such a level of detail and precision that the architects would have access to a robust and comprehensive survey of the existing building and would not have to produce one themselves,” explains Benjamin Sattes. “At the same time, we were able to use Leica Geosystems’ free Internet-based visualization software TruView to allow people to take a virtual tour of the Inselhalle.”

Leica TruView can be used to analyze and take measurements within large point clouds in a CAD or other 3D technology environment, even for users without 3D laser scanning experience. The point clouds are presented as photorealistic images. Architects can move around in a virtual world inside the point cloud, measure distances, highlight details, make annotations, and save the results. The project participants can also use the processed data to communicate effectively over the Internet. Using 2D layouts and a 3D model of the existing building, and with TruView as a substitute for a site visit with the additional feature of being able to take measurements, each architect has the optimum basis for expressing his ideas and designs.

Linking Designs to the Real World
Thanks to the visualization concept developed in-house by Z&M 3D Welt, the architects, civil engineers, and landscape planners can see how their proposals and plans would look in the context of the
Leica TruView: Moving around in a virtual world inside the point cloud to take distance measurements.

Z&M 3D Welt is able to visualize the real environment from the raw laser scanning results. The captured point clouds visualize the existing objects and do not have to undergo further processing into 3D models with the customary loss of detail and accuracy.

The Sustainability of Using 3D Models
Users are often faced with the question of how best to make data available for future use with minimum cost and effort. The data obtained from laser scanning can be accessed immediately to provide measurements from the 3D model and pass them on to the judging committee. The competitors particularly appreciate the ease of operation – it is so easy that no experience is needed to move about freely within the model.

The future designs and animations for the “Inselhalle Lindau” project can be found at: www.zm-3dwelt.de/inselhalle.

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