Modern Art Scanning

Thomas WEBER and Katharina RATKE, Germany

Key words: Laserscanning, 3D-modelling, Surveying Room Installation Art, Industrial Design, Cultural Heritage

SUMMARY

This paper deals with geodetic documentation of objects of modern art and modern design. All following examples are initiated by restorers from the “Pinakothek der Moderne” in Munich. In the context of exhibitons there are shown different (room) installations from several artists. The example for industrial design is about a habitation concept, called ”Futuro“, which was conceived by the architect Matti Suuronen in the 1960’s. One of the last original futuro houses is standing in Berlin.

The task for all objects was a documentation in sense of the restoration. For the installations the main target was to have the opportunity to exactly rebuild the art object at any place and any time. The aim of the working process at the Futuro-Project was to create a documentation of deformations and damages, which are done to the building and interior decoration by the time. Also detailed plans should be generated, because there are no existing blueprints of the dwelling. Furthermore 3d models should be formed of the modern art objects in CAD software.

The objects were acquired with modern surveying instruments like laser scanners, prismless measuring total stations and digital cameras. The different observations were combined with each other and then processed with CAD software to threedimensional models. From these models floor plans or any other sectional drawings can be generated as a possible result. From digital pictures orthophotos were derived. Last but not least the results were combined with information which is typical for the different objects of modern art.

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1. INTRODUCTION

This thesis is based on a collaboration between restorers working for the “Pinakothek der Moderne” with the Chair of Geodesy of the Technical University Munich. Furthermore, other measuring projects, a seminar thesis and a diploma thesis resulted from different requests by the restorers in order to document objects of modern art or design.

The Doerner-Institut was assisted in the context of the international project „Inside Installations. Preservation and Presentation of Installation Art“. In an interdisciplinary cooperation a concept for different measuring methods to document installations was created. The institute itself is part of the Bavarian State Painting Collection (Bayerische Staatsgemäldesammlung) in Munich. The central task is to look after the extensive collection, which cover the whole spectrum from the 14th century all the way to contemporary art. Its core activity also includes the preventive conservation of art objects and their restoration, particularly with regard to scientific research and development of new methods for preserving cultural heritage.

The “Pinakothek der Moderne” also houses “Die Neue Sammlung”. Its collection includes over 70,000 exhibits of industrial design, graphic design and of the arts and crafts. In collaboration with restorers of the “Neuen Sammlung” a futuristic looking dwelling was acquired by geodetic work and reconstructed in CAD.

2. SURVEYING OF ROOM INSTALLATIONS

2.1 Acquiring Methods for Objects of Artwork

Installations normally consist of many different objects and their effect and expression are affected by their topological arrangement. Geodetic measurements serve as documentation of the position of each object inside the complete installation art. In contrast, due to visual judgement, handmade draws, photos or videos can only be used in a restricted way to document the exact position of an artefact. So there is still scope left for subjective interpretations. All surveyed installations are created by the artist himself or by his representatives, so they all count as original arrangements and therefore documentation is important for the artworks history. Scaled plans resulted from surveying services allow almost authentically reconstructions of the installations. The blueprints can base the reconstruction, but they must not. In several cases the changeability of the artwork is important for the artist, otherwise he must personally be present during recreation of the installation. For surveying the installations any methods for acquiring the objects can be used, e.g. collecting data by hand, tacheometry, photogrammetry and laserscanning. The chosen method depends on shape and complexity of the exhibit. Most objects should be measured contactless because of the high value of some artwork.

The first example "Mikado" by Fred Sandback (1943-2003) shows a quite simple installation. Five black cords are fixed in a room of 10 m in length and width. All anchor points, where the lanyards cut the wall or floor areas should be documented. At first the work was done by restorers collecting the data by hand, with simple tools like folding rules, measuring tapes and plummets. But after problems have occurred, they asked a surveyor for help, who managed the problem in a short time with a tacheometer.

Fig. 1: Fred Sandback, Mikado (2003)

The next example, an untitled installation by Donald Judd (1928-1994), was also done with a reflector less measuring total station. There are 16 different looking boxes of douglas fir plywood mounted on the walls and three bigger boxes are located on the floor in one exhibition room. This constellation was completely modelled in a three dimensional drawing. The project was completely dealt with one person in one day.

Fig. 2: Donald Judd, Untitled Plywood Wall Work (1976)

But installations are often not structured as simple as the two examples shown above, founded by the two American minimalists Sandback and Judd. Sometimes they have a structure of complex geometry, are build out of many different peaces or the topology of the different objects is very dense. Then photogrammetric methods are used for the metric preservation of the installations topology. Tacheometry or collecting the data by hand is not efficient enough for detailed and small objects. Also the fieldwork is not profitable anymore if it takes a lot of time for acquiring the data.

Fig. 3: Mark Manders, Silent Factory

Alternatively, laserscanning was tested at an installation called „Silent Factory“, created in the year 2000 by the artist Mark Manders (*1968) from Netherlands. Two neighbouring chimneys tower on one side, overtopped by an object looking like a loudspeaker, which is standing on wooden tables, on the other side. Most objects are carried by iron racks. Next to an arm chair different findings are lying on the floor; e.g. a watering can, tea bags, pots and a pair of shoes. The installation was scanned with the Cyrax 2500 system (Leica Geosystems) from six positions. The chosen spatial resolution was up to one millimetre, because of the small objects on the floor. All in all the time for the surveys took three hours.

In most cases a combination of different surveying methods will give the best results. With a mixture of collecting data by a total station, digital photographs and laserscans was tried to capture the topography of another installation. A spherical camera also should be tested therefore, but because of too many shadow areas affected by objects inside the room, this method wouldn’t be practicable and the processing would be too expensive. The installation which should be sampled by the combined methods was made by a sculptor from Switzerland, Thomas Hirschhorn (*1957). The title of the artwork created 2002 is “Doppelgarage”. A hobby room, workshop, storage room and think-lab all rolled into one is shown inside two exhibition rooms by many requisites. The neon-light interior contains hilly landscapes assembled from current newspaper clippings, formed into a collage on four tables, upon which model railways run around oversized mushrooms. Everywhere parts of texts by Marcus Steinweg’s philosophical reflection on Nietzsche can be found.

Fig. 4: Thomas Hirschhorn, Doppelgarage (2002)

2.2 Results Achieved by Terrestrial Laser Scanning

At first the exhibition hall itself has to be generated sometimes as part of the artwork itself (see “Doppelgarage”) or as reference system to orient the different artifacts inside. After registering the point clouds scanned from more different perspectives, slices, representing the topology of the whole installation, could be created (see Fig. 5). Also every distance from any object to another could be measured immediately in the point cloud. From defined slices through the scanned points different plans or views of interest can be derived. Easier structured part of the installation like boxes, cylinders and cones can be constructed directly in scanner-software to three-dimensional CAD-objects. In combination with common CAD software tools it is possible to create more complex 3d-models. In this case an adequate interface is necessary which supports export/import-functions of these objects. Alternatively, plug-ins may be used to provide the point cloud for processing in common CAD systems. Thereby ground plans and different views can be determined (see Fig. 6) and printed in user-defined scales.

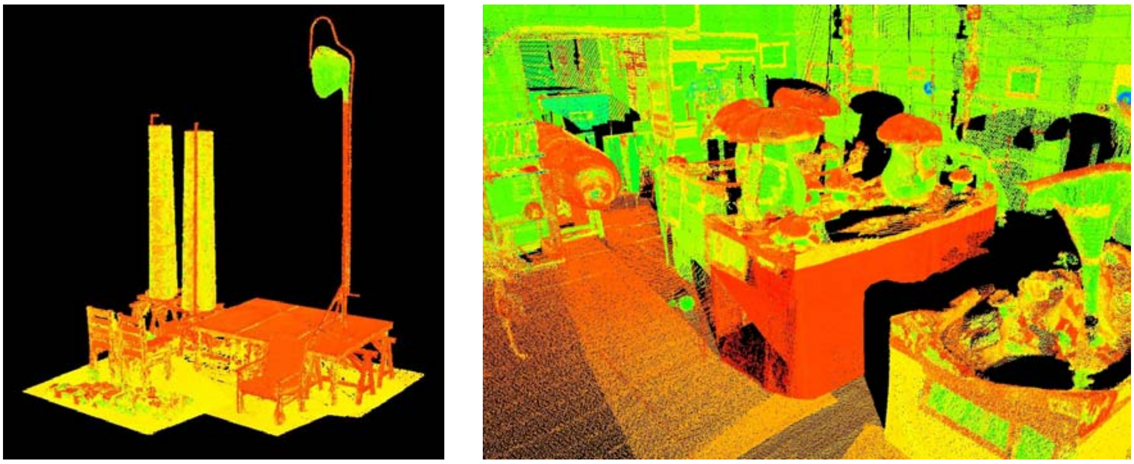

Fig. 5: Point clouds of Silent Factory and Doppelgarage

The advantage of laserscanning is an almost complete digital copy of the installation (Fig. 5). The geometry of the exhibition room is normally also included as well as neighboured exhibits. With terrestrial Scanners you have problems with very small objects (< 2 cm in size), because of the instruments precision and laser beam diameter, and with detailed, dense constellations in accommodation, like the landscapes with mushrooms seen on the right screenshot in figure 5. There are a lot of black areas, where the laser beam couldn't hit any target even after more different scannerpositions. In those cases close-up range scanners may be more helpful alternatives.

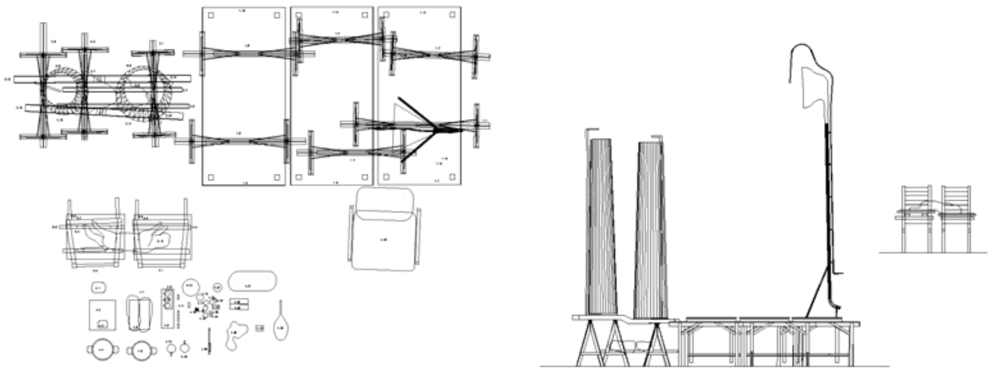

Fig. 6: Groundplan and detailed views from cuts, derived from a 3d-model, which is based on laserscanner data

Digital rectified photos help to document areas, where terrestrial laserscanning breaks down. Especially flat objects are suited for this method. So during the teardown process of

Hirschhorns installation pictures of the walls were taken by a digital camera, after the interior objects were already disappeared. The needed tie-points were acquired with a reflectorless measuring total station. Rectifying them using laserscanner points might be possible, too – if the scan resolution is dense enough.

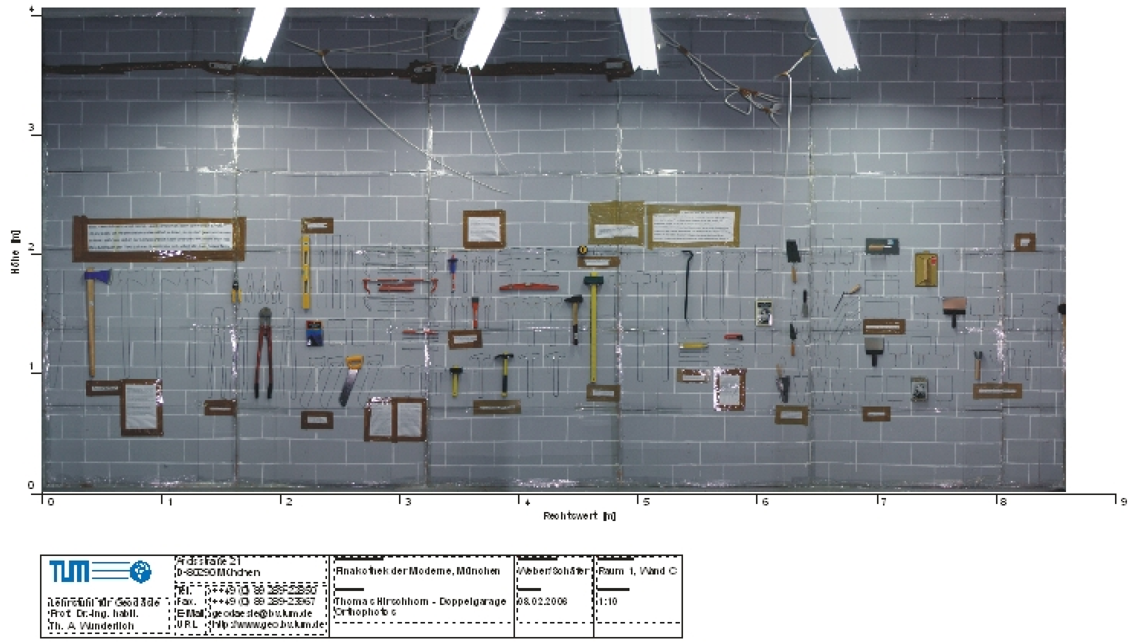

Fig. 7: Example of a digital ortophoto-plan printed in scale 1:10 representing one wall of the installation “Doppelgarage”

At the end all modelled CAD-objects got the corresponding inventory number from a database, where every artefact is listed with a small description of its appearance and its material attributes, which is important for restoring and preservation of course. Also the coordinates defining the artefacts position inside the artworks coordinate system are listed there and thus they can be staked out by a surveyor during a rebuilding process in future.

3. MODERN DESIGN “FUTURO”

3.1 About Futuro

In 1968 a ski cabin or holiday home called “Futuro” has been designed by the Finnish architect Matti Suuronen, the prototype no.000 was completed in 1968, too. The exceptional habitation design was standing on a steel foundation ring perched on four legs. It was made up of 16 fibreglass sandwich elements insulated with polyurethane foam, 8 thereof formed the house top and the remaining 8 elements put together the bottom of Futuro. One of the bottom segments included a moulded access door, which looked like a jet plane’s door: when pulled down, it served as the front steps. Into the top, 16 acrylic window elements were installed. The standard interior fittings consisted of six special bed-chair combinations, a

double-bed recess, a combined fireplace and slab that also served as a grill, a kitchenette, and a bathroom with a toilet. Futuro could accommodate eight people. Partitions could be used to create temporary "guest rooms".
Today neither original plans of Futuro design nor detailed plans of furniture exist. It is supposed that the Futuro-shell is an ellipsoid with 8 metres in diameter and 4 metres in height.

Fig. 8: Futuro, Berlin, Germany (www.flyhi.de)

It is not known how many Futuro houses have been built but the estimation is around 60. It was presently noted that Futuros exist in following countries: South Africa, China, Japan, Malaysia, Vietnam, Australia, New Zealand, USA, Canada, Russia, Estonia, Sweden, Norway, Finland, the Netherlands and Germany. In the recent years, Futuro has been part of many exhibitions. A transformation from a utility building to an art icon has taken place (Home & Taanila, 2002).

3.2 The Surveying

In 2004, "Die Neue Sammlung" of the National Museum for Applied Art in the Pinakothek der Moderne started a project for analysis and documentation of the Futuro house no.013, which is standing in Berlin (Fig. 8). The Chair of Geodesy was asked to do the surveying in which Futuro's geometrical shape had to be determined and finally a three-dimensional model should be generated. For surveying laserscanner technology has been chosen, because it offers contactless measurement of a lot of datapoints within a short period of time. Furthermore complex geometries can be easily mapped in detail due to high point density. The laserscanner HDS2500 and HDS3000 by Leica Geosystems was used. 62 targets have been tagged onto Futuro. The house has been surveyed from 21 scannerpositions, for some of them gaging from a lifting platform was used (see Fig. 9). Alltogether about 17.5 million points have been measured. In addition the tie point targets have been measured with a tachymeter in order to create a local coordinate system. The surveying campaign made a claim on two staffs for two days.

Fig. 9: Surveying from the lifting platform

3.3 Registration of Scans and Modelling of Futuro

The registration has been made using Cyclone and disposed no problems, because there were a lot of identical targets in several scans. The results of the registration are orientated scans in the local coordinate system of the tachymeter. When Cyclone is used, it is possible to model planes and regular surfaces, e.g. cuboids, spheres or cylinders. Due to the fact that Futuro with its interior furniture consists of a lot of free-forming surfaces, only a few of them could be modelled using Cyclone, e.g. the base frame, see Fig. 10. The remaining modelling has been done in the CAD-software Allplan/Allplot FT from Nemetschek AG. The required parameters, cross sections and polylines have been derived from Cyclone for modelling.

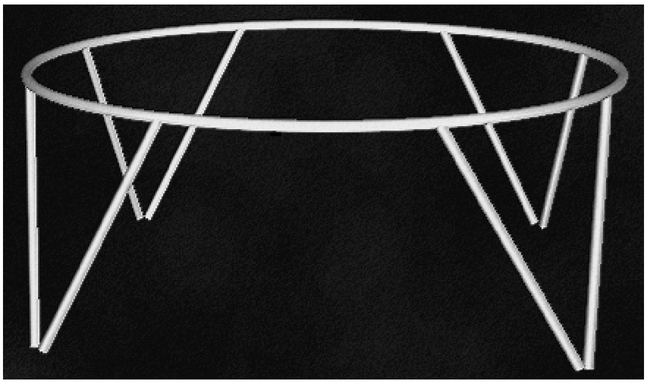

Fig. 10: The modelling base frame

A self-developed software tool classifies surfaces of second order degree, qualified Futuro's basic shape from the registrated point cloud as a rotating ellipsoid. The semi-major and semi-minor axis have been calculated by adjustment theory with a = b = 3.925 m ± 1 mm and c = 1.891 m ± 1 mm. The cylindrical projection was the base of the transformation from the local cartesian coordinates into the ellipsoidal coordinates. The ellipsoidal coordinates allow

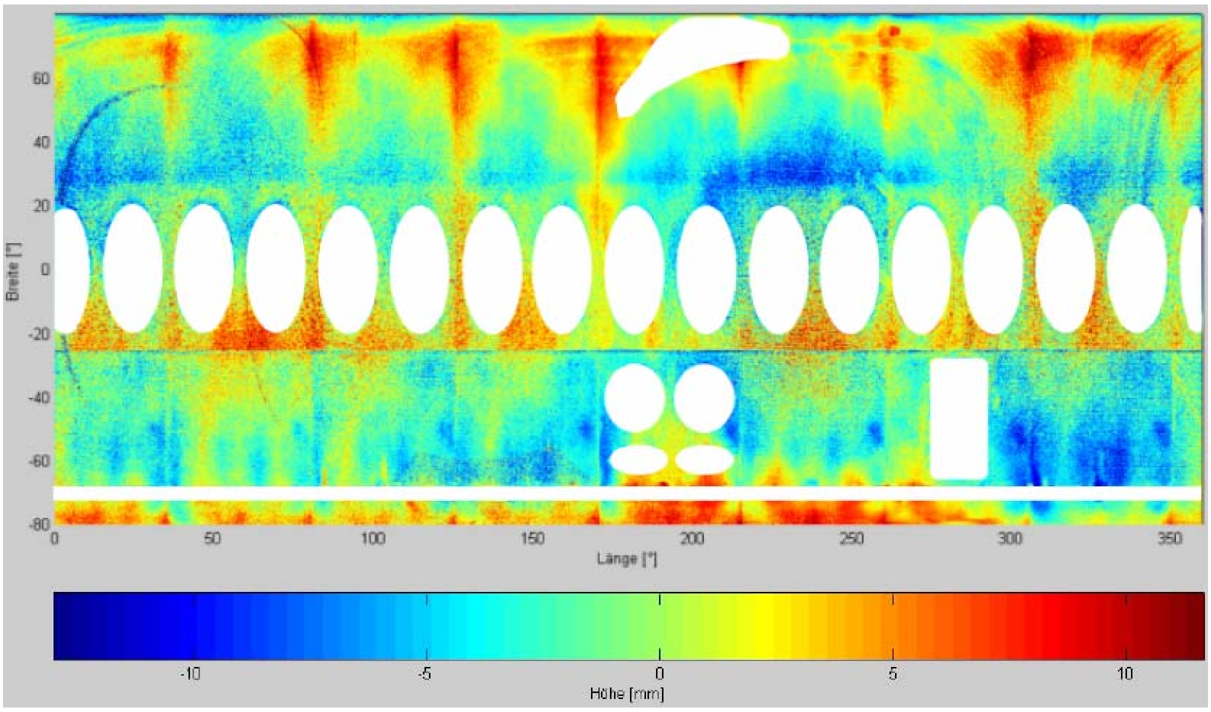

Fig. 10: The ellipsoidical coordinates of the Futuro´s surface

the analysis of Futuro's surface because of the ellipsoidal heights. The residuals to the nominal ellipsoidal surface shown in different colours in figure 10 inform about potential deformation areas of the Futuro object. The segmentation of the futuristic habitation design into 16 sectors can be recognized by the eight vertically and one horizontally line pattern.

The subsequent modelling in Allplan/Allplot FT supplied among others following results: two-dimensional sectional drawings have been generated in addition, (Fig. 13 and 14). The calculated parameters of Futuro's surface and other information of the point cloud from Cyclone allow the digital reconstruction (Reverse Engineering) of the construction plan that will be used for the documentation and visualization purposes of the architectural design.

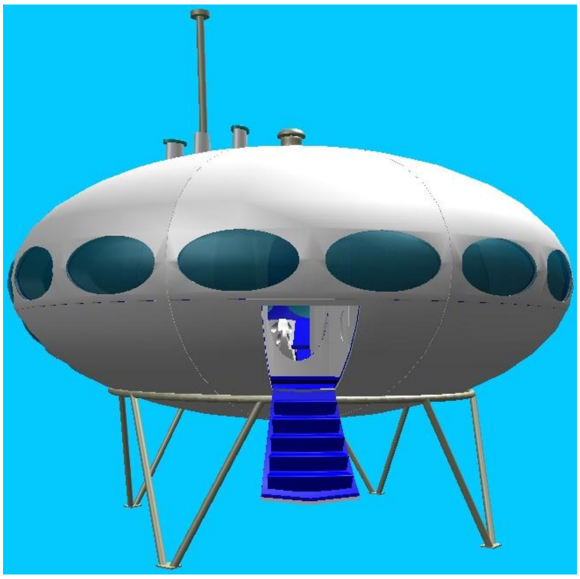

Fig. 11: The exterior view of Futuro

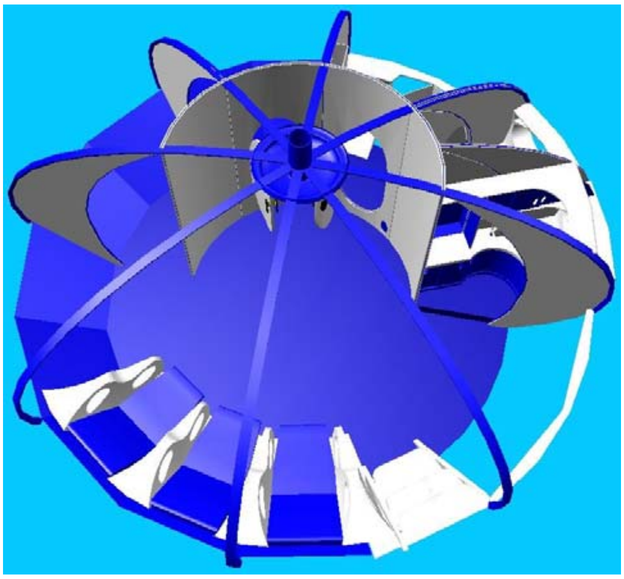

Fig. 12: The interior view of Futuro

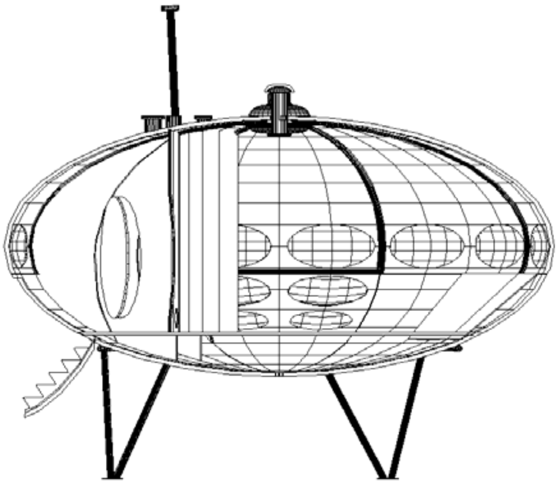

Fig. 13: The profile of Futuro

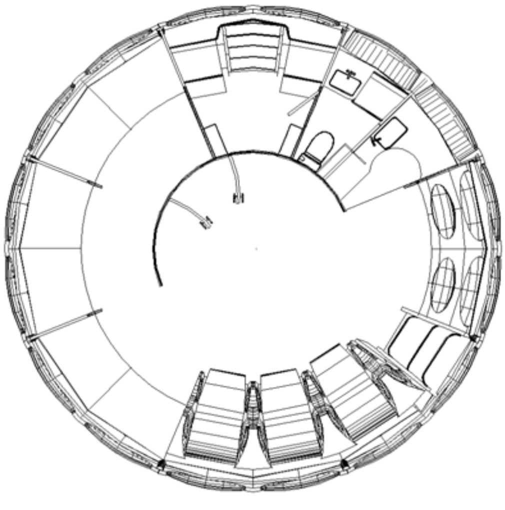

Fig. 14: The ground plan Futuro

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BIOGRAPHICAL NOTES

Thomas Weber
Graduated in August 1999 in surveying at the Technische Universität München, Germany. Since January 2000 he is working as an academic assistant at the chair of Geodesy at the Technische Universität München.

Katharina Ratke
Graduated in March 2006 in surveying at the Technische Universität München, Germany. Since that time she has been working at the Chair of Geodesy, Technische Universität München as an academic staff.

CONTACTS

Dipl.-Ing. Thomas Weber, Dipl.-Ing. Katharina Ratke
Technische Universität München, Chair of Geodesy
Arcisstraße 21
80290 Munich
GERMANY
Tel. + 49 89 289-22850
Fax + 49 89 289-23967
Email: geodaesie@bv.tum.de
Web site: www.geo.bv.tum.de