REDEVELOPMENT OF A QUARTER WITH SUPPORT OF ARCHITECTURAL AND SUBSURFACE PHOTOGRAMMETRY

Markus Eichholz, Jürgen Heckes, Landolf Mauelshagen, Karin Möhrke, Ursula Seebacher

Deutsches Bergbau-Museum (DBM) der DMT-Gesellschaft für Lehre und Bildung mbH, Am Bergbaumuseum 28, D-4630 Bochum 1, F.R. Germany

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ABSTRACT

In interdisciplinary cooperation a team of archaeologists, architects, architecture and art historians, conservators, geologists and photogrammetrists tries to set up within the scope of a pilot study the basis to redevelop an urban area of Oppenheim/FRG at the river Rhine. The medieval town has got a lot of underground cavities, vein systems and cellars, which are of historical interest. The recording, inventorying and exploration of the complex phenomena are wished for finding out contexts of town development, construction, dating, function, house types and general typology. Terrestrial photogrammetry (Rollei 6006 Réseau) as well as light profile recording based on geodetic control serve as the means for producing plans, profiles and sections of surface and underground installations. All constructive elements, that have been evaluated by an analytical plotter Zeiss Planicomp C100 or that are related to out-door work, can be combined by a CAD-system and plotted. An option are even 3-D-plots. Photos, which are scanned and digitally rectified by a computer, can be fitted into cross sections. The output is done by a printer. All the various representations are used by different researchers, town planners and stress analysts.

INTRODUCTION

The term "subterranean cavities" expresses such excavation pits, which have been often developed by miner's experience but which served exceptionally for the winning or exploitation of mineral basic material and were more used for living, working and depot purposes. subsurface openings, Such "buildings", whole urban quarters can be proved since the bronze age and exist in many regions of the earth. The most famous complexes are situated near Göreme in the central part of Turkey, in the loess areas of China, in the Soviet Union, in Czechoslovakia, in France, in the tuff areas of central Italy and in Germany. Sometimes rather complex mixed shapes are now existing between above ground and underground architecture.

These subsurface "towns" have been driven into the soft material in place, they possibly have one or more entrances, can cover several levels and are often supplied with ventilating and draining systems. For making the life comfortable in such housings, the buildings are architecturally grouped and provided with installations for the daily need, which have been formed out of the material in situ (Leiszring et al. 1990, Slotta 1990).

HISTORICAL REMARKS AND ACTUAL SITUATION

The small romantic town Oppenheim on the left bank of the river Rhine, which is well-known for its wines and festivals as well as for its historical centre, is marked by an eventful history. In the 8th century it is mentioned for the first time, in the 13th century it got its freedom and flourished as a place of trade to the north, where palatial edifices were built. From this time the first underground store-rooms could definitely be dated. The wide expanded subsurface systems (at the slope between the castle and the old Rhine bank), veins, halls, cabins, manholes, springs and cistern,

served the citizens as hiding-places and protection during the Middle Ages, where misery and pestilence, fires and wars shook the town in a terrible manner. The overhead town was almost totally destroyed during the 17th century by the Spanish under Spinola (1620), by the Swedish under Gustav Adolf (1631), by the Imperialists (1634) and by the French under Mélac (1689) (Brockhaus 1898).

of the Fortunately most "undergrounds" survived and bear witness of the past. Although the inhabitants were in the know of the subsurface systems since centuries. used at last in the second world war, they did not have exact about the stability knowledge of the multi-storied conditions cellars, which probably were combined and which are even situated under streets and other traffic lines. The vaults and tunnels are constructed variety in a of different shapes (round arch. catenary, triangle form, pointed gable, cross vault) and techniques (sealing, stone work, belt, rib, cf. Fig. 1 - 4)). A lot of systems have meanwhile been closed by masonry, others filled up with concrete and rubbish, some of them collapsed. Such cave-in can have different reasons: weathering of supporting vaults and walls, drainage and underground water, which flushed the soft loamy strata of the tertiary period or the underlying fractured chalk stone, so that problems of stability are arising. There might exist even unknown subsoil cavities, that can be detected by geophysical surveying.

Until today some thirty local depressions happened in the town, so the municipal council had to bring out a programme to solve these problems of stability and to save its architectural heritage. Three above ground and underground objects were chosen for a first pilot study. The complexity of the task concerning documentation and research requires interdisciplinary co-operation of specialists from

archaeology, architecture, history of architecture and art, conservation, geology, geophysics, photogrammetry, restoration and statics with the support of the town council Oppenheim and the Land Rhineland-Palatinate. The following institutions were involved in the project: Land Office for Cultivation of Monuments, Section for Middle Ages' Archaeology and Monument Research/Mainz, Geological Land Office/Mainz, Limited Company Darmstadt, StadtBauPlan DeutscheMontanTechnologie, Institute for Applied Geophysics, Institute for Water- and Ground-Protection and DBM-Department for Photogrammetry / Bochum. All together they evolved the basic materials for construction works, which can yield to the redevelopment of the historical centre under high financial expenditures.

DOCUMENTATION, METHODS OF SURVEYING AND MONUMENT RECORDING, CARTOGRAPHY, GEOLOGY, GEOPHYSICS

The documentation of the actual inventory of the three complex constructions is preferably organized by a homogeneous basic data bank, which can be handled by the users of the different subjects. photogrammetric Surveying and methods can produce the foundations for a later cartographic lay-out by evaluation at a CAD-system, for the judgement of statics and for the construction activities, which can be drawn off this estimation to garantee safety for the buildings and prevent dangers. The base for all surveys is the above ground land-register grid (coordinate system). Starting on the cadastral points the natural photogrammetric control points at the buildings and points for site plans were determined by means of an automatic electronic tachymeter Zeiss Elta 4 as well as the control points underground via polygonal course (accuracy: cm). Points, which symbolize the characteristic features of the cellar geometry, were recorded too

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information. In narrow spaces and niches details were measured by hand Much more informations for a metric evaluation can be achieved by a stereo-photogrammetric documentation and by photos from a light profile projector (developed by J. Heckes). The last mentioned were taken at representative profiles of a vein or gangway (single image middled format photogrammetry, camera, cf. Fig. 6, 7). After the measurement in a plotter the photo profiles can be combined geodetic arithmeticly by observations for producing three dimensional representations or for calculating volumes. All stereo-photos were taken freely positioned with a partial metric camera Rollei 6006 Réseau (121) with automatic film. aperture and Zeiss transport using a lens Control points

and lead to a generalized line

Distagon 40 mm. served for the model orientation at plotter analytical an Zeiss Planicomp C100. The roughly stereoplotted structures (Fig. 5) and façades are treated in an up-to-date way by the CAD-System AutoCAD (Autodesk 1989). The lines and polyline-segments, even as verv small increments, are registered during the plotting on the HP 1000 computer of the plotter and transfered to a PC (DXF-files) and be handled can with a11 of possibilities modern CAD (Mauelshagen et al. 1990). A11 geodeticly determined co-ordinates are loaded as a data bank into an AutoCAD-file and treated On graphically. the screen the treatment and revision of photogrammetric plans and "geodetic" graphs are performed in layertechnique. Because of the same coordinate system (above and underground) the illustrations are joined together and plotted by a HP-DraftMaster using additional layer informations from a "catalogue" as map frame, legend, signs, colours etc.. Longitudinal and transverse sections, profiles and ground plans are elaborated. They are all

situated at representative positions or levels and show a lot of special and differentiated signs (Fig. 6, 8 - 12, original scale 1 : 50, colours for different specific features and perceptions). Even scanned photos can be fitted into sections as pixel images (Fig. 9, rectified arch). The cartographic concept is based on structural and editing drawing files. which includes the integration and implementation of features and informations from other research fields. The composition of the different layers depends on the themes, which the ultimate user considers as important, outstanding and significant.

At some places the archaeologists down an excavation for brought finding a better dating of the (Fig. 10). cellars Geophysical refraction surveyings, such as seismic, seismic in combination with drillings, electromagnetic induction and georadar (Rüter et al. 1989), detected. where dangerous and espescially dangerous parts are situated (Fig. 11); the analysis of data is still going on. The geologists took soil and water samples for finding out shear. grain-size distribution and plasticity (Fig. 12). All results of the pilot study will into drop the concepts of redevelopment for the whole overhead and underground city Oppenheim. May be that in the near future a lot of the undergrounds can fortunately be used as wine caves and will be an attraction for tourism.

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Fig. 1



Fig. 2



Fig. 5 Rough stereo-plot of a double storied underground scene of Oppenheim







Fig. 4

Fig. 1 - 4 Rollei 6006 Réseau photos of different shapes of arches, tunnels and vaults from the underground of Oppenheim

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Fig. 6 Reduced underground-plan, Merianstr. 18, Oppenheim, with some profiles (light projector)





Fig. 7 Two photos made by the light profile projector from an underground passage

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Fig. 8 Photogrammetric plot and longitudinal underground section from the western part of Merianstr. 1-3, Oppenheim



Fig. 9 Enlargement of the inferior part of the underground section Fig. 8 with fitted pixel image (rectified arch)

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Fig. 10 Enlarged but reduced part of the underground-plan, Merianstr. 18, Oppenheim, with archaeological elaborations



Fig. 11 Ground-plan of the subsoil including the ground-floor, Merianstr. 18, Oppenheim, with signs for dangerous (hatching) and particularly dangerous parts (cross hatching) - geophysical research -



Fig. 12 Reduced underground-plan, Merianstr. 1-3, Oppenheim, with geological specifications (diagrams: shear, grain-size distribution, plasticity)

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