

# 3D-PHOTOMODELS AND DIGITAL METRIC IMAGES - THE USE OF NEW TECHNOLOGIES IN ARCHITECTURE AND MONUMENT CONSERVATION

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Photogrammetric single image techniques, like the generation of rectified images and image unwrapping methods are well suited for use in architecture and monument preservation. They combine true scale geometric measurements with full image information under quite inexpensive production costs. Digital image processing methods play a more and more important role for the production of rectified images. Because of the increasing performance of personal computers as well as the availability of necessary peripheral hardware, like CD-writers and photorealistic printer and laser imaging units, rectification with analogue equipment is no longer necessary today. Especially the PhotoCD delivers good requirements for digitising and storing digital image data for photogrammetric purposes.

Besides the rectification of digital metric images, in many cases a 3D-visualisation of the whole building is desirable. In contrast to a simple visualisation, the use of 3D-models in restoration and monument conservation requires a high degree of detailed information and exact measures in the model. For this purpose, a 3D-photomodel has to be constructed on the basis of geodetic and photogrammetric measurements. A 3D-photomodel consists of a three-dimensional CAD-model, which describes the shape of the building and the image information that is wrapped over the CAD-model with the correct position information. Because of the high accuracy, which is required for conservational and restorational purposes, the CAD-model and the images have an exact coordinate reference in a unique coordinate system. Depending on the required accuracy and the degree of detail information, we choose different approaches. But in every case we use exact geodetic information and rectified images for the construction of the 3D-photomodel.

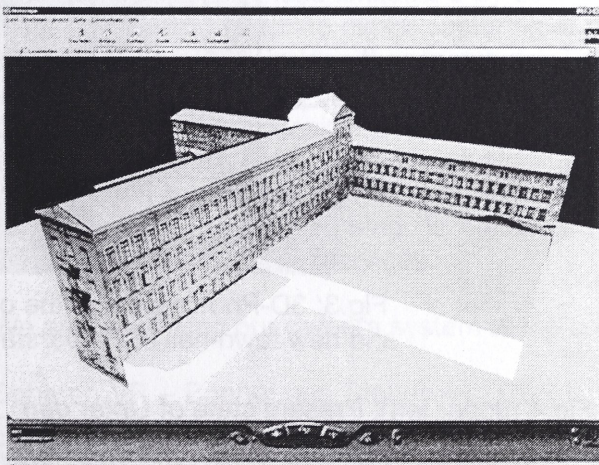


Fig.1: 3D-Photomodel of furniture factory in Lunzenau in a VRML-Browser



Fig.2: 3D-Photomodel of furniture factory in Lunzenau, detail view



The easiest way to build and view a 3D-photomodel is the construction of a VRML-scene directly from the rectified images with the help of a 3D-CAD-model. For this purpose, Fokus GmbH developed a new software (Fig.1 and 2). The input data for this software consist of a 3D-model and rectified images. The 3D-model has to be created from geodetic measurements for instance with Autocad in DXF-format. The rectified images and the belonging reference information can be directly imported from the rectification software *EDDI-2D* which is available from the Fokus GmbH, too. A special feature of the created photomodel is the interactive functionality. By double clicking on a part of the photomodel, the user gets more information about the chosen part of the building and he can directly go to the rectified image in order to make detailed measurements. Thus, the photomodel becomes the visual user interface of a metric image data base system.

For higher quality demands with more detailed information, the resolution of VRML-scenes is not sufficient. In that case the 3D-model has to be constructed with more details. The data for that 3D-model can be determined for instance by photogrammetric methods. If the building was destroyed, a lavish construction on the basis of historical plans is necessary. After that, the rectified images can be wrapped over the 3D-model with the help of a 3D-rendering software. Fig.4 shows the result of such a work. The 3D-photomodel of the town hall in *Halberstadt* was derived from present and historical images and shows the building after a possible reconstruction. The texture of the historical part of the building was completely taken from historical photographs taken by Meydenbauer in the year 1896. The figure is an image from a digital animation, which lets you walk around the historical building.

As you see, also historical photographs can be used to visualise the authentic state of historical monuments in a three-dimensional way. In some cases, it isn't possible to build a CAD-model, because there exists no measure information about a destroyed building. But under special conditions it is possible to calculate the camera viewpoint of a historical photograph. With this information an image of the present state of the surrounding area can be taken and laid over the historical image (Fig.4 and 5).

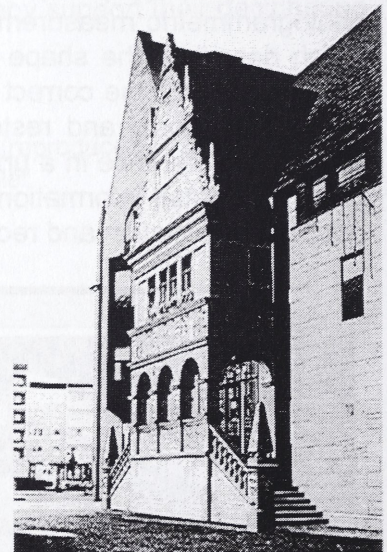
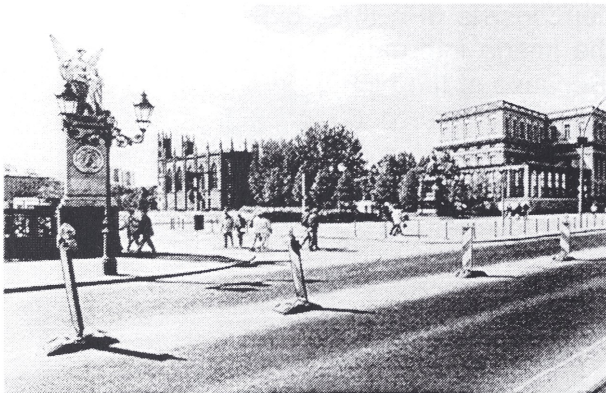


Fig.3: 3D-Photomodel of the old and new town hall in *Halberstadt*

Fig.4 (upper left): Present state of *Unter den Linden 1*, Fig.5 (lower left): Photorealistic visualisation of the destroyed *Kommandantur* in today's surroundings