Visualisation of opencast mine planning

Alexander Dohmen
Technische Fachhochschule Georg Agricola, Bochum, Germany

Marc Dohmen
DOHMEN, HERZOG & Partner GmbH, Aachen, Germany

ABSTRACT: For the surface mining the visualisation of the planning data becomes more and more important. First the digital planning models were mostly used to estimate the reserves and the shape of the ore-body. Today the inhabitants who will be affected by the opencast mine claim to be informed how the landscape will look like during the mining-operation and later on. The paper shows the support of modern mine-planning software.

1 *INTRODUCTION*

In the mining industry digital systems for modelling the topography and the deposit itself are well known as the first step towards a later mining operation (see figure 1) (N.N. 1990) The figure 1 shows a cross section of a hard rock mine in Germany. You can see the ore body and the overburden. Also you can see the drilling holes.

The quality of the models and the reliability of the calculations of overburden and mineable reserves for instance are today mainly an economical question depending on the effort which is put into the geological information on the one hand and the method of calculation on the other. Till these days the question of presenting the results how a mine looks like was not so important. But this has changed.

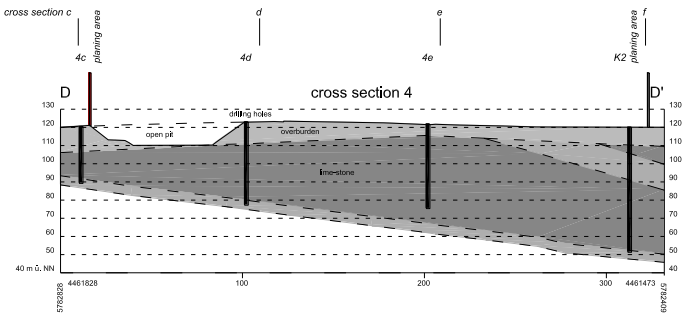

Figure 1. Cross section of a Hard rock open pit mine (lime-stone).

Any opencast mine will cause an environmental impact as it is shown in figure 2. This impact is limited in time, but of considerable local importance. Therefore opencast mine planning has to consider basic environmental requirements and legal preconditions right from the beginning, e.g. by accepting migitation schemes. Yet the requirement profile on the planning is much more presumptuous today. Public sensitiveness and concern in connection with opencast mining are permanently increasing in such densely populated regions as in Germany.

Figure 2. Aerial photograph of a lime-stone mine.

2 MINE MODELS

The concept of the mine layout - today mainly done by CAD-systems - has always been presented in a set of two-dimensional maps (see figure 3). Typically these are plan-view presentations of successive mine workings. The ground plans show – by means of upper and lower bench-edges as well as contour lines – the sequence of the mining and dumping operations. Furthermore, they contain sensitive objects, such as truck ways, operation buildings and plant installations or supply lines. The working plans also

show the reclaimed areas and their intended future utilisation. As a rule, these two-dimensional presentations can only be read and understood by experts and are usually not sufficient for a public discussion of the mining venture. A first improvement to a better public presentation was achieved by the integration of aerial photographs into the still two-dimensional ground maps (see figure 4). As you can image the understanding of the mine still looks like difficult for the public (Dohmen, Czerwonka 1997).

Larger opencast mine operations in Germany must be presented to the public authorities by the mining company and are subjected to an approval procedure with public participation (see figure 5).

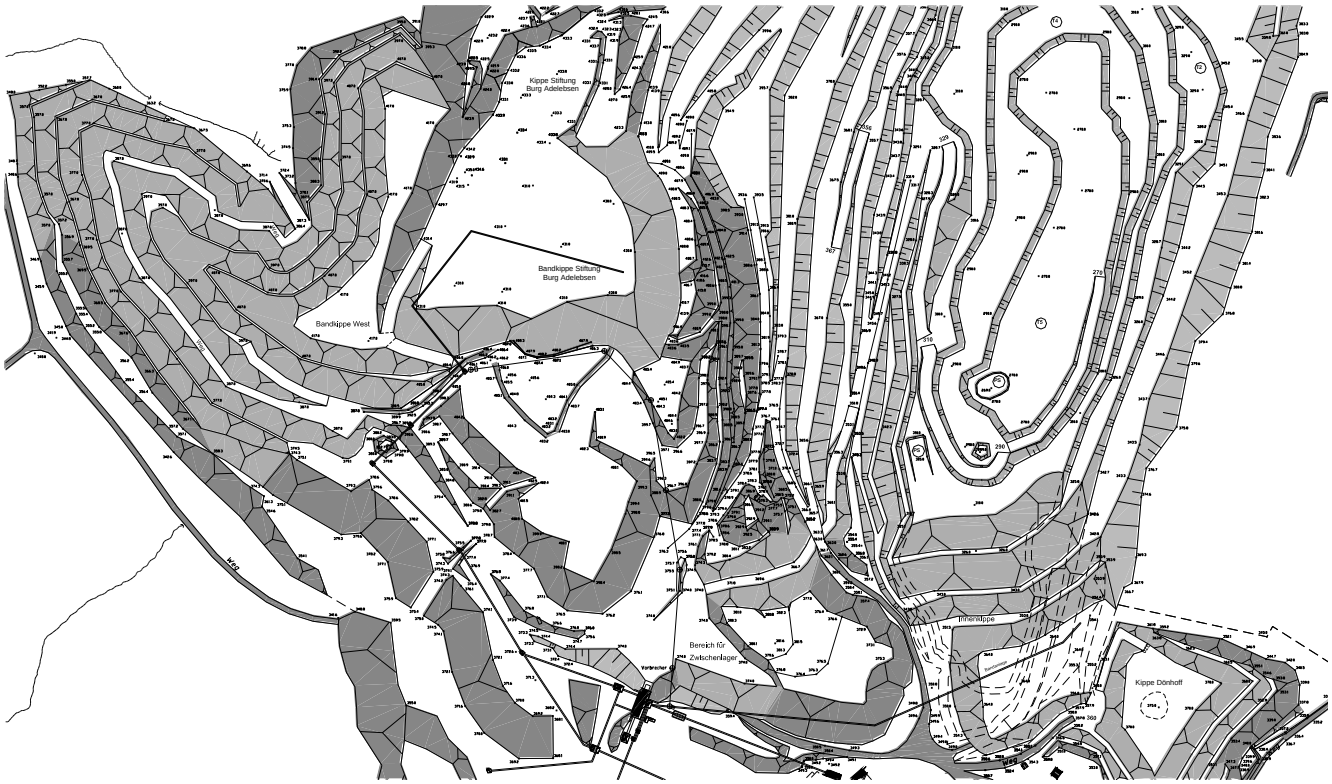

Figure 3. Open pit planning.

Figure 4. Ground plan with landscape view.

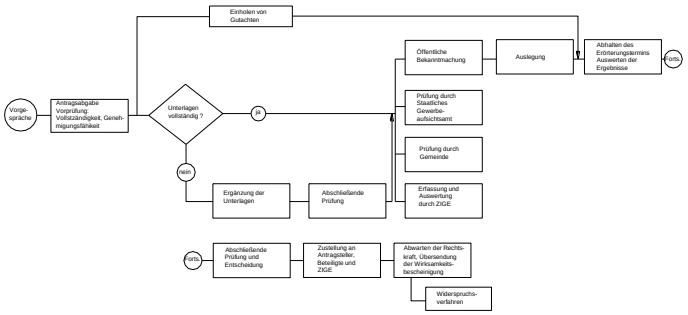

Figure 5. Flow chart of getting public permit for a mine operation.

On order to get a public permit for operating an opencast mine you have to draw up several expertises evaluating the effects of mining on the landscape, ground water, the flora and fauna, and on human health caused by dust, noise or explosion shock waves. All theses studies have do be presented in public meetings.

Consequently, a presentation of the mining venture and its effects on the landscape in a manner as realistic as possible is of steadily increasing importance. The real operational planning recedes more and more into the background (Fleckenstein 1998).

3 SURFACE MODELS

The three-dimensional surface models (DTM i.e. Digital Terrain Model) are mostly based on terrestrial or photogrametric surveying. In our example you can see the surveying data are calculated by the program-software AutoPLAN to a three-dimensional surface model using linked triangles. This model is the basis for further planning. The AutoPLAN software contains several modules for the construction of the mine-layout. For instance scarps, benches or ramps

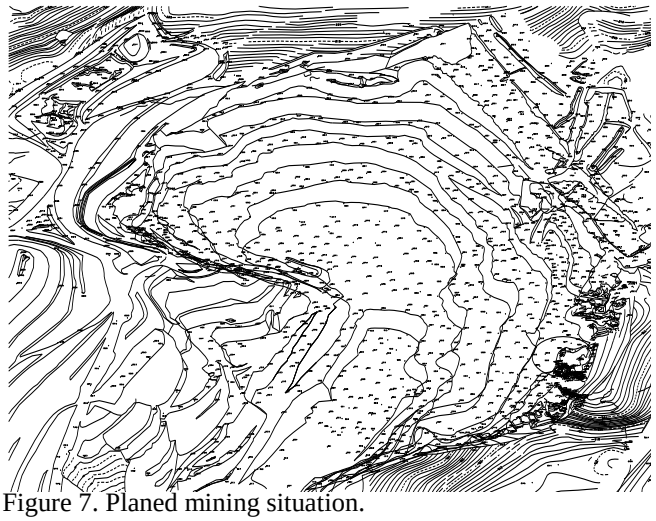

Figure 7. Planed mining situation.

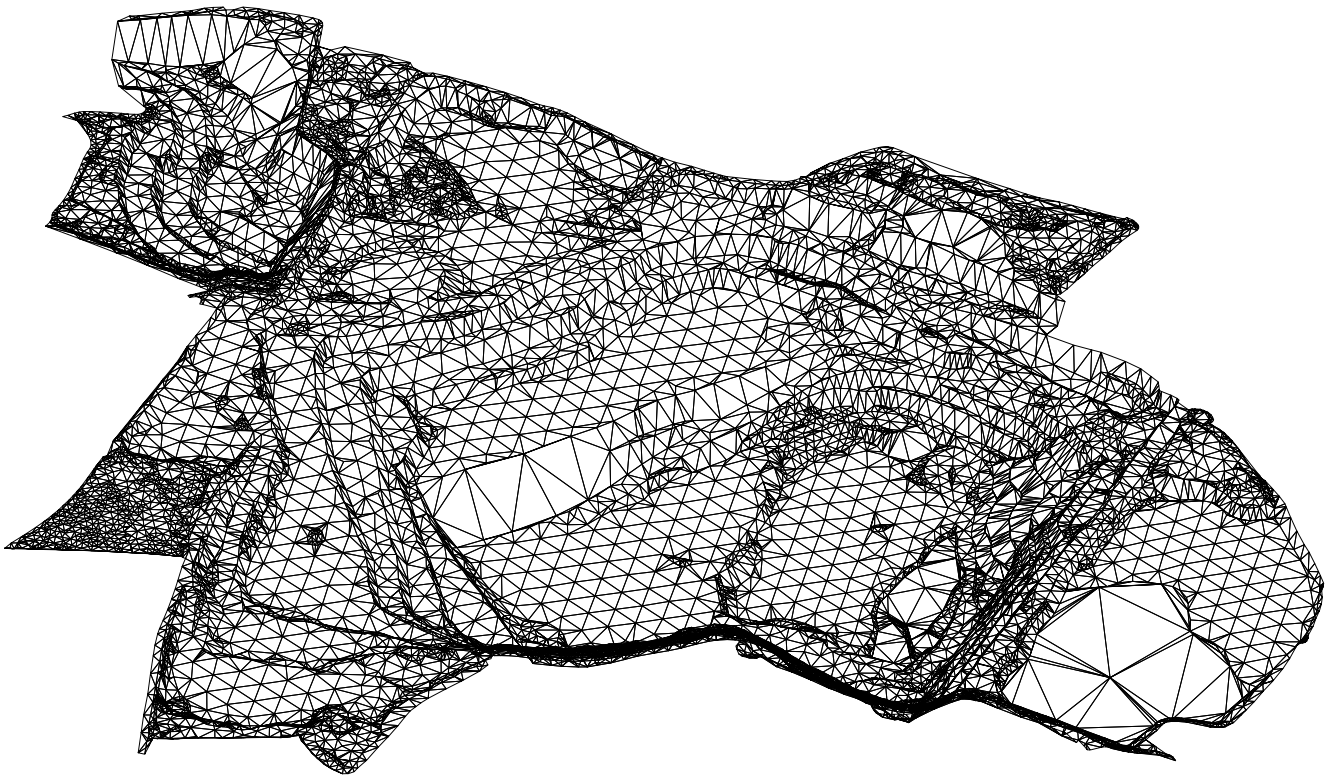

Figure 6. The topography of a mine with DTM.

The database of opencast mine plans is stored three-dimensionally in the computer. Thus three-dimensional surface models can be easily produced (see figure 6).

can easily be calculated (see figure 7). In this way the mine-layout can follow the geological conditions on the one hand and can be optimised on the other.

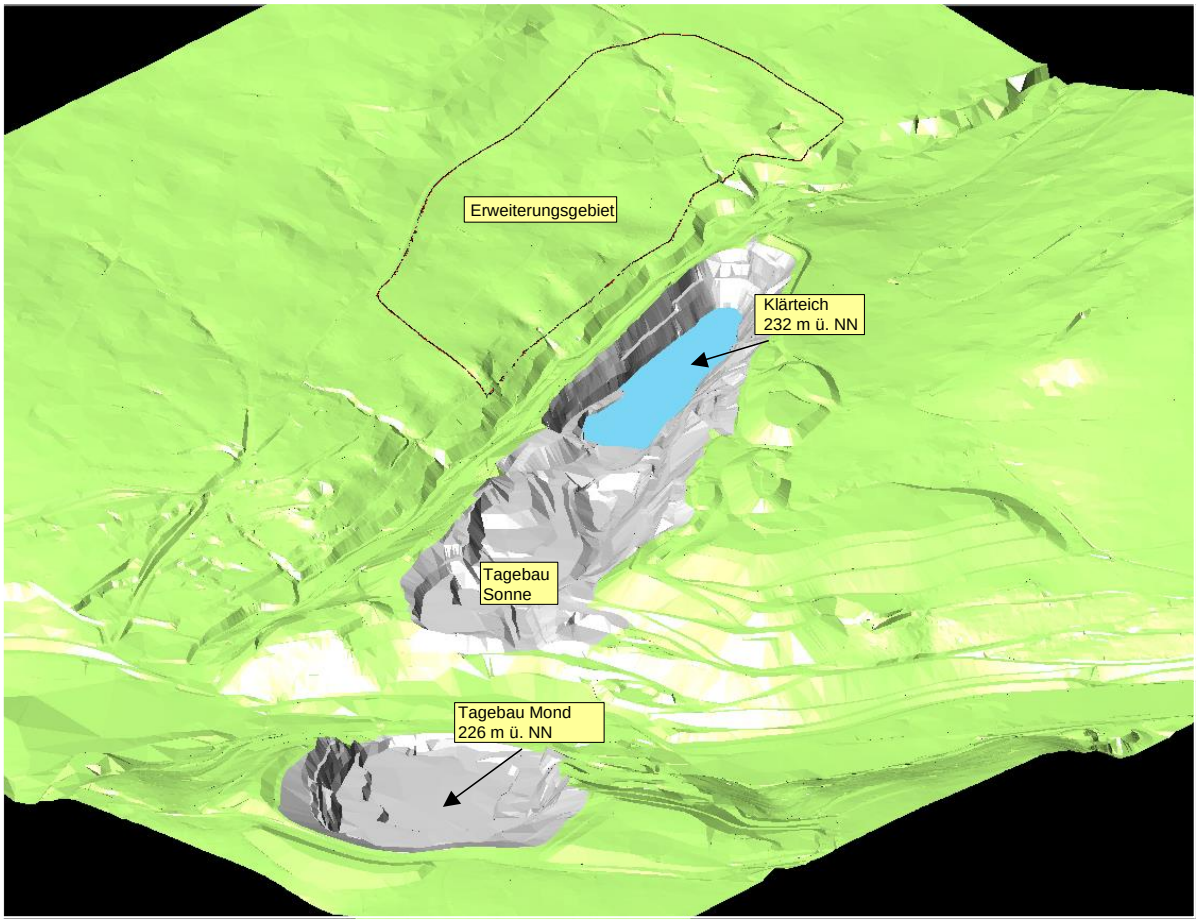

Figure 8. 3D-Model of the actual open pit situation.

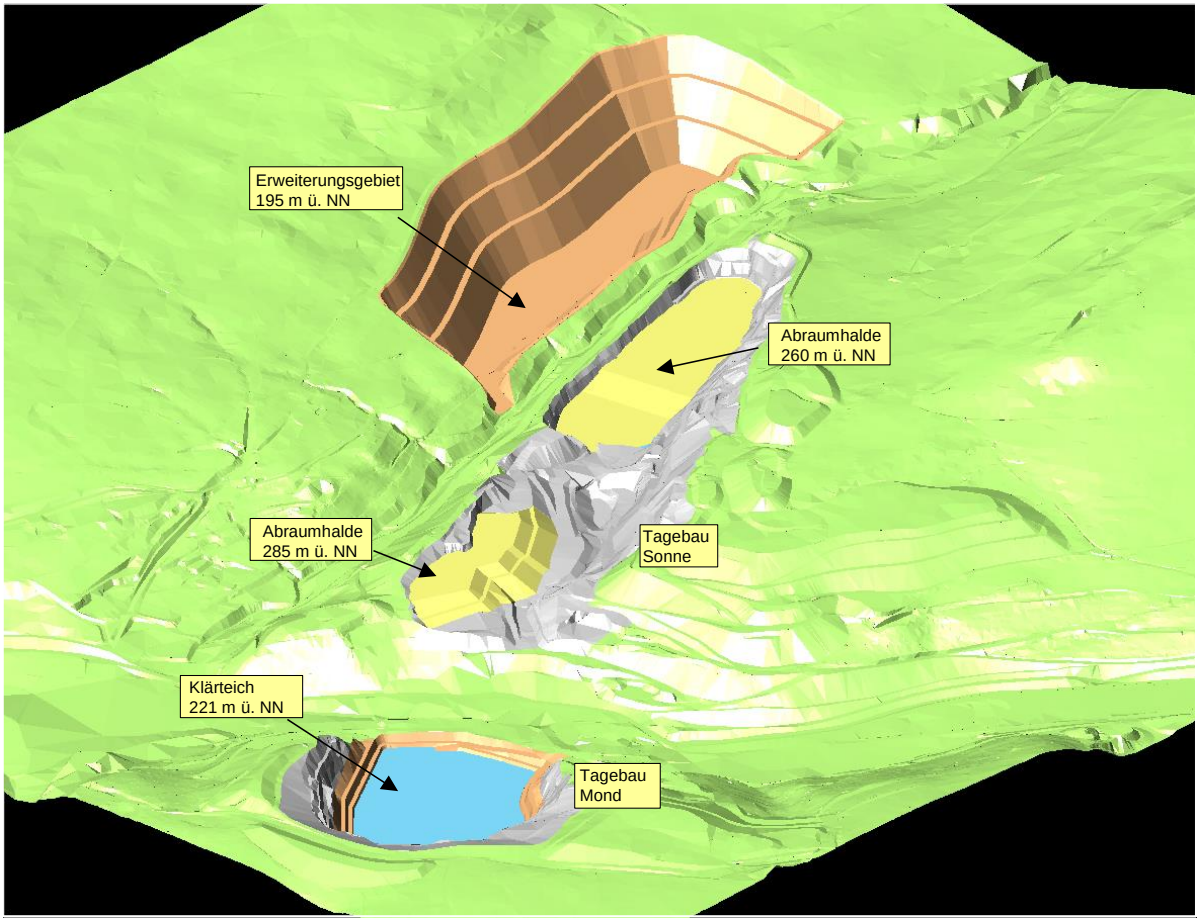

Figure 9. 3D-Model of the out mined open pit.

Figure 10. Native topography

Figure 11. Mining face

Figure 12. Refilled final stage of opencast

The calculation of the volumes of reserves and overburden is done automatically as well as any cross section. The planning of the waste dams inside or outside the mine is analogue. Further details are given by the program for instance the distances for the loading and transporting equipment. Also the program gives advice for the best place of the primary crusher or the water pumps.

Today photo-realistic pictures of the landscape can be integrated by efficient software. This procedure is state of the art in the presentation of building projects (see figure 8 und 9). Such models with varying perspectives convey a much better image of the mining operation to the layman. Mostly, these three-dimensional models are restricted to the direct neighbourhood of the open pit, otherwise it would be a large-scale task. Furthermore, the morphology of the terrain with its diverse forms of utilisation is manifold and can thus only be presented in voluminous landscape data bank.

Of primary interest in the public discussion are to demonstrate the effects of the mining operation on the surrounding neighbourhood as a whole, especially with regards to changes in the landscape. In this context a direct look into the opencast pit, e.g. from residential areas, is of special interest. For the adequate simulation of the changes in the landscape, the digital data of the mine layout are today blended with digital pictures of the landscape from such critical locations (see figures 10, 11 and 12). This procedure enables a photo-realistic, three-dimensinal view into the opencast mine project integrated into the surrounding landscape.

Latest developments include computer-animated presentation of different views into the mine.

4 CONCLUSION

A modern planning system for an opencast mine does not only help to optimise the mine layout, but gives simultaneously an impression to the public of what a mine looks like during future operation and helps to get the opencast mine accepted by the public.

5 REFERENCES

Dohmen, Marc & Czerwonka, Hans-Joachim 1997. Tagebauplanungs- und Informationssysteme. In Erzmetall 50 (1997) Nr. 11: 697- 706.

Dohmen, Marc 1999 AutoPLAN 2000 Posterpräsentation World Mining Congress 1999 Düsseldorf

Fleckenstein, Kurt & Kolb, Peter & Neugebauer, Hubert 1998. Visualisierung von Landschaftsveränderungen im Steine-Erden-Bergbau. In Steinbruch und Sandgrube 10/98: 6-8.

N. N. 1990. Ore body modeling and mine planning softwar. In Mining Engineering August 1990: 978-979.