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Digital Data for Engineering Geology: Disaster or Benefit

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Is digital data handling for engineering geology a disaster or a benefit? The first introduction of the use of digital data and the work with digital data to make geological and geotechnical models of the underground is quite some time ago. At the introduction the general feeling was that these tools would largely facilitate the work of an engineering geologist and improve the results of engineering geological and geotechnical modelling. However, digital interpretation and the use of digital modelling techniques did not yet make a break through in engineering geology or geotechnical engineering. The use is fairly limited and, if used, often confined to only visualise the results of the modelling. The benefits of a good presentation and visualisation of data and underground models should not be underestimated, but is only one of the aspects which were expected to be beneficial at the introduction of digital data and computers.

The reasons may be many, but a careful inspection of the way of working with geological and geotechnical data in engineering geology reveals a major flaw in the approach towards data in engineering geology. In the old times the traditional hand-made geological model, interpretations and interpolations camouflaged this flaw.

Before the digital times nobody in engineering geology had much interest in the accuracy of data interpolation and interpretation. Data was interpreted to the best knowledge of the engineering geologist or geotechnical engineer taking into consideration the geological environment and the available data (often a limited quantity). It was clear that the interpretation could not be quantified and nobody asked for accuracy. (Strange enough, accuracy of field or laboratory measurements has always been regarded as important). Also nobody had much interest in the accuracy of geological maps. The consequence for the average site investigation in engineering geology was that the accuracy of the geological and geotechnical model of the underground was largely unknown.

In the digital times data interpolation and interpretation are regarded as of major importance, and, consequently, the accuracy of geological maps and geological models

become major topics. One way to solve the accuracy problem of the geological and geotechnical model is to increase the quantity of data to such a level that the no expertise of a geologist is required (just interpolation). The consequence is an increase in work and thus costs.

The higher costs could be justified if it would lead to better results. This seems, however, not to be the case. Site investigations seem not to become a lot better if made with interpolation only, even not with large quantities of data.

If no large quantities of data are used, but a geological interpretation, a disastrous and unexpected site effect is often observed. Everybody, including the clients, in general civil engineers, seems to find it necessary to ask questions about the accuracy of the model. It seems that because a computer is used the accuracy of the model has to be known. In most cases (according to the author: in virtual all cases) the answer can only be: "it looks good, but for the accuracy: no idea". This confirms then the existing ideas about geo-fantacy (and geologists in general).

Hence, digital modelling in engineering geology leads then to more work, more costs, or, we show that geological models cannot be justified mathematically, and have to admit that the model largely depends on expertise only.

Is 3D modelling totally useless in engineering geology? It is the opinion of the author that 3D modelling techniques can only find a place in engineering geology if they are considerably better than the traditional hand interpretations. Then it would result in better site investigations and would lead to cost reduction for the total project.

As shown above the weakest point in engineering geology and geotechnical engineering is the geological model. The geological model is made based on the expert opinion of mostly one single geologist (or engineering geologist or geotechnical engineer). There is no mathematical justification for the model and the accuracy of the model is unknown. An improvement would be if it would be possible to use during the making of the geological model the expertise of more experts; i.e. if more than one geologist could be involved in making a model. Obviously for the average site investigation this would be far too expensive. An alternative may be the use of expert systems and knowledge bases. The knowledge base may include tools that facilitate the interpretation, but especially, should include geological standard models that in a particular geological environment can be fitted to a given set of data.

If such a database could be developed by a large team of experts the database would get the status of a reference standard. Apart from reducing the influence of a single geologist, it would also (at least partly) rebut the criticism of non-geologists on accuracy of the model (the geo-fantasy) because the geological model can be referenced to the standard model in the standard database. In Delft a proposal to start with research to the possibility of a geological knowledge base has been made. The partners so-far are Technical university Delft, Netherlands Institute for Applied Geosciences (NITG), and ITC.