Comparison of Czech and German Information Systems Used for Exploration of Geological Situation in Civil Engineering Practice

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Abstract

The main aim of publication is to compare the information systems of the institutes of Czech Geological Survey and German Federal Institute for Geosciences and Natural Resources from a point of view of information which is needed for civil engineering purposes. The information systems are a base of the modern society. Thanks to them we are able to apply older exploratory works in order to evaluate currently solved projects. An information system becomes a strategic tool to evaluate exploratory works but also for land-use planning. The Czech Geological Survey information systems consists of the database of Borehole Explorations, the Final Reports Archives and the Inventory of Landslides. These three databases are fundamental for civil engineering purposes. The German Federal Institute for Geosciences and Natural Resources information system contains similar databases. It deals with the database of boreholes and the archives of scientific reports and publications. An Inventory of landslides is not available in the German Geological Survey information system even if these questions are discussed within Geohazards. As for the basic map documents which are available online, both the institutes include a geological map, a map of soils, a geophysical map and a map of underground waters or a hydrogeological map and a map of sources or raw materials information system. On the top of that, there is an engineering geological map available in Germany.

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On the contrary, the Czech Republic disposes of a collection of maps which are not available in Germany. It deals with a map of surface water chemism, mining influence, mining maps, an inventory of risky storage areas and a complex radon map.

1. Introduction

Czech Geological Survey institute has been operating since 1919. Since then it has been developed and also it changed its name several times. Czech Geological Survey work is based on duties of the state geological survey within the area of the Czech Republic. It collects information dealing with geological composition of the whole area of the Czech Republic. Czech Geological Survey aim is to create the most complex and clearly arranged information collection which may be utilised further for important decisions of administrative authorities and also for companies that use this information within their sphere of business, such as civil engineering companies, geological companies, etc. Their necessary part of work is the evaluation of geological environment suitability within planning of construction works. The information is also available for any interested party. Coverage depends on the amount of information that has been found out on a given region within the Czech Republic and on a range of archiving in Czech Geological Survey institute. In case of some kinds of detailed information as for example a precise composition of a bore core or a final report is, these data might be a subject of payment.

There is a similar institute called Federal Institute for Geosciences and Natural Resources in the Federal Republic of Germany that has been writing its history since 1873 already with its seat in Hanover. Its aim is more or less similar as that of Czech Geological Survey institute. The following sections contain detailed characterizations of the Czech Geological Survey and the Federal Institute for Geosciences and Natural Resources (Bundesanstalt für Geowissenschaften und Rohstoffe), including comparison of accessibility of the information within civil engineering practice.

2. Usability of Czech Geological Survey Databases in Civil Engineering Practice

Czech Geological Survey (CGS) institute has its seat in the capital of the Czech Republic in Prague. All the data that have been obtained since 1919 are stored in its archive. In the past it was impossible to look through the data without a physical visit of the building of Czech Geological Survey in Prague [4].

But Czech Geological Survey continuously works on its modernization and facilitates an access to needed data for its customers. It means that a lot of data is already available online in an electronic form. This way, it is possible to look for the data online by means of the Internet. There is the so called digital archive that has been continuously extended. The system serviceability lies in the promptness and convenience of the access. Also damage of circulated documents is completely eliminated in the electronic form of access to documents.

The Czech Geological Survey (CGS) functions as the state geological survey (SGS) in the Czech Republic and performs related tasks as authorized by the Ministry of the Environment (MoE) by virtue of Act No. 62/1988 on geological work. This involves the collection, processing and provision of information regarding geological structure, protection and use of mineral and groundwater resources, and geohazards [4].

Considering the requirements within civil engineering activities when before every realisation of a civil engineering structure it is necessary to evaluate the suitability of foundation soil and geohazards that might arise within a wider area, Czech Geological Survey offers a lot of information. It deals especially with the Inventory of Borehole Explorations, the Inventory of Landslides and the Archives of Final Reports.

Information obtained from the archives above significantly saves the costs incurred on exploration of the area of interest. It might serve as primary information about the area of interest. However, in case of sophisticated building structures, the exploration of the area of interest must be performed regardless of the range of data obtained from previous explorations. The first database from the three stated above which is inseparably connected with the intention of a building structure realisation is the Borehole Explorations. The Borehole Explorations database contains principal information needed in evaluation of construction works realisation. At the same time, it deals with the largest database operated by Czech Geological Survey. Information on the individual boreholes is displayed in details by means of location marks in the form of colourful crosses on the Geological Map Server. The colour of crosses indicates the borehole depth which might range in certain limits. The shallowest boreholes are indicated by yellow colour if the depth is in the interval from 0 to 5 meters. The deepest boreholes are indicated by red crosses if the depth is higher than 500 meters. If it deals with a borehole for which also hydrogeological information has been recorded, then its
A full form of the reports is available physically in the research room of the archive building only on payment. It deals with the information that is provided by organizations which realise explorations. These organizations pass reports to Czech Geological Survey. However, they may limit the accessibility of these data according to their requirements. The Geological Maps in a scale of 1:25,000, 1:50,000 and 1: 500,000, a map of Hydrogeological Zones, a map of Surface Waters Chemism, Soil Map in a scale of 1: 50,000, Mineral Information System, Mining Impacts, Mining Maps, Inventory of Hazardous Waste Facilities, Complex Radon Map, etc.

3. Usability of German Federal Institute for Geosciences and Natural Resources Databases in Civil Engineering Practice

Germany disposes of publicly accessible information as well as the Czech Republic. Apart from civil engineering, this information serves for many different purposes. German Federal Institute for Geosciences and Natural Resources is the geoscientific centre of excellence within the federal government and part of its scientific and technical infrastructure. This institute is subordinate to the Federal Ministry of Economic Affairs and Energy [1]. The information provided by this institute includes a wide scale of information about all geoscientific and natural resources issues. Sources of this information are completely independent. The institute also serves for the purpose of education of the public and for supporting questions as environment protection and improvement of the quality of life. In the terms of foundation engineering, the most important information that may be obtained from BGR is Borehole Explorations. By means of borehole application location marks in a form of crosses that indicate individual concrete boreholes are recorded on a topographic map. Boreholes depth is indicated in different colours. The shallowest...
boreholes that range up to 2 meters are indicated in green, the deepest boreholes that range from 100 to 9,000 meters are indicated in red colour. Only basic information on boreholes is available free of payment. It deals with borehole name, borehole coordinates, precise depth of borehole, year of drilling, method of drilling, project name, localization, information on organization or borehole implementer, last reached geological horizon. Further available information is the information whether underground water was found out, whether geophysical works and laboratory tests were performed, whether samples are available, information on borehole core, archived or scanned data and also information on groundwater encountered. However, it deals with general information only. Detailed information on borehole core, its stratigraphy, petrography, and genesis of drilled layers is available on payment. In the past, data on borehole explorations were accessible with great difficulty only straight through the federal countries. Data format was inconsistent, data were often out of date and a lot of data were not accessible at all. On the base of a project, state-wide complex data accessibility was created. For the time being, the data are accessible publicly and can be used absolutely easily.

Another important part of the information system is the Archive. Materials stored in library and archive can be lent on payment. Large format maps, reports, collections from the area of regional geology, geology, petrology, pedology, geophysics, stratigraphy, mineralogy and others are stored here. Information systems in connection with the rock environment within the foundation engineering is given in [3] and in [5] [12] [7]. Apart from the databases mentioned above, the Federal Institute for Geosciences and Natural Resources deals with Energy Resources. BGR continuously analyses and evaluates global developments in reserves, resources, exploration and markets for the energy resources crude oil, natural gas, coal and uranium. Energy resources are principal in keeping the living standard on a high level. Germany is one of the biggest world energy consumers. Therefore, within this institute attention is focused on energy resources that are mostly imported. BGR publishes a Report on Occurrences of Energy every year. The Federal Republic of Germany as one of the biggest world consumers of mineral resources is within BGR institute focused on Mineral Resources. The institute is also concerned in Underground Waters. Together with institutions from Germany, Europe and the rest of the world BGR works on improved regional groundwater resource information principles. BGR is competent in questions of underground water exploration, in qualitative and quantitative evaluation of underground waters sources, underground water usability and their protection. They also offer information on Soils in cooperation with pedology services. Further, they solve Disposal of Radioactive Waste, Use of Deep Subsurface in structures and cavities and Underground Storage of Carbon Dioxide or similar. As for maps, a Map of Soils, a Geological Map, a Geophysical Map, a Map of Underground Waters, Geoengineering Map and a Map of Resources are available. Knowledge of the geological environment not do without geophysical surveys [15]. For more information on the geological environment for the creation of maps of hydrogeological, slope instabilities, etc. are listed in publications [22] [16] and in [17]. The existence of groundwater does not mean their possible usefulness, many of them have to be adjusted [24] [9].

4. Comparison of Accessible and Utilized Databases in Civil Engineering Practice

Comparison of the institutes in the Czech Republic and in BGR is not easy and can be evaluated from several points of view. A number of knowledge for creating analysis provided information systems based on studies [21][19]. Mentioned information systems are also a suitable tool for educational purposes, specified in [8] [23] and in [10] [13].

The first criterion of comparison is the different size of both the countries. Czech Geological Survey (CGS) in the Czech Republic has been operating since 1919 as one institute with the seat in Prague. Data obtained within the whole territory of the republic have been created uniquely and stored into CGS archive even though there have been many changes since its foundation, for example when Czechoslovakia was divided in 1993. Important changes come these days when data are made accessible in an electronic form. It enables to obtain information quickly, effectively and distinctly about any area of interest. CGS has been running this activity since 2004 and gradually bigger and bigger volume of data has been accessible. There is Federal Institute for Geosciences and Natural Resources (BGR) in Federal Republic of Germany with the seat in Hanover. BGR represents one from three institutes of Hanover Geocentre. It also includes State Authority for Mining, Energy and Geology (LBEG) and Leibniz Institute for Applied Geophysics (LIAG). Because of the fact that Germany is made up from federal countries, available databases were not identical. Their huge heterogeneity represented fundamental problem for cross-border research.

The second criterion is the consolidation of both the institutes within INSPIRE program, where European legislative frame was created. This program was started in 2011 and it deals with the creation of European
The third criterion is focused on the information dealing with civil engineering activities, when we need available geological data. It deals with the data on foundation soil and its surroundings. For this purpose, the base of data is Borehole Explorations database that is nearly identical in both the countries, in the Czech Republic as well as in Germany. Within this database the topographic map is created. Coloured location marks in a form of crosses which illustrate depth intervals of the individual boreholes are displayed on the map. The difference lies in determined intervals of the depth and in colours of the location marks. In the case of the Czech Republic, the shallowest boreholes are indicated in yellow if the depth interval is from 0 to 5 meters and the deepest boreholes are indicated in red with the depth higher than 500 meters. If it deals with a hydrogeological borehole, its cross is displayed on blue background. In the case of the German Institute, the shallowest boreholes that range up to 2 meters are indicated in green, the deepest boreholes in the interval from 100 to 900 meters are indicated in red. Hydrogeology is not indicated in the...
map at all. The available information is very similar in the case of both databases. Basic information is available cost free. More detailed information is available on payment. The information can be bought online.

Final reports and scientific publications belong to other information dealing with foundation engineering. In both the cases, they are stored in the archive. It also includes large format maps, scientific researchers and thematic literature. They can be borrowed directly in the archive building. In both the cases it deals with data on payments according to valid price list of services.

In the case of the Czech Republic, in addition, the map of slope instabilities (landslides) is available. Available information includes active and already inactive landslides through the whole Czech Republic, including the detailed description of the body, its basic geology, geometry or similar. This database is accessible at no cost and it is very effective for example in the case of evaluation of linear construction route location. However, this database is not available in Germany even if it deals with one from the activities that BGR is concerned with. The publication is also based on publications dealing with the analysis of engineering geological maps [11]. The existence and importance of geological maps, engineering geological maps are also listed in publications [2] [27].

Many differences come from geographic position of both the states, from their size or morphology and in the case of Germany it deals with the seaside with completely different geological conditions.

We may say that both the institutes make very similar data accessible. These data may be used for national interests as well as for interests of international cooperation but also for the public. The publication is based on a number of previous studies [25] [18] [14] and [20].

5. Conclusion

A fundamental part of construction work realization is primary search evaluation of selected locality suitability from the point of view of foundation engineering. From good evaluation of geological situation of foundation soil and its surroundings, we may obtain preliminary information on realisation costs. Everything comes from building demands and local geological conditions. A different range of explorations must be performed for sophisticated civil engineering project in complicated geological conditions or for linear constructions that go through very heterogenic geology then in the case of a civil engineering project with easy foundation soil falling into category of undemanding buildings.

The aim of the article was to evaluate the geological databases possibilities within the area of the Czech Republic and the Federal Republic of Germany. In the Czech Republic, there is the Czech Geological Survey institute that is subordinate to the Ministry of the Environment. In the Federal Republic of Germany, it is concerned in Federal Institute for Geosciences and Natural Resources institute that is subordinate to the Federal Ministry of Economic Affairs and Energy. Both the institutes have a long term tradition with considerable development in the areas of scientific researches but also in terms of archiving and dissemination of data to the public. For civil engineering companies it deals with very cheap, easily accessible and complex primary information on the area of interest.

Because of the fact that both the countries are members of the European Union, they acceded to the unique system of spatial data sharing within the INSPIRE project - INfrastructure for SPatial InfoRmation in the European Community. This project enables easy orientation within both the countries. As regards civil engineering activities, the Inventory of Boreholes Explorations creates the base. In terms of boreholes explorations database, coloured crosses with different colours according to the boreholes depths are displayed on the topographic map. They enable us creation of a basic picture on a given area explorability without execution of a demanding and costly exploration. Every cross, or borehole contains information on the place, way of drilling, type of exploration activities and underground water or similar. Concrete data on stratigraphy including drilling documents are accessible on payment. This system is nearly identical for the Czech Republic and for Germany.

Both the institutes also dispose of the archive that stores scientific publications and reports, large format maps etc. that are also available on payment according to the valid price list of services.

In addition, the Czech Republic disposes of a very detailed database of slope instabilities that is accessible cost free to wide public. It contains the information on superficial range, depth, geometry or body gradient. Further, it includes information on geology and precise description including photo documents and author. They are indicated in the map by means of polygons and they are divided according to their state into active and steady. A part of this database is also information on entry a landslide revision.

Although BGR is also concerned in Geohazards and includes also landslides, there is no interactive online map of similar character available.
Principal differences also come from both countries geography. Because of the fact that the Federal Republic of Germany lies on the seaside, their activities also represent a certain extension dealing with marine resources and geology. At the same time, they have data created separately in different information system dealing with the individual federal countries available. However, their inconsistency has been eliminated within the interconnection initiative within the whole European Community.

In this regard and because of the country size, the Czech Republic has been unique since its beginning. Both the institutes offer many other materials that it is possible to proceed from within civil engineering project realisation. It deals with geological maps, hydrogeological maps, geophysical maps, soil maps, and mineral resources maps, etc.

References


