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MAPS OF CLASH OF OPINIONS – CLASSIFICATION OF GEOLOGICAL CONDITIONS IN KARVINÁ REGION

Summary. New methodology for evaluation of input theme area of interest for maps of clash of opinions is presented in this contribution. The main idea is to prepare new layer called “seismic characteristic of foundation conditions”. This new layer, which is represented by values of specified significance, enables to confront parameters of different thematic layers.

NUMERYCZNE MAPY ZAGROŻEŃ POWIERZCHNI – KLASYFIKACJA WARUNKÓW GEOLOGICZNYCH REGIONU KARWINA

Streszczenie. W ramach artykułu przedstawiono rozszerzenie do metodologii opracowania map numerycznych, dotyczących zagadnień związanych z zagrożeniem sejsmicznym. Główną ideą jest wprowadzenie nowej warstwy tematycznej „charakterystyka warunków sejsmicznych podłoża”. Zawartość tej warstwy, w konfrontacji z zawartością innych warstw tematycznych mapy, pozwala na uzyskanie nowych jakościowo informacji, związanych z zagrożeniem sejsmicznym.

1. Introduction

“Maps of clash of opinions” for evaluation of seismic loading are so created that they provide basic information about character of seismic loading of structures for given places. Methodology of maps elaboration enables using GIS technology for creation of result maps of clash of opinions [6]. Basic methodology of maps elaboration was published in [7]. The main principle is confrontation of three basic input themes – area of interest, seismic loading and constructional objects and structures. Selected thematic layers with their characteristic parameters will be related to each of these three input themes. The thematic layers will be prepared in the form of map layers. Evaluation of two mentioned input themes was already

elaborated – seismic loading (only mining induced seismicity) in [3, 5] and constructional objects and structures in [4]. Detail evaluation of third input theme “area of interest” is presented in this paper.

2. Input theme area of interest

Parameters of this input theme have direct influence on both other input themes – seismic loading (for example amplification of seismic effects on the surface due to local geology) and structures (ground conditions, depth to water-table, ground-bearing capacity, landslides).

The following thematic layers of area of interest were selected based on basic methodology for maps elaboration [7]:

- local geology and tectonics,
- depth to water-table,
- accumulation of surface water,
- thickness of sedimentary layers,
- deformation of surface due mining,
- undermined areas,
- landslides and other dynamic events,
- behaviours of rock massif.

Generally, it is possible to compile maps of clash of opinions at different scales. Due to complexity of the basic methodology, for detail evaluation we are only preparing maps with regional scale. Karviná region (area of mining induced seismicity occurrence) is selected area for the first data collection and for the first result maps creation. Set of thematic layers presented in basic methodology can be reduced by selection of specific area of interest, eventually new thematic layer can be added. For example, the thematic layer “accumulation of surface water“ (it means dams) is not taken into account in selected Karviná region, and conversely thematic layers “deformation of surface due mining“ and “landslides“ gain the signification especially in Karviná region.

There are two different ways of clash determination. Each of thematic layers of area of interest can enter the map of clash as separate unit. Than the confrontation between seismic loading, constructional objects and parameter of selected thematic layer (regardless of other thematic layers parameters) will be the resulting clash of opinion. If we are interested for

example only in seismic effect amplification due to local geology, than the seismic loading and constructional objects will be confronted only with thematic layer “thickness of sedimentary layers” (regardless of landslides, depth to water-table etc.).

For the general seismic load assessment of interested area, it is necessary to take into account all parameters of interested area, which can affect seismic loading of objects on the surface. Here, the problem of thematic layer parameters confrontation arises, because these parameters cannot be compared with each other directly. Hence, new term – “seismic characteristic of foundation conditions” is established for evaluation of selected parameters and for the better orientation in the maps of clash of opinions. This new parameter includes all useful information about area of interest and it is established for the purpose of clash of opinions interpretation only. New thematic layer “seismic characteristic of foundation conditions” displays this new parameter and will be created based on thematic layers of area interest. Some of parameters of input thematic layers are varying in time (for example active landslides, depth to water-table etc.) so the thematic layer “seismic characteristic of foundation conditions” will be elaborated for given time period (just like thematic layers of seismic loading).

3. Classification of “seismic characteristic of foundation conditions”

Thematic layer named “seismic characteristic of foundation conditions” will be created based on parameters of selected thematic layers of interested area. Following classes of foundation conditions were selected for the purpose of clash of opinions interpretation:

- optimal foundation conditions,
- favourable foundation conditions,
- unfavourable foundation conditions,
- critical foundation conditions.

Class of foundation conditions will be selected according to summary of values of specified significance. Different values of specified significance will be assigned to selected parameters of interested area thematic layers. Rate of this value describes how the parameter influences effect of seismic loading at the surface. The higher is weighted value of parameter, the worse influence has this parameter for seismic effects to constructions. Weighted values of selected parameters for Karviná region are in table 1. For other area of interest, it is

necessary to change weighted values according to the character of the area and according to set of thematic layers.

Table 1

Summary of values of specified significance
for individual classes of foundation
conditions (for Karviná region)

class of foundation conditions	summary of values of specified significance
optimal	0-2
favourable	3-4
unfavourable	5-6
critical	over 6

Values of specific significance are applied only to those thematic layers, whose parameters can be confronted mutually. These thematic layers of interested area are chosen for Karviná region:

- subsurface geology,
- depth to water-table,
- deformation of surface due mining,
- landslides.

Assessment of selected thematic layers and specific significance of their parameters is presented below.

Subsurface geology

Valuated parameter of thematic layer “subsurface geology” is class of soil or class of rock (classes of soils and rocks are signed according to Czech standard 73 1001- Foundation of structures, subsoil under shallow foundations). For the purpose of weighted valuation, classes of soils and rocks are classified to three groups as we can see in table 2. Evaluation of foundation soil according Czech standard CSN 73 0040 (Loads of technical structures by technical seismicity) is auxiliary criterion for classification of soil and rock class presented in table 2. In the standard CSN 73 0040, foundation soil is classified into three categories (a, b, c). Ground-bearing capacity R_{dt} is one of the parameters for category determination (for the least bearing soils is $R_{dt} \leq 0.15$ MPa, for the most bearing rocks is $R_{dt} > 0.6$ MPa). Ground-bearing capacity is used also for classification of soil and rock classes for purpose of

elaboration of thematic layer “seismic characteristic of foundation conditions”. Values of specified significance for soil and rock classes are presented in table 2.

Table 2

Values of specified significance of thematic layer “subsurface geology” according to soil and rock classes

	$R_{dt} < 0.15 \text{ MPa}$	$0.15 \text{ MPa} < R_{dt} \leq 0.6 \text{ MPa}$	$R_{dt} > 0.6 \text{ MPa}$
ground-bearing capacity (for specific boundary conditions)	fine-grained soils of soft consistency: CH CV CE CL CI CS CG MH MV ME MI ML MS MG	rest of fine-grained soils of stiff, solid and/or firm consistence	
	fine-grained soils of stiff consistency: CH CV CE CL CI CS MH MV ME MI ML		
	sand soils: S-F of medium compactness SC of stiff and/or solid consistence (width of foundation $b=0,5 \text{ m}$)	rest of sand soils	
	gravel soils: GC of stiff and/or solid consistence (width of foundation $b=0,5 \text{ m}$)	rest of gravel soils	
	rocks : class of rock R6 – with very high and/or extremely high density of discontinuities	rocks: class R3 R4 R5 - with very high and/or extremely high density of discontinuities class R4 R5 R6 - with medium and/or high density of discontinuities class R5 R6 - with very low and/or low density of discontinuities	rest of rocks
value of specified significance	2	1	0

Depth to water-table

Evaluated parameter of this thematic layer is depth to water-table under the surface. Evaluation of foundation soil, according Czech standard CSN 73 0040, is an auxiliary criterion for evaluation of depth to water-table, just like by thematic layer “subsurface geology”. Two boundary values of depth to water-table under the foundation base (1 and 3 meters) are mentioned in this Czech standard, according to ground-bearing capacity R_{dt} . This ground-bearing capacity is determined for foundation depth between $0.8 \text{ m} \div 1.5 \text{ m}$ (table 15 in CSN 73 1001). According these boundary conditions, it is possible to convert boundary values of water-table depth under the foundation base (1 and 3 meters) to water-table depth under the surface (2.5 and 4.5 m). Values of specified significance of this thematic layer depending on depth to water-table under the surface are in table 3.

Table 3

Values of specified significance of thematic layer
“depth to water-table”

depth to water-table under the surface	< 2.5 m	from 2.5 to 4.5 m	> 4.5 m
value of specified significance	5	3	0

Deformation of surface due mining

Activity of surface deformation is evaluated parameter of this thematic layer. For given time period (e.g. for given year), deformation of surface due mining can be active or inactive (stable). Some deformations can be also expected in the future. Activities of surface deformations and their values of specified significance are presented in table 4.

Table 4

Values of specified significance of thematic layer
“deformation of surface due mining” according the
activity of deformations

deformation of surface due mining	active deformation for given time period	inactive deformation for given time period	area without deformation
			deformation expected in the future
value of specified significance	5	2	0

Landslides

Occurrence of landslides is next important parameter for evaluation of “seismic characteristic of foundation conditions” in Karviná region. In the table 5, types of landslides according their activity in given time period are presented, including corresponding values of specified significance.

“Seismic characteristic of foundation conditions” is established only for elaboration of “maps of clash of opinions“. It has only informative value for the better orientation in maps. Areas with the unfavourable and/or critical foundation conditions (according this methodology) must be analysed individually according to the standards.

Table 5

Values of specified significance of thematic layer "landslides" according the activity of landslides in given time period

landslides	active landslides	potential landslides	stabilized landslides
		potential landslides due mining	buried landslides
weighted valuation	5	2	0

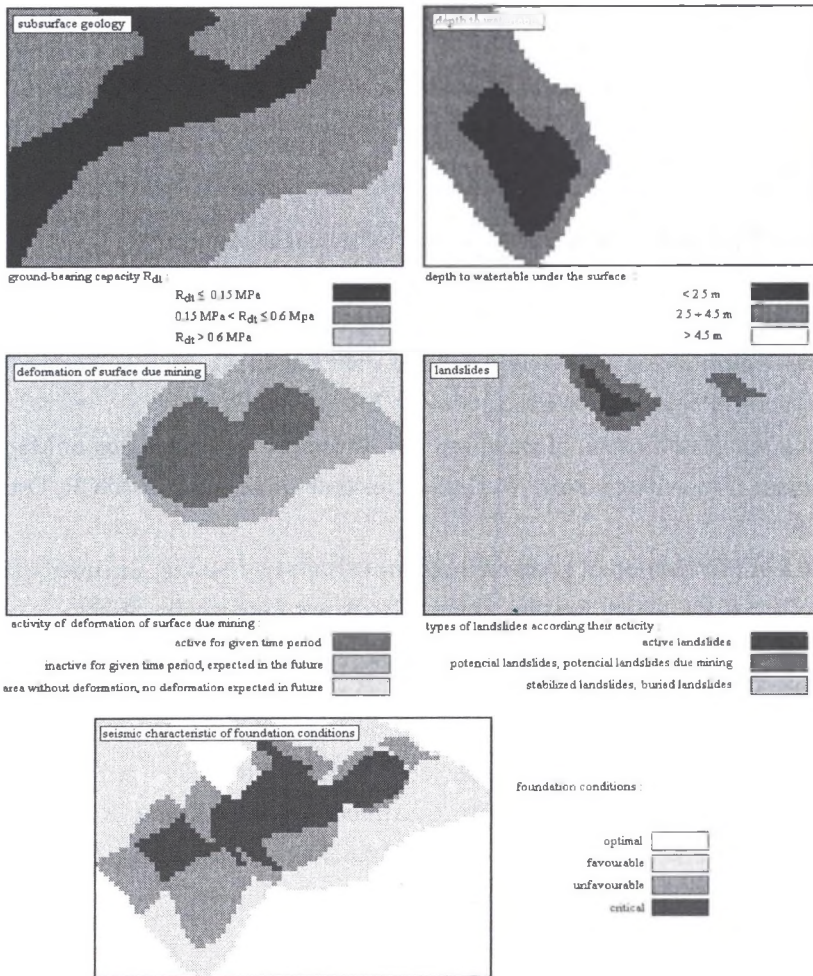


Fig. 1. Example of determination of „seismic characteristic of foundation conditions“ based on four individual thematic layers of input area

Rys. 1. Przykład określenia sejsmicznej charakterystyki warunków sejsmicznych podłoża na podstawie czterech osobnych warstw tematycznych analizowanego rejonu

4. Conclusion

Detail evaluation of input theme “area of interest” is presented in this paper. New thematic layer named “seismic characteristic of foundation conditions” will be created based on parameters of selected thematic layers of interested area. “Seismic characteristic of foundation conditions” is established only for elaboration of “maps of clash of opinions“, and it has only informative value for the better orientation in resulting maps.

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Omówienie

Numeryczne mapy zagrożeń powierzchni w rozpatrywanych obszarach pozwalają określić intensywność oddziaływań sejsmicznych dla określonych lokalizacji i/lub ustalić prawdopodobieństwo ryzyka uszkodzeń obiektów wskutek drgań sejsmicznych. Mapy takie mogą służyć do oceny zagrożenia obiektów budowlanych z tego tytułu. W artykułach prezentowanych na ubiegłorocznej Konferencji [3, 5] przedstawiono wyniki badań oraz projekt metodologii określania wpływu sejsmiczności górniczej na obiekty. Źródłem danych eksperymentalnych był rejon Karwiny. Główną ideą tego projektu było przeliczenie maksymalnych pomierzonych prędkości drgań (wg normy czeskiej 730040) z uwzględnieniem liczby wstrząsów, a w szczególności liczby takich zdarzeń o dużej intensywności.

W ramach artykułu przedstawiono rozszerzenie do metodologii opracowania map numerycznych, dotyczących zagadnień związanych z zagrożeniem sejsmicznym. Główną ideą jest wprowadzenie nowej warstwy tematycznej „charakterystyka warunków sejsmicznych podłoża”. Zawartość tej warstwy, w konfrontacji z zawartością innych warstw tematycznych mapy, pozwala na uzyskanie nowych jakościowo informacji, związanych z zagrożeniem sejsmicznym.