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Displaying of Easements on the Web Portal within the Context of the Slovak Republic

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ABSTRACT. The content of vector cadastral map has prescribed structure. Easements are in a separate vector map layer since 2009. The number of easements has been significantly growing in recent years, and it has turned out that the way of displaying of easements in vector maps is not sufficient. There are some issues, e.g. overlapping line and area objects, lack of transparency and lack of connection between the map and the file of descriptive information. The vector maps are accessible to citizens through web portals. Vector maps are originally GIS maps, which means that if they are put on web without any change, the displaying of easements will transmit limited amount of information to the user. The main purpose of this article is to present a solution for displaying of easements through web portal. According to our solution, easement is displayed differently in vector maps and at web portal. Graphical interface of web portals provides higher variability of means and methods of cartographic expression. In order to make displaying of easements through web portal closer to non-professional public, interactive means are used, e.g. colour line symbols, colour area symbols (also with possibility to switch objects on or off), mouse-over techniques for adding textual information and hyperlinks. Our proposal requires some changes in the structure of vector cadastral map, specifically it is necessary to add new attribute for objects in layer of easements. These amendments are essentially negligible in comparison to the effect of displaying of easements through web portal.

Keywords: vector cadastral maps, map symbols, interactive cartographic methods, object attributes, energy lines.

1. Introduction

According to the Civil Code (Act No. 40/1964 Coll.), easements limit owner of the real estate so that he is obliged to give or to do something to the authorized person or to forbear from doing an action. Burdened real estate should provide all the necessities in favour of operation of the legally concerned objects. Selected

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laws specify the easements and define their range. It is distinguished whether the whole real estate or a part of the real estate (an area) or just a narrow strip (a line) is a burden; the recording method in cadastral documentation is different. Only if the easement is bound to a part of the real estate it is displayed in cadastral map (Poldaufová and Katona 2016).

In the past, the easements were displayed only in survey sketches, not in a cadastral map. Since 2009 the easements that are bound to a part of the real estate are displayed in the vector cadastral maps (hereinafter VCMs) (Decree No. 461/2009 Coll., Hudecová 2011). VCMs have standardized digital form (Gašincová et al. 2016). Their content has prescribed structure; consists of graphical elements (points, lines, areas) coupled into objects.

Objects in VCMs can be connected to text information from the descriptive information file via attributes. Every object is placed into one of the thematically organized layers. Easements form one of these layers. Maps are saved in files organized according to cadastral districts; graphical software “Kokeš” is used. The VCMs format “VGI” (vector graphical interface) is interconvertible and suitable for processing in CAD/CAM support software.

VCMs from the whole area of the Slovak Republic are available at the map client web portal ZBGISť – Basic data-base for the geographic information system (URL 2). Free of charge application serves to work with data from the information systems managed by Geodesy, Cartography and Cadastre Authority of the Slovak Republic. It is a complex tool for displaying, search and analysis of spatial data and map services of ZBGISť, external map services and one’s own data, as well as for advanced map outputs creation. This portal enables the user to browse the cadastral maps and to combine them with other geospatial data.

The number of easements in the VCMs is significantly growing and the current system of displaying is insufficient. The VCMs are accessible to citizens through web portals. VCMs are originally GIS maps, so putting them on the web without change was not a proper procedure (Voženílek 2005).

Our solution distinguishes means and methods of cartographic expression for VCMs and for web portal. We propose various map symbols, means and methods of cartographic expression. The solution is beneficial for institutions and individuals, who do not have interactive access to the VCMs, but they can examine cadastral maps through web portals. In order to improve easements displaying on the web portal, it is necessary to make some changes in VCMs’ structure. However, from our point of view these amendments are essentially negligible in comparison to the effect of displaying of easements through web portal.

1.1. Displaying of easements in vector cadastral maps

The method of easements displaying in VCMs has been developing since 2009 (Hudecová and Geisse 2017). Easements were displayed only with one line no. 0.141, as specified by the Slovak Technical Standard (Slovak Technical Standard 2001), and the objects had no attributes until 2016. There were many paired or overlapping lines so it was not possible to identify objects and to distinguish

whether the object displays a line or an area. Objects were not linked to the description data file in the cadastral documentation. The objects in the easement layer only informed, whether the real estate was burdened with an easement or not. For more information about the easements, it was necessary to examine survey sketches, owner’s folios and other public documents concerned with registration of the easements.

Since 2017, a new technical guideline for easement displaying in the VCMs was placed. Every object in the easement layer represents one easement which is defined by one public document. Every object includes attribute “E” (cadastral proceeding), the value of which is the identification number of the cadastral proceeding.

Easements are displayed with two line symbols (Table 1). Line symbol no “0.091” (Slovak Technical Standard 2001) is used for displaying of the main axis lines, e.g. energy lines or gas lines. Line symbol “0.141” is generally used for displaying of the areas, e.g. right to cross a real estate or servient tenement (protection zone) of main axis lines. Also combination of line symbols is allowed (Figure 1) (Guideline 2016).

Table 1. Easements line symbols in the VCMs.

Easement category	Type of line according to STS	Example of easement
area	0.141	right to cross a real estate
line	0.091	mains axis of gas line

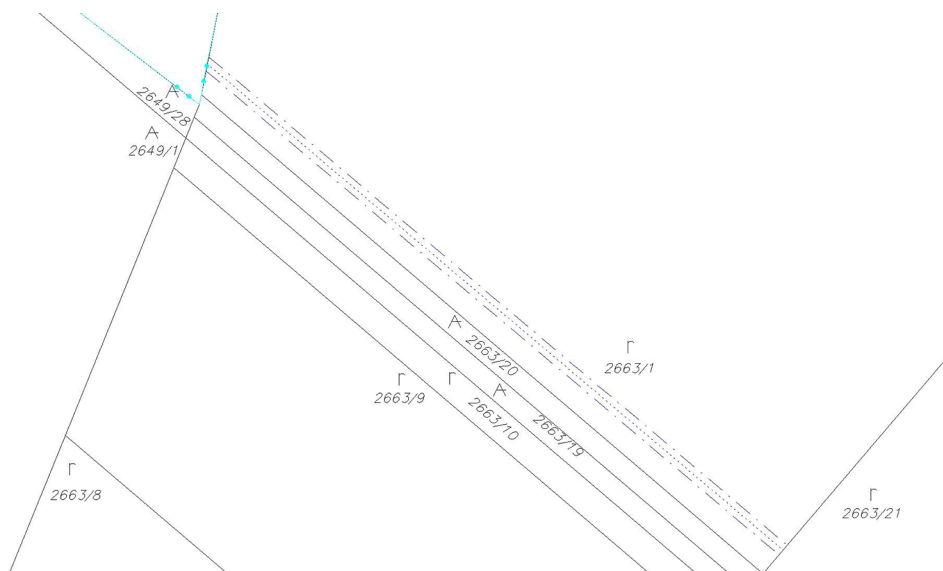


Fig. 1. Displaying of easements (energy line with servient tenement) in the VCMs (since 2017).

This solution has some benefits for those, who can interactively operate VCMs through graphical software. Surveyors or cadastral officers can identify whether the object is a line, an area or a combination of line and area as well as distinguish paired or overlapping lines. The “E” attribute (cadastral proceeding) enables the connection between an object in the VCMs and the description file in the cadastral documentation.

2. Materials and methods

The data displayed in the map can be classified and represented through various graphic symbols which conform to accepted and well defined conventions (Longley et al. 2005). The choice of methods and means depends on several factors such as purpose and form of the map.

The VCMs are a technical base for real estate’s registering and should be structured, without unnecessary elements, clearly legible and consistent with the descriptive information file. Easements layer is one of ten layers in VCMs. The content, structure and colours in each layer is different.

The web portal enables browsing of VCMs with user friendly access to the information from the cadastral documentation, which is transparent for all the ordinary citizens using interactive cartographic methods and switchable layers.

2.1. Method of line symbols, area symbols, colours and attributes

Method of line symbols, area symbols, colours and attributes is used in CAD/CAM maps. Expression method of the line symbols is one of the most used methods. Line symbol can be used to display spatial objects as an independent mean of expression or as a part of other means of expression, e.g. area symbols.

Line symbols can have four graphic variables (structure, width, colour and orientation) by which the characteristics of spatial objects are expressed. Structure is composed of basic graphic elements (lines, points, areas) grouped to the line symbol. It is one of the basic recognition parameter of line symbols. Width is defined as a space between borders of the line in units of map. While the structure is used mainly for expression of qualitative characteristics of objects, the width is the most suitable parameter for expression of quantitative characteristics. The colour can also express quantitative and qualitative characteristics; for every qualitative characteristic different tone of colour is used. Orientation is an asymmetry of line symbol along and across the axis. Line symbols are placed to the map by reference line of the object, which is mostly the main axis of line objects (Voženilek and Kaňok 2011).

The method of area symbols is mainly used for distinguishing and highlighting areas. Area symbol can be used to display spatial objects in couple of ways – as an independent method of expression or as a part of more complicated means of expression, e.g. cartogram.

Area symbol have two graphic variables – fill and outline. Fill is represented by colour or raster area bounded by an outline. Qualitative distinction between the

areas is achieved through various tones, shades or saturations of colours. Outline is the line, which bounds the fill of an area symbol. It provides all the graphic variables of a line symbol (structure, width, colour and orientation) and it is used mainly for expression of secondary characteristics of the displayed object. Area symbols do not have reference point or line. In the map they are displayed by placing an outline, which bounds an area with real appearance of the displayed phenomena (Voženílek and Kaňok 2011).

In vector form of the map, the information about the objects can be extended by using attributes. Attributes are used for selection of objects in the graphical software as well as for connection of objects in the map with the database in CAD systems (Voženílek and Kaňok 2011). Attributes can identify a place or an entity, distinguishing them from other places and entities or classify them into categories (Longley et al. 2005).

2.2. Interactive cartographic methods

Interactive maps which are web based can have hypertext structure. This makes them better than digital or analog maps. It can use layers which can be switched on or off and the map symbols are also web objects that can receive mouse “events” enabling many functions and hyperlinks (Kraak and Brown 2001). Methods enable us to interact with the objects in the map, so we can get information about the object stored in the attributes; access to this information can be obtained via mouse-over techniques or by clicking map symbols (Kraak and Ormeling 2010). With the help of functions such as panning, zooming and an integrated legend, the limitations of display size and resolution of the screen can be compensated (Voženílek 2005).

2.3. Draft principles of methodology

The solution is based on two assumptions. Properties and structure of VCMs are respected; necessary changes in existing VCMs content should be minor and all information about easements must be accessible through web portal for nonprofessional public.

Because of that, the displaying of the easements in the VCMs and on the web portal can differ. To achieve the goal means and methods of cartographic expression should be supplemented and expanded as follows:




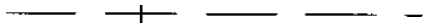





- In the VCMs, all objects in the easement layer would include attribute “EC” (easement category), which corresponds to burden type (how the property is burdened) according to the Slovak legislation. The value of “EC” attribute is “1” for area (e.g. right to cross a real estate), “2” for main axis, “3” for belt corresponding to servient tenement (protection zone) and “4” for planned belt (planned servient tenement). For every easement category, the line symbols (outline or line) and the symbols according to the Slovak Technical Standard (Slovak Technical Standard 2001) are in Table 2. These symbols would be used for displaying easements in VCMs as well as on the web portal.

Table 2. Easement categories attribute.

Easement Category (EC)	Line symbol	(STS 013411)	Symbol
1 area	outline	0.141	—————
2 main axis	line	0.091	—————
3 belt	outline	0.031	— — — — —
4 planned belt	outline	0.161	—————

- In the VCMs, objects in easement layer with the value of attribute “EC”=2 (easement category – main axis) would also include attribute “ELT” (easement line type), which corresponds to the sorting of line symbols in the Slovak Technical Standard. The list of symbols in Table 3 will only be used for displaying of easements on the web portal.

Table 3. Easement line type attribute for mains axis lines (selection).

Easement Lines Type (ELT)	Symbol	STS 013411
1 Energy lines		6.5920
2 Gas lines		6.3220
3 Oil pipelines		6.8020
4 Thermal lines		6.5120
5 Water lines		6.1520
6 Sewage lines		6.2320
7 Electronic communication lines		6.7020
8 Cable collector		6.8120
9 Other lines		0.041

- In the VCMs, objects in the easement layer with the value of “EC”=2, “EC”=3 and “EC”=4 (easement category) if stipulated by a specific law, would also include attribute “EST” (easement servient tenements) with value corresponding to the width of servient tenement belt according to the sorting in the specific act. On the web portal, all the servient tenements would be coloured using method of area symbols. The example for energy lines is in Table 4. The objects with the value of “EC”=1 (easement category – area) would not have this additional attribute, but they would be also coloured on the web portal to make them more visible for the ordinary citizens. Area colouring would not be used in the VCMs.
- The web portal should be created as a comprehensive interactive map with a hypertext structure with a connection to the description data file. It is proposed to use user-friendly line symbols (Table 2, Table 3) and area colour symbols (Table 4) that can be switched on or off. Citizens and organizations which do not have access to the cadastral documentation can access all the information about the easements stored in attributes “EC” (easement category) (Table 2), “ELT” (easement line type) (Table 3) and “EST” (easement servient tenement) (Table 4) using hyperlinks, clickable objects in the map and object selection.

Table 4. *Easement servient tenement attribute – example for energy lines (selection).*

Energy lines Easement Servient Tenements (EST)	Servient tenement [m]	Area colour
1 Overhead lines (1 kV – 35 kV), isolated conductors	4	Green
2 Overhead lines (35 kV – 110 kV), isolated conductors	15	Blue
3 Overhead lines (110 kV – 220 kV)	20	Purple
4 Overhead lines over 400 kV	35	Red

3. Results and discussion

The results are presented on two examples to illustrate a separate solution for the displaying of easements in the VCMs and on the web portal. Means and methods of cartographic expression are different. Examples for “the right to cross a real estate” displaying are in Figures 2, 3 and for “energy lines with servient tenement” are in Figures 4, 5, 6.

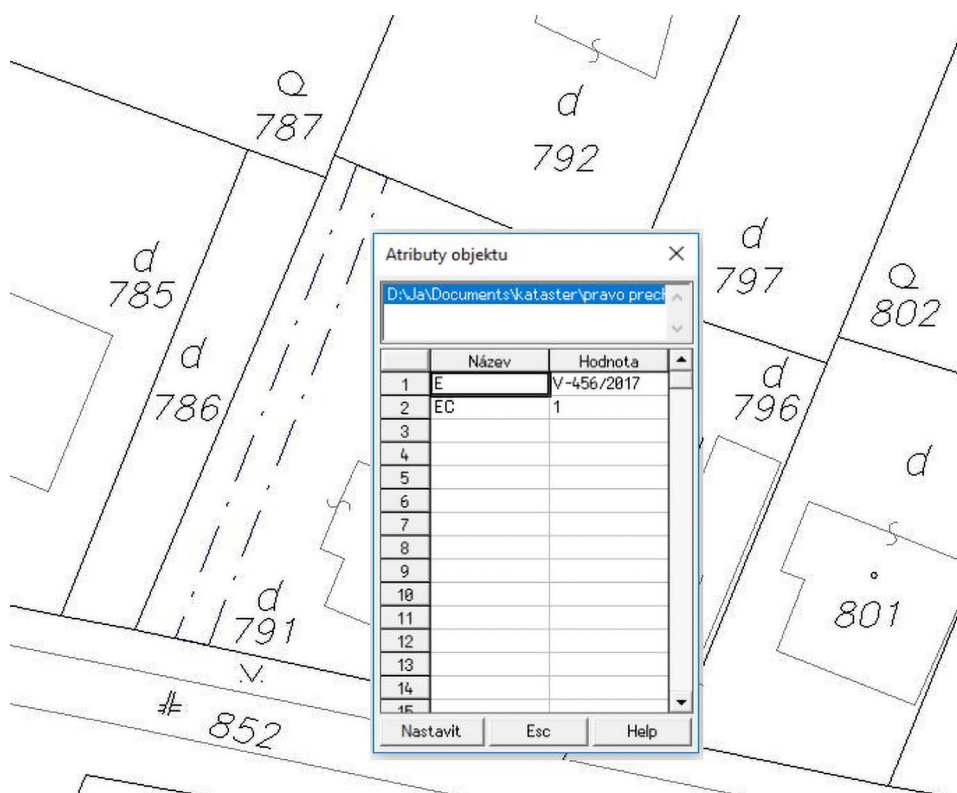


Fig. 2. *Displaying of the right to cross a real estate easement in the VCMs in graphical software “Kokeš”.*

The right to cross a real estate burdens a part of the real estate; Solution for the VCMs is on example (Figure 2). Object obtains the values of attribute “E=V-456/2017” (cadastral proceeding – identification number) and attribute “EC”=1 (easement category – area) (Table 2). Line no. 0.141 is used (Table 2).

An example of the right to cross a real estate displaying on web portal is in Figure 3. The map object is clickable; connection to the description data file is available. Text grouped in table inform about: cadastral proceeding, easement category, comment as the explanatory note concerning the burden and hyperlink to Civil Code (Act No. 40/1964 Coll.). The hyperlink refers to the Slov-lex web portal (URL 1) which provide consolidated and up-to-date wording of all types of legislation. The area of the easement is coloured to make it more visible. The shade of the colour is chosen according to the size of the easement area. Lighter shades of colours are used to keep the transparency of the map. There is an option to switch off the colour area symbol.

An example of displaying energy lines with servient tenement in the VCMs is in Figure 4. The object has the values of attribute “E=V-1234/2017” (cadastral



Fig. 3. Displaying of the right to cross a real estate easement on the web portal.

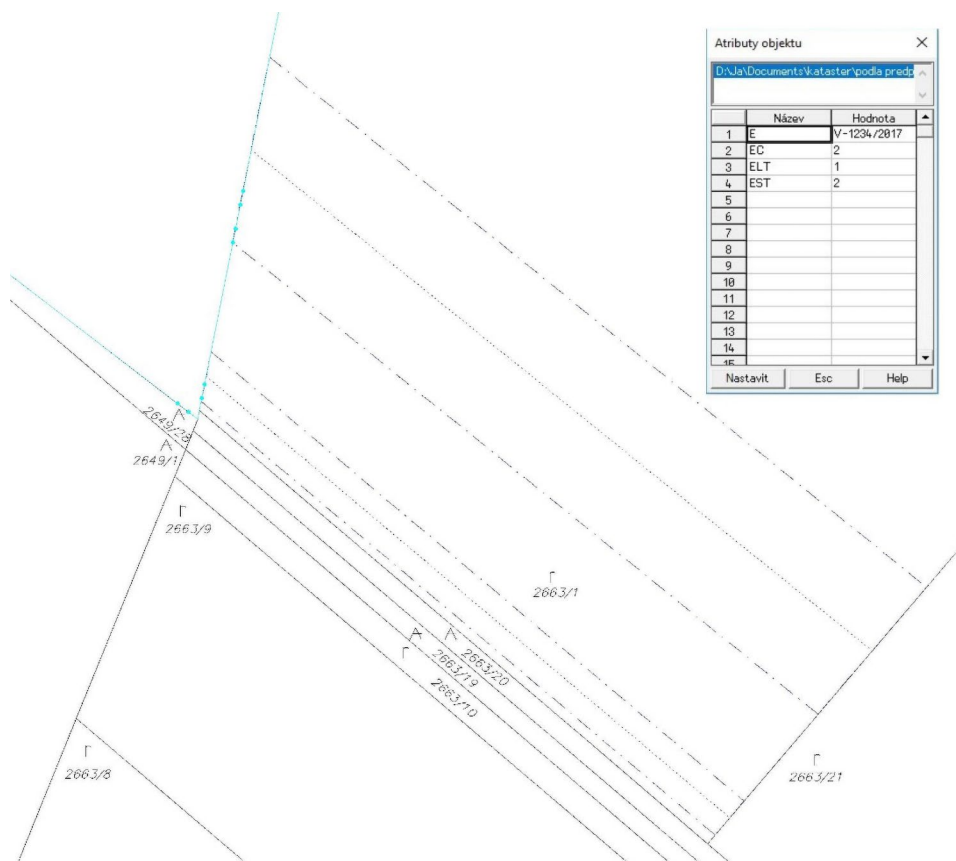


Fig. 4. Displaying of the energy lines with servient tenement easement in the VCMs in graphical software “Kokeš”.

proceeding – identification number), attribute “EC=2” (easement category – main axis) (Table 2), attribute “ELT=1” (easement lines type – energy line) (Table 3) and attribute “EST=2” (extent of servient tenement – overhead lines 35 kV – 110 kV with isolated conductors, which have servient tenement 15 m) (Table 4). The combination of lines 0.091 (for main axis) and 0.141 (for displaying the extent of servient tenement) is used (Table 2).

Examples of displaying energy lines with servient tenement on the web portal are in Figures 5, 6. The object in the map is clickable and the connection between the map and the description data is available via hyperlinks. After clicking on the object, a table with descriptive information pops up. The table includes information about cadastral proceeding, easement category, easement line type, servient tenement and the comment as the explanatory note concerning the burden and hyperlink to Act on the Slov-Lex web portal (URL 1), which defines specific rules of protection (such as restriction to plant and grow permanent crops, plant trees, build structures, etc.). The type of line for displaying the main axis is used

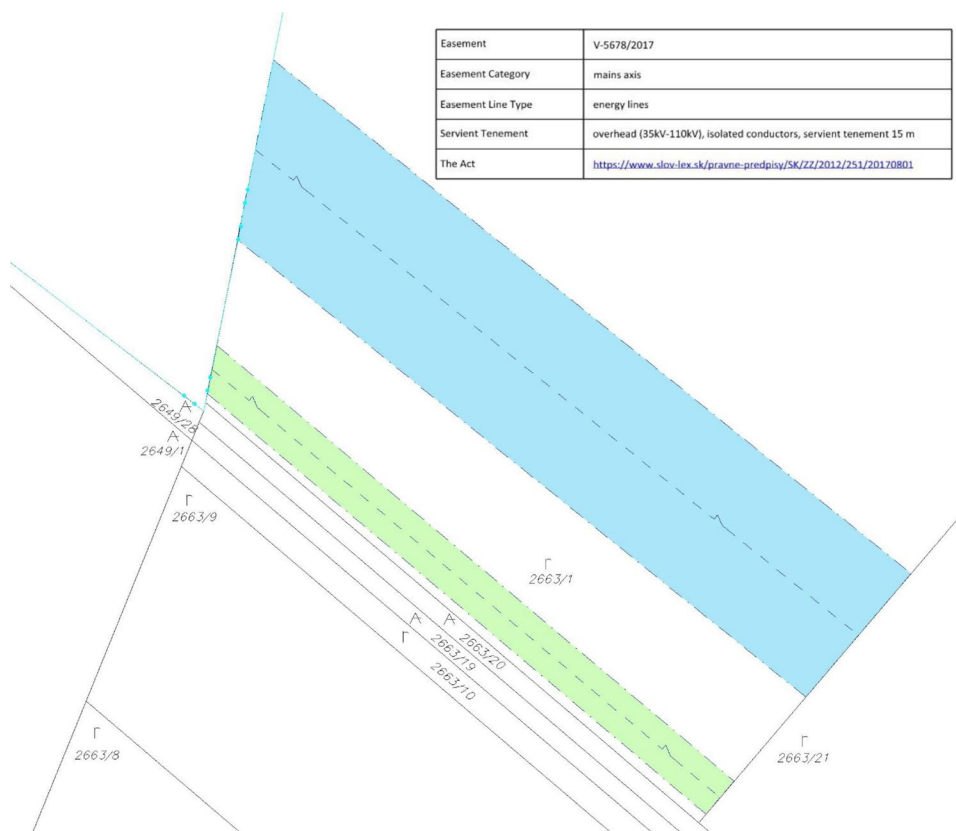


Fig. 5. Displaying of the energy lines with servient tenement easement on the web portal.

according to the value of “ELT=1” attribute (easement lines type is energy line – line no. 6.5920 is used) (Table 3). The extent of servient tenement is displayed with the same line type as in the VCMs (line no. 0.141). The area of the servient tenement is coloured to make them more visible for the citizens. The shade of the colour is chosen according to the value of the “EST=2” attribute (extent of servient tenement – overhead lines 35 kV – 110 kV with isolated conductors have servient tenement 15 m) (Table 4). Lighter shades of colours are used to keep the transparency of the map. There is an option to switch off the colour area symbols or to switch off the area of the servient tenement completely, so only the main axis would be displayed (Figure 6).

The interactive clickable layer introduces new possibilities:

- Explains all the attributes – EC = area (easement category) (Figure 3), EC = mains axis (easement category) (Figure 5), ELT = energy lines (easement line type), EST = overhead (1 kV – 35 kV), isolated conductors, servient tenement 4 m (extent of servient tenement) (Figure 5).

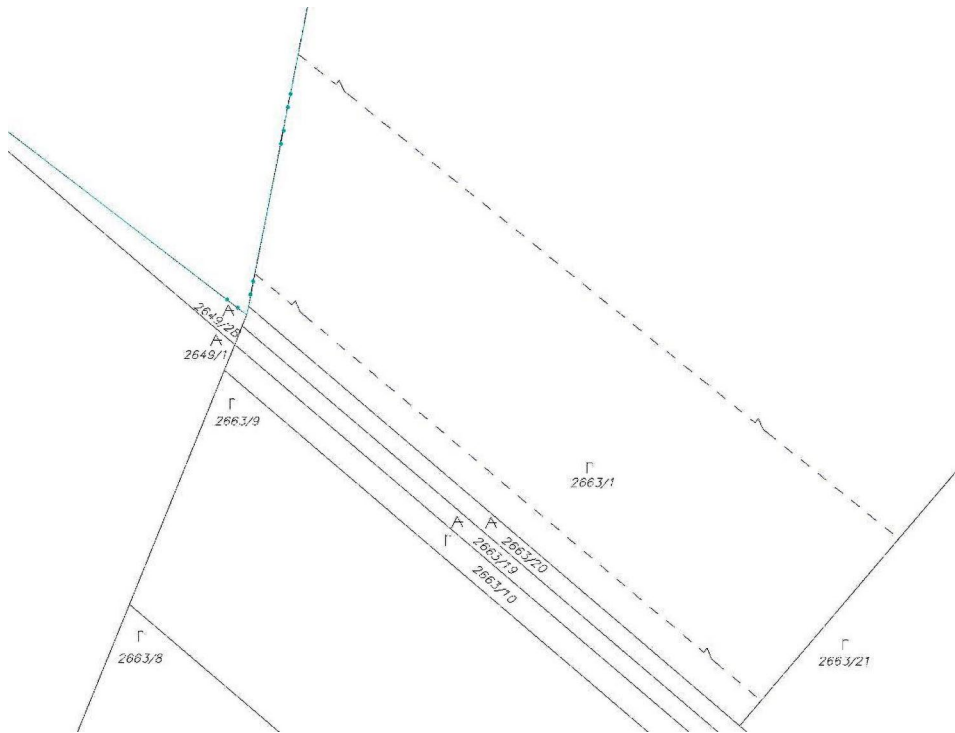


Fig. 6. Displaying of the easement energy lines with servient tenement easement on the web portal (the extent of servient tenement is switched off).

- Has a hyperlink to open the act which define the easement – the Civil Code (Act No. 40/1964 Coll.) (Figure 3), the Act on energetics (Act No. 251/2012 Coll.) (Figure 5).
- The area of the servient tenement can be coloured; the colour tells the owner about range of restriction at the first glance (Figure 5).
- The coloured area or the whole extent of the servient tenement can be switched off, which keeps the transparency of the map (Figure 6).

The current system for displaying of easements shows the owner only whether the easement is there or not. On the web portal, they see only a line symbol, which is the same for all easements and they cannot find out anything more about the easements without searching in the cadastral documentation, which costs them time and money. With our proposal, the citizens can see the type of the easement right from the map on the web portal through a specific line symbol. After clicking or getting a mouse over an object, they can see other information about the easement stored in the attributes. They can also see the degree of restriction in the servient tenement after switching on the layer with colour fill. This solution is way better for citizens and organizations which do not have full access to the cadastral documentation, because they can see all the information about the easements through the web portal and it also saves them time and money.

4. Conclusions

Our proposal for displaying of easements has separate solutions for web portals and for VCMs. It meets two requirements: properties and structure of vector map are respected and all information about easements through web portal is available to non-professional public. Having separate solutions is advantageous also for cadastral offices because the changes in the existing VCMs content are minor. Vector cadastral map is a technical base for registration of real estates. It is necessary to accommodate the displaying of easement layer for this purpose, so the means and methods of cartographic expression of easement in the VCMs are different from those in web portals.

We achieved the distinction between types of easements through their detailed categorization (Table 1). The solution contains list of map symbols (Table 2) and also object attributes for connection of the map with the description file of cadastral documentation and new displaying system for servient tenements (Table 3). The proposed changes to the displaying of easements in the VCMs are only minor, but the functions on the web portals would be expanded. Our proposal for displaying of easements in interactive clickable layer provides all the information about the easements for citizens and organizations which do not have interactive access to the VCMs. The information is given clearly and transparently through explanation of attribute values and colour fill of the areas. The colour fill or the whole extent of servient tenements can be switched off, which keeps the transparency of the map. Hyperlink connection to the web portal SloV-Lex (URL 1) provides detailed information about the easements, the servient tenements and the rules of protection. The solution is applied and explained using a case involving the right to cross a real estate (Figures 2, 3) and energy lines with servient tenement (Figures 4, 5, 6).

References

Act No. 40/1964 Coll. Civil Code.

Act No. 251/2012 Coll. on energetics.

Decree No. 461/2009 Coll. of the Office of Geodesy, Cartography and Cadastre of the Slovak Republic, implementing the Act No. 162/1995 Coll. on the real estate cadastre and the entries of ownership and other rights to the real estate (the cadastre act).

Gašincová, S., Weiss, G., Gašinec, J., Labant, S. (2016): Structure, quality and methods for updating a vector cadastral map registered in the cadastral documentation in the Slovak Republic, 16th International Multidisciplinary Scientific GeoConference SGEM 2016, Proceedings book 2, Vol. 2, Albena, Bulgaria, 547–554.

Guideline No. 23 for recording of the scope of easements in file of geodetic information of cadastre of real estate (2016): Office of Geodesy, Cartography and Cadastre of Slovak Republic, Bratislava.

Hudecová, Ľ. (2011): Vector Cadastral Maps, Geodetický a kartografický obzor, 57(99), 243–248 (in Slovak).

Hudecová, Ľ., Geisse, R. (2017): Displaying of easements in vector cadastral maps, In X. International Scientific and Professional Conference Geodesy, Cartography and Geoinformatics 2017, Conference proceedings book (in press), Demänovská dolina, Slovakia.

Kraak, M. J., Brown, A. (2001): Web Cartography: Developments and Prospects, Taylor & Francis, London.

Kraak, M. J., Ormeling, F. (2010): Cartography, Visualization of Geospatial Data, 3rd ed., Pearson Education, Harlow.

Longley, P., Goodchild, M., Maguire, D., Rhind, D. (2005): Geographical Information Systems and Science, 3rd ed., John Wiley & Sons, Chichester.

Poldaufová, O., Katona, P. (2016): Easements with a public-law element, Slovenský geodet a kartograf, 21(2), 9–11 (in Slovak).

Slovak Technical Standard STN 01 3411/Z1 (01 3411) Map drawing and symbols (2001): Slovak Office of Standards, Metrology and Testing.

Voženílek, V. (2005): Cartography for GIS, Geovisualization and Map Communication, 1st ed., Univerzita Palackého v Olomouci, Olomouc.

Voženílek, V., Kaňok, J. (2011): Metody tematické kartografie, Vizualizace prostorových jevů, 1st ed., Univerzita Palackého v Olomouci, Olomouc (in Czech).

URLs

URL 1: Slov-Lex Legislative and Information Portal. Ministry of Justice of Slovak Republic,
<https://www.slov-lex.sk/web/en>, (8.3.2018).

URL 2: ZBGISť – Basic data base for the geographic information system Map Client application – the Real Estate Cadastre theme. Office of Geodesy, Cartography and Cadastre of Slovak Republic,
<https://zbgis.skgeodesy.sk/mkzbgis/sk/kataster>, (8.3.2018).

Prikazivanje služnosti na web portalu u kontekstu Slovačke Republike

SAŽETAK. Sadržaj katastarske karte u vektorskom obliku ima propisanu strukturu. Služnosti se nalaze u odvojenom sloju karte u vektorskom obliku od 2009. godine. Broj služnosti znatno je porastao posljednjih godina te se pokazalo da način prikazivanja služnosti na kartama u vektorskom obliku nije dovoljan. Postoje neki problemi, npr. preklapanje linijskih i površinskih objekata, nedostatak transparentnosti i povezanosti između karte i datoteke s opisnim informacijama. Karte u vektorskom obliku dostupne su građanima preko web portala. Karte u vektorskom obliku izvorno su GIS karte, što znači da će prikaz služnosti korisnicima prenijeti ograničenu količinu informacija, ako se one stave na web bez ikakvih izmjena. Glavni je cilj ovog rada predstavljanje rješenja za prikazivanje služnosti preko web portala. Prema našem rješenju služnost se prikazuje različito na kartama u vektorskom obliku i na web portalu. Grafičko sučelje web portala osigurava veću raznovrsnost sredstava i metoda kartografskog izražaja. Kako bi se prikazivanje služnosti preko web portala približilo nestručnoj javnosti koriste se interaktivna sredstva, npr. linijski znakovi u boji, površinski znakovi u boji (također s mogućnošću da se objekti uključe ili isključe), tehnika korištenja miša za dodavanje tekstualnih informacija i hiperlinkova. Naš prijedlog zahtijeva neke izmjene u strukturi katastarske karte u vektorskom obliku, a posebno treba dodati nove atribute za objekte u sloju služnosti. Te izmjene su u osnovi zanemarive u usporedbi s ishodom prikazivanja služnosti preko web portala.

Ključne riječi: katastarska karta u vektorskom obliku, kartografski znakovi, interaktivne kartografske metode, atributi objekta, energetski vodovi.

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