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## SELECTED POSSIBILITIES OF THE GIS DATA IMPORT IN PROGRAMS AUTOCAD CIVIL 3D AND GEOLISP

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### Abstract

AutoCAD Civil 3D with the Geolisp overlay are one of the most popular programs used in the GIS class systems in Polish mining. The article describes some interesting and little known possibilities of the programs in the scope of data importing. In particular, it presents the issue of using the data which are available on the Internet in WMS and WFS formats. The issue was discussed on the basis of data obtained from the website [geoportal.gov.pl](http://geoportal.gov.pl). The possibility of the two-way connection with the relational databases and popular in GIS programs shapefile format was mentioned. The ability to load data using Geolisp software was mentioned.

## WYBRANE MOŻLIWOŚCI IMPORTU DANYCH GIS W PROGRAMACH AUTOCAD CIVIL 3D I GEOLISP

**Słowa kluczowe:** mapa górnicza, Systemy GIS, formaty: WMS, WFS, SHAPEFILE

### Abstrakt

AutoCAD Civil3D wraz z nakładką Geolisp jest jednym z najpopularniejszych programów wykorzystywanych w systemach klasy GIS w polskim górnictwie. W artykule opisano kilka interesujących, a mało znanych możliwości programów w zakresie importu danych. W szczególności przedstawiono problematykę korzystania z danych w udostępnianych w Internecie w formatach WMS oraz WFS. Zagadnienie omówiono na przykładzie danych pozyskanych ze strony [geoportal.gov.pl](http://geoportal.gov.pl). Wspomniano o możliwości dwukierunkowej łączności z relacyjnymi bazami danych i popularnym w programach GIS formatem shapefile. Wymieniono możliwości wczytania danych przy pomocy oprogramowania Geolisp.

## 1. INTRODUCTION

Information concerning space is usually organized as Geographic Information System – GIS, this is the system which may be defined as “a powerful set of tools for collecting, storing, retrieving at any time, transforming and displaying data on space coming from the real world for the specific, particular set of targets” (Burrough, McDonnell 1998). The basic element of this System is the database that contains information both about

the geographical location of objects and their geometric properties and spatial relationship. Geospatial data are currently used in almost every branch of economy.

The essential document for building such systems, including the wide range of data in European Union, is published in March 2007 by European Parliament and the Council of Europe, Directive establishing infrastructure for spatial information in the European Community (INSPIRE-INFrastructure for SPatial Information in Europe, Dyrektywa 2007/2/WE 2007).

The introduction of the Directive is intended to allow the use of a wide range of spatial data that have so far been collected in many databases by different institutions. At the same time, due to lack of data consistency and interoperability, it was very difficult to use the data contained in these databases. The transposition of the Directive into the Polish area is the Act of 4<sup>th</sup> March 2010 on spatial information infrastructure (Ustawa... 2010). The detailed rules for accessing the spatial data sets are specified in the Chapter 5 of the Act. Administrators create and support a network of services concerning the sets and services of spatial data. In particular the access to search and viewing services is widespread and free. Data sets for specific spatial data issues, included in the annexes to the Act are created, supported and developed primarily by lead authorities and other administrative bodies. The largest number of topics is attributed to the country's main surveyor.

According to the art.13 of the Law, the minister appropriate for computerization is responsible for creating and supporting the central point of access to the services specified in the Law, in the full thematic and territorial scope, organized in the form of geoportal infrastructure of spatial information ([www.geoportal.gov.pl](http://www.geoportal.gov.pl) 2017).

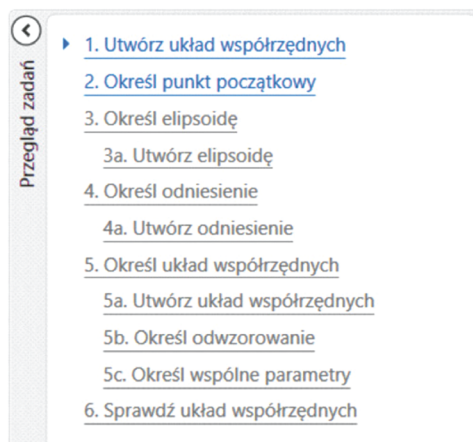
Due to the above, the article discusses the issue of importing data from a geoportal and the regional geoportals created within the framework of the realization of the records contained in the Act for programs AutoCAD Civil3D and Geolisp. These programs are the element of GIS systems operating in most mines in Poland. Creating such systems in mining is connected with records introduced, first of all, in Regulation (Rozporządzenie...

2015) on survey-geological documentation, which allow the possibility of creating measurement, calculation and cartographic documentation using electronic information technology in the form of electronic documents. These records have increased the use of information technology in mining industry (Biegun, Krawczyk 2016, Jelonek et al. 2015, Maciaszek et al 2015, Pomykoł, Poniewiera 2009, Sokoła-Szewioła, Poniewiera 2014, Toś, Szewczyk 2016). In systems operating in mining it is also important to obtain data from existing systems of this kind from the state geodetic and cartographic resources. Hence, the issue of using data collected, among others, within IIP, is important for the realization of the tasks of the mining companies. The article also discusses the possibility of two-way connection with relational databases and popular in the GIS program shapefile format. The possibilities of data loading using Geolisp software, among others GML, have been mentioned.

## 2. DISPLAYING GEOPORTAL DATA IN CAD DRAWING

The Main Geodesy and Cartography Office provides spatial data, including general geographic data of a cadastral nature, ortophotomaps, numerical terrain model and many others. These data are available through the website [geoportal.gov.pl](http://geoportal.gov.pl), and it is possible to display them in an usual drawing of AutoCAD Map program.

Apart from the national geoportal ([geoportal.gov.pl](http://geoportal.gov.pl)) many cities, municipalities or institutions provides their data in terms of WMS service (Web Map Service), in the case of the raster data or WFS (Web Feature Service),



### Utwórz układ współrzędnych

- Utwórz definicję układu współrzędnych
- Utwórz odniesienie
- Utwórz elipsoidę
- Utwórz transformację geodezyjną
- Utwórz ścieżkę transformacji geodezyjnej
- Utwórz kategorię układu współrzędnych

Fig. 1. Defining your own coordinate system

Rys. 1. Określenie własnego układu współrzędnych

in the case of vector data. The way in which the data are imported is given in the further part of the article. In order to display properly the spatial data, the drawing must have a coordinate system assigned. It does not need to have the same coordinate system as the data from geoportal, AutoCAD will automatically make the appropriate recalculation. However, it would be safer to have the same coordinate system, because AutoCAD contains theoretical coefficients that may differ from the actually realized by the geodetic warp in a given country. In AutoCad Map 3D we are able to define our own coordinate system using the command `_AdelDelCrdSys` or select the redefined one by the command `_MapCsAssign` (fig. 1). Because there are thousands of coordinate systems defined in the program, it is convenient to filter only Polish ones by typing the word "Poland;" from the found list we select, for example, "CS2000 zone 6" and press the button "Assign".

If the map is not in the coordinate system 2000/6, and we want to use data obtained in the geoportal in the local coordinate systems, in which the survey-geological documentation is carried out in mines, we can make the transformation to these coordinate systems by means of the Geolisp program.

## 2.1. Map Transformation in the Geolisp program

In the Geolisp software, on the basis of data, provided by mines and offices, transformation formulas were developed for the most commonly used in mining recalculations. The two basic formulas were applied: for the accurate calculations, complex polynomials are used, and for the approximate – conformal transformation. Linear transformation is more convenient for converting numerical maps, because then the mutual position of objects (topology) does not change. The Geolisp software enables the transformation of the text files, raster drawing and numerical maps. The program allows to perform transformation based on the common points, Geonet parameter files or the external software, for example, such that is used by the Geodetic and Cartographic Documentation Centers.

Transformation programs assure that all map objects receive new coordinates, and texts that are parallel to the frame, and blocks, remain parallel to it. The unit scale of blocks and the height of inscriptions are unchanged. It is possible to transform data from the local coordinate systems to the national coordinate system and the reverse transformation, from the national to the local coordinate system (fig.2).

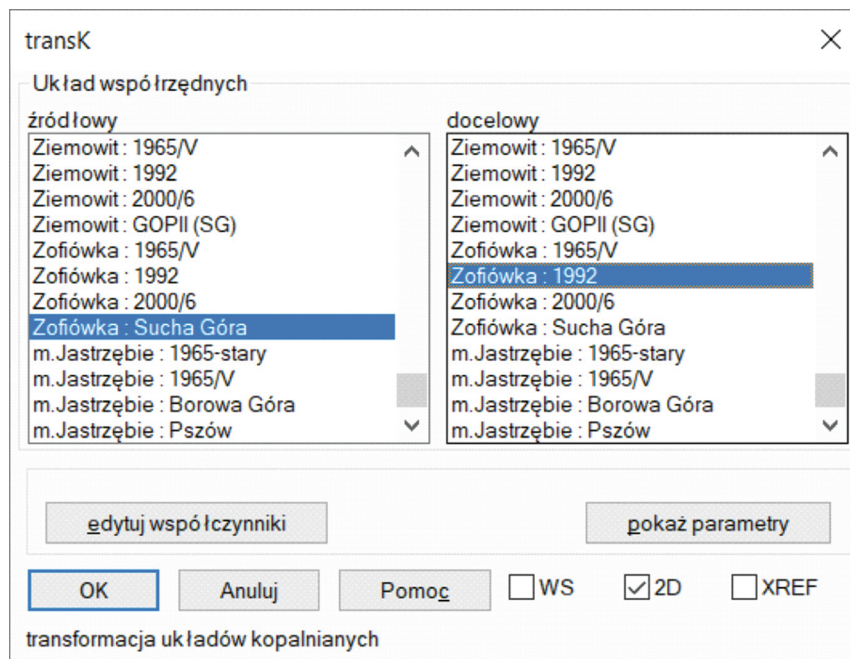


Fig. 2. The dialog window of the coordinate transformation program

Rys. 2. Okno dialogowe programu transformacji współrzędnych

### 3. THE CONNECTION WITH THE GEOPORTAL (SERVER WMS)

In order to find the interesting address of the WMS server, from which we want to use, the easiest way is to type in the Internet search engine words, for example, “WMS geoportal,” or “WMS Service.”

We choose the command `_MapConnect`, and next we choose, from the list on the left, “Add WMS connection.” In the window “Connection name” we enter any value, in the window “Name or address...” Fig.3, for example:

`http://maps.geoportal.gov.pl/wss/service/img/guest/Administrative/MapServer/WMSServer.`

The username and password are left blank, and we indicate the login button. The program will display a list of available layers, that is thematically grouped data sets, for example plot boundaries or buildings. Select the layer that is to be loaded and indicate the button “Add to the map.” In this case, the administrative map of Poland will be presented into the drawing.

Data in the WFS form are inserted in the similar way, however, from the dialog box, shown in the fig.3,

we select the position “Add WFS connection.” Vector WFS data is generally not available for free, as is WMS raster data.

### 4. THE TWO-WAY CONNECTION WITH THE SHAPEFILE FORMAT

Shapefile is a popular file format that is used in the Geographical Information System. It was created by the ESRI Company, and it is currently developed on the open standard basis. In this format, each layer is presented as two files: a vector drawing and descriptive data, as tables. Each row of this table is associated with one map object. The table can be opened, for example, in a spreadsheet. The layer of the shapefile file can be watched in AutoCAD in two ways: firstly, import the layer into the drawing – it will be treated like any other object drawn in AutoCAD, and it will be saved together with the whole drawing, in the DWG format, (this method was described in point 5). The second method is the connection to the shapefile, which allows to share continually the actual data with other programs that are able to read the shapefile format, for example, viewing our maps through the Internet searching engine. The vector and descriptive

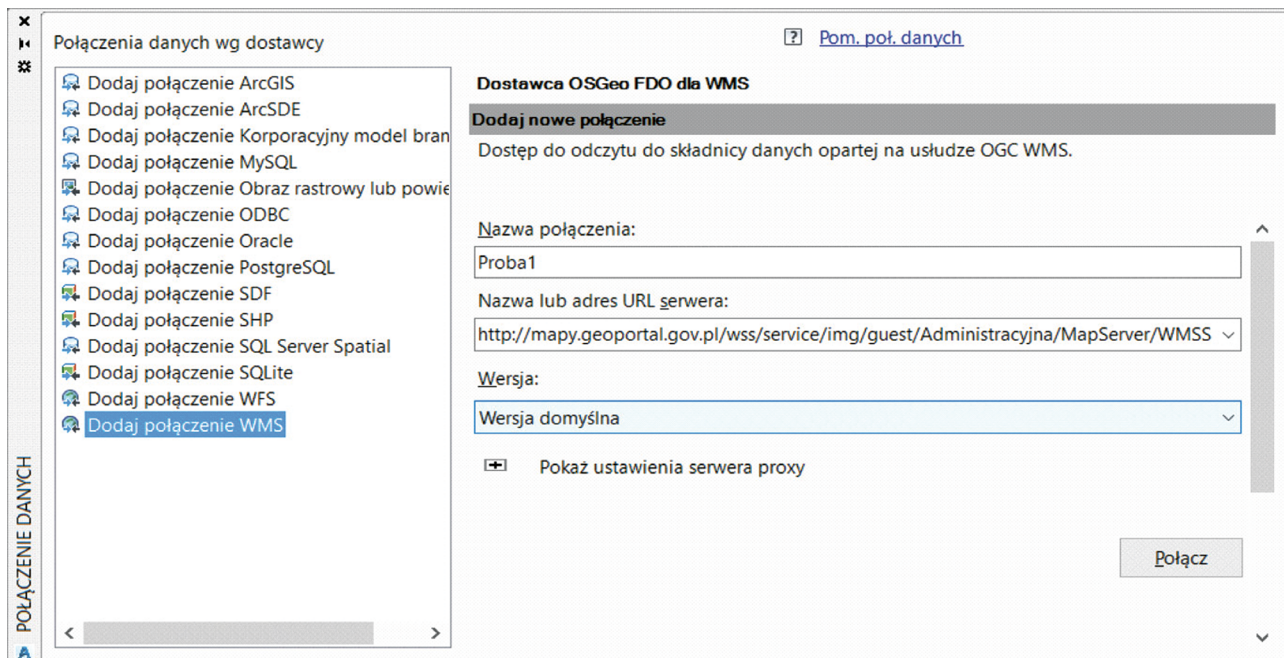


Fig. 3. Adding new WMS connection to the current drawing

Rys. 3. Dodanie nowego połączenia WMS do obecnego rysunku

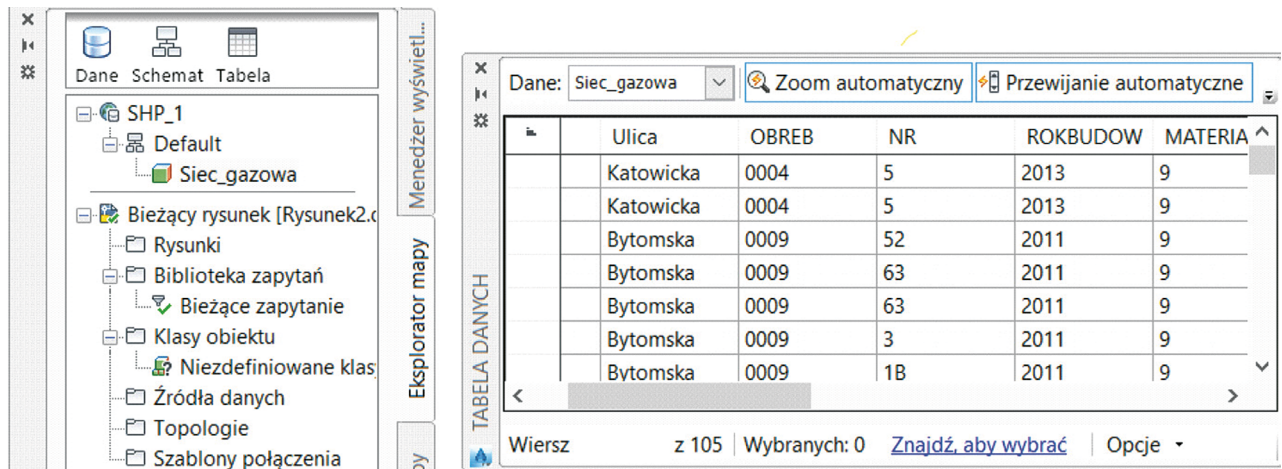


Fig. 4. AutoCAD workspace and the table concerning objects in the drawing

Rys. 4. Przestrzeń robocza AutoCAD i tabela dotycząca obiektów przedstawionych na rysunku

data can be changed, deleted, and added new objects in AutoCAD.

In order to connect the drawing with the, the following activities are performed: the command “MAPCONNECT” is entered, from the list of the available formats, the command “Add SHP connection” is selected, in the box “Folder or file” the name of the possessing file is entered. The button “Connect” and “Add to the map” is indicated.

It is comfortable to use so called “workspace” in AutoCAD, if the name of the file is indicated in it, this will show the associated table of the descriptive data (fig.4).

If the row in the table is selected, the objects on the map will light up, if the objects on the map is indicated, the adequate row in the table will light up. Data can be filtered, for example, to have a gas network in Katowicka Street in Bytom selected.

## 5. THE SHAPEFILE IMPORT

The shapefile can be imported to the drawing using the command `_MapImport`. Objects will then be ordinary AutoCAD objects: regions, lines, points, texts. Attributes (for example, number, diameter, address, an owner), are added to the descriptive data. These data are the data table, which is saved together with a drawing in the DWG file. These data can be viewed and edited in the box “objects properties.” The Geolisp System contains the command `cShp` that in the place of AutoCAD elements enters the proper contractual signs with an adequate description.

It is worth mentioning the command `_AdeQuery`, which enables filtering and changing the features of the objects of the given qualities, for example, it marks the gas lines of a diameter  $> 100$  in red, and the rest lines are in green. The command `_MapExport` saves the drawing in the shapefile format.

## 6. THE CONNECTION OF THE DRAWINGS OF THE OBJECTS WITH THE RELATIONAL DATABASE

To each object in the drawing can be added an additional description, another drawing, a link to a website, any file or program. All this is possible in the object properties box. Furthermore, as it was mentioned in the previous paragraph, information in the form of an internal table can be added to the drawings of the objects. It is also possible to connect with an external server, for example Oracle, SQL or other by means of the command `MapConnect` that is presented in fig. 3. Below, there is presented an example of connection to the MS Access database:

- the connection of the MS Access to the drawing

It is conveniently to turn on the workspace – the command `MapWspace`. Drag the file `mdb`, containing the database, to the tab “Map Explorer.”

- creating a connection template

A connection template defines in which database column there is a unique identifier, for example, a num-

ber of a plot. It is possible to choose one or more columns, which is useful, if the identifier will consist of several elements, for example, of a number of a border sheet and a plot.

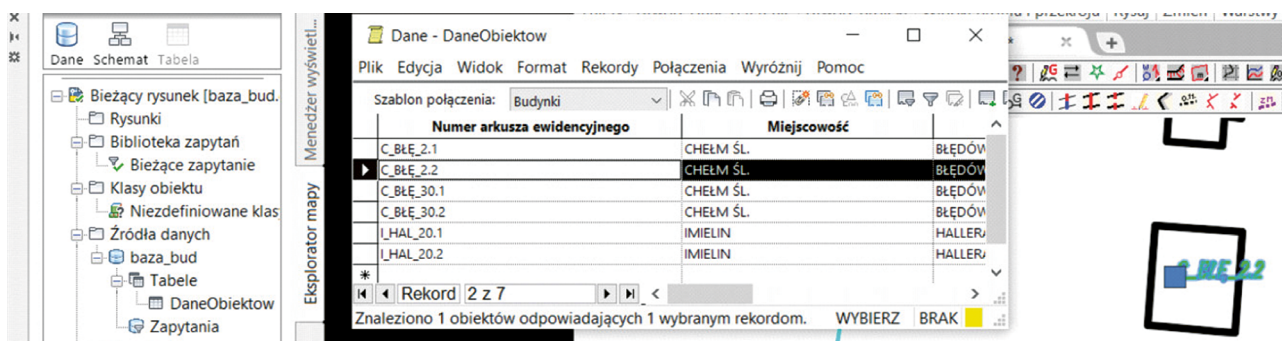
Indicate the “Connection template” in a workspace, and choose the command “Define a template.”

Enter any name of a template, for example, Plots buildings (fig. 5). Connect the database with the drawing.

It is possible to connect manually each identifier of a database with a responsive element in the drawing, what is obviously labour-consuming. If there are texts, containing the key, on the map, the link can be automat-

**Fig. 5.** A command box that creates the connection between the objects of a drawing and a database – communication between a database and a map

**Rys. 5.** Lista poleceń tworząca połączenie pomiędzy obiektami rysunku i bazą danych – połączenie pomiędzy bazą danych i mapą



**Fig. 6.** Selecting the row in a table causes choosing the adequate objects on the map

**Rys. 6.** Wybór rzędu w tabeli powoduje wybranie właściwych obiektów na mapie

ic. To do so, indicate the connection template created in the previous point and select the command to generate the connection. Specify which objects are to be connected with the database. They may be, for example, the closed polylines on the plot layer, inside which there is their number.

The connection of a drawing with an external database means that pointing the object on the map opens the database and shows information about this object, and selecting information in the database causes choosing objects in the drawing (fig. 6).

Tables, connected to the drawing, are in the AutoCAD working space, in the tab Map Explorer.

## 7. DATA IMPORT IN THE GEOLISP PROGRAM

A major problem in geodesy is the transfer of the data between different geodetic programs. Nowadays, more and more popular is the GML format, which should minimize this problem in the future. In any case, many geodetic programs, popular in Poland, allows to import and export data in their own format, it is usually the text format ASCII. It is generally better than using international formats such as DXF or shapefile, because it ensures that attributes, the interconnection of the objects or topology will be transferred correctly. The Geolisp System includes procedures for reading and saving files in many different programs, among others: EDN, GEONET, EWMAPA, GEO-INFO, MSEG, EWOPIS and many others. Geolisp does not provide full compatibility with these programs, it mainly limits to one type of the objects, however, it is possible to read and save successfully, for example, plots in the format edzEwmaps, gas network in the format givGeoinfo, read the Geonet parameter files, and so on.

Moreover, the Geolisp provides the following functionality:

- Reading and saving of the point from the XYZ text file (TXT). The data can be transferred “on the fly” to the proper coordinate system.
- Inserting a number of contractual signs into drawing, based on files in many different formats (creating a map on the basis of codes).
- A direct access to the database in Excel formats, Oracle and MSSQL Server.
- Reading and saving the attributes of the blocks, descriptive data and additional data.
- Saving to a file in many formats the drawing objects: texts, lines, and the like.
- Codes generation on the basis of the features of the objects.
- Data searching and group processing of the text files.
- Comparing objects, for example, the area of the record parcels, with a base and differences register.
- Many others.

## 8. SUMMARY AND CONCLUSIONS

The article focuses on selected options of the AutoCAD Civil 3D and Geolisp programs in the scope of data import. In particular, the connection to the relational and online databases was discussed. Presented abilities are of a particular importance, because of the fact that there is an opportunity to use data created within IIP. The scope of these data is so wide that they can increasingly be an important material to be used also in mining companies, conducting the underground mining extraction, where GIS class systems exist, it is based on the AutoCAD Civil 3D and Geolisp programs. The described commands work on AutoCAD Civil 3D software, so they will not be available either in the AutoCAD or others CAD programs. However, there are many overlays for different CAD programs that perform presented tasks in a similar way.

AutoCAD Civil 3D program includes the functionality of the AutoCAD and AutoCAD Map 3D programs, additionally, it has numerous functions that make the work of surveyors and engineers easier. It allows, among others, the data import in various formats (among others, in the presented article, in the ESRI SHAPEFILE format), integration with relational databases, performing topological analyzes.

Geolisp is an overlay on the CAD software that is able to read LISP language, for example, AutoCAD, BriscCAD, GstarCAD, ZwcAD and others. Through its customization to Polish realities in the scope of: geodesy, mining, geology, urban planning or railway, it is the excellent extension of the capabilities of the CAD programs. Geolisp includes a transformation factor for most commonly used coordinate systems (Sucha Góra, Borowa Gora, ROW, JTSK, PL-1992, 1965 and others).

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