IMPORTANT ACTIVITIES OF THE GEODESY OFFICE

Transition to the new coordinate system

In 2006 the bulk of the activities pertaining to the national geodetic system was directed at the transition to the new national, European coordinate system, which is gradually being initiated into operative use.

Activities in the following areas were implemented as part of the transition to the new national coordinate system:

- **horizontal system:**
  - establishment of the national network of permanent GPS stations;
  - analysis of the compliance of the referential networks;
  - preparation and creation of instructions and manuals;
  - establishment of the transformation model;
  - idea project of re-surveying EUREF;
  - survey of the micronetwork of the Kanin, Mangart and Rodica trigonometric points of the 1st order;

- **height system:**
  - linking of the Gotenica gravimetric point to the leveling network;
  - leveling survey of the Koper mareographic station;

- **gravimetric system:**
  - stabilization and recalculation of gravimetric points;
  - survey of the basic gravimetric network.

**Horizontal system**

The establishment of the SIGNAL network began in 2000 and finished in 2006 with its entry into operative use. It is a part of the geodetic data distribution system. The data also include the data on real estate and the national territory topography.

The SIGNAL network is a basic national geoinformation infrastructure for determining the accurate position with the modern GPS satellite technology anywhere in the territory of Slovenia. It was created by the Surveying and Mapping Authority of the Republic of Slovenia. It comprises a network of 15 permanent GPS stations (receiver and GPS aerial) and the monitoring and distribution center of the GPS Service at the Geodetic Institute of Slovenia in Ljubljana, which runs it in a technical sense. The Ljubljana station is included in the European network of the permanent GPS stations. The SIGNAL network does real time data exchanges with five other networks of the Austrian APOS network and the station in Zagreb.
The strategic goal of the SIGNAL network is to introduce the new national coordinate system, which will bring greater security and quality of real estate and other spatial data due to its accuracy. The practical purpose of the network is to enable accurate surveys throughout the country using satellite technology.

The SIGNAL network is extraordinarily important for the operation of the national land survey service and for the spread of the use of spatial data at the national level. It enables surveyors, other professionals and even laypeople to determine a position or coordinates. It enables surveys and data acquisition in real time with centimeter accuracy anywhere in the territory of Slovenia. The surveyed coordinates refer to the European coordinate system ETRS89 (European Terrestrial Reference System 1989), which ensures the comparability of coordinates in Slovenia with coordinates in the other countries in Europe. Good-quality surveys ensure greater security of real estate data (buildings, Land Cadastre).

For surveyors, the SIGNAL network is a means of transitioning to the new national coordinate system, which will be based on the European ETRS 89 system. Gradually all the coordinates of real estate and topographic objects will be calculated for the new system. Other spatial records will also be transformed into the new system.

Figure 13: National network of permanent GPS stations named SIGNAL
The analysis of the compliance of the densification networks, which were surveyed both in the current national coordinate system as well as in the future new coordinate system. The points of the framework networks are ETRS points, and they represent a link between the two coordinate systems. By the end of the year 2000 ETRS points were created.

<table>
<thead>
<tr>
<th>Network name</th>
<th>Network size</th>
<th>Network type</th>
<th>Number of new points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kostanjevica na Krki</td>
<td>100 km²</td>
<td>static and fast static</td>
<td>8 static and 13 fast static</td>
</tr>
<tr>
<td>Velike Lašče</td>
<td>350 km²</td>
<td>static</td>
<td>9 static</td>
</tr>
<tr>
<td>Bizeljsko</td>
<td>400 km²</td>
<td>static and fast static</td>
<td>25 static, 14 fast static</td>
</tr>
<tr>
<td>Velenje in Mislínja</td>
<td>300 km²</td>
<td>static and fast static</td>
<td>17 static and 38 fast static</td>
</tr>
<tr>
<td>Juliske alpe</td>
<td>900 km²</td>
<td>static</td>
<td>20 static</td>
</tr>
<tr>
<td>Goričko</td>
<td>350 km²</td>
<td>static</td>
<td>25 static</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>2400 km²</strong></td>
<td><strong>6 static in 3 fast static</strong></td>
<td><strong>104 static, 65 fast static</strong></td>
</tr>
</tbody>
</table>

Table 2: Surveyed framework networks in 2006

As part of the assignment "Models of transformation between coordinate systems" different models of transformations between coordinate systems were examined. The effects of the listed methods of transformations were compared in a concrete test area. The software application for transformation was created as part of the assignment: Software package SiTra and instructions for use. The following transformation parameters were calculated for the territory of Slovenia:

- transformation parameters for the entire territory of the country with approximately 1-meter accuracy (and somewhat lower in the extreme southeast of the country),
- regional transformation parameters, where the territory of the country is divided into 3 regions, with up to 0.5-meter accuracy,
- regional transformation parameters, where the territory of the country is divided into 7 regions, with up to 0.3-meter accuracy,
- transformation parameters for the territories of individual GPS network of the Surveying and Mapping Authority of the Republic of Slovenia with up to 0,1-meter transformation accuracy.
The project outline for resurveying EUREF was created. Given that the campaign results will be essential in defining the new national geodetic datum, the geodetic professionals believe the repeat of the EUREF GPS campaign is one of the key assignments in implementing the transition to the new coordinate system.

The primary purpose of surveying the micronetwork of trigonometric points of the 1\textsuperscript{st} order, which are simultaneously also EUREF points, is the determination of the coordinates and elevation above the sea level to GPS excenters. The EUREF points designate the new coordinate system in the territory of the Republic of Slovenia.
Height system

The Surveying and Mapping Authority of the Republic of Slovenia linked the Gotenica absolute gravimetric point to the leveling network. The data on the gravimetric point's elevation above the sea level is required for calculating the adjustments to the basic gravimetric network.

In 2006, the Koper mareographic station was integrated in the national height system. Currently there are 6 stabilized benchmarks around the Koper mareographic station and a benchmark at the station itself which form a leveling loop. The length of the leveling loop is approximately 1 kilometer.

*Figure 16: The object of the new Koper mareographic station (photo: Jože Miklič)*
Gravimetric system

In the autumn of 2006, the Surveying and Mapping Authority of the Republic of Slovenia implemented the survey of the new basic gravimetric network of Slovenia, which is a part of the vertical dimension of the new coordinate system. In the territory of Slovenia the network comprises 29 relative points (1st order) and 6 absolute points (0th order). The survey also included the points beyond the border of Slovenia: the excenter of the Austrian absolute gravimetric point and four Croatian relative points. This ensured better homogeneity of our gravimetric network. Moreover, the network will be linked to the gravimetric networks of the neighboring countries. The entire survey thus encompassed 40 gravimetric points.

Figure 17: Gravimetric network of Slovenia with a link to the neighboring countries
Accomplishments in the fields of geodesy, topography and cartography

- The activities for the establishment of the basic configuration of the network of the permanent GPS stations were completed. The required equipment was purchased and installed for that purpose. The network of the permanent GPS stations was put into operation in December 2006.
- The GPS Service, which monitors the network operation and distributes data to the users, started functioning.
- In most of the planned territories the surveys for determining the transformational parameters - for the preparation of the transformation model for the transition to the new coordinate system - were implemented.

![Implementing surveys for determining transformational parameters](photo: Jože Miklič)

- The survey of the gravimetric network of Slovenia, which represents a part of the vertical dimension of the new coordinate system, was implemented.
- Color digital air survey of the entire territory of Slovenia was implemented, which is the first time since 1975 that the entire territory of Slovenia was surveyed in a single year. These aerial survey photos are a basis for creating new orthophotos in the color and infrared techniques, and the new digital relief model with the 5m x 5m grid cells for the entire territory of Slovenia in 2007. Concomitantly with the aerial survey project, the creation of orthophotos and the digital relief model, the procedure of professional control of the quality of all the products of this project was established and all the products are regularly assessed through the procedure.
- The updating of the national topographic map at 1:50,000 began.
The data for the European database of topographic and cartographic data at 1:250,000 (EuroRegionalMap) were prepared in compliance with the EuroGeographics standards.

The data for the European database of cartographic data at 1:1,000,000 (EuroGlobalMap) were updated.

The activities of the Commission for the standardization of geographical names continued in the field of the register of geographical names.

The acquisition of topographic data at 1:5,000 was implemented for 14% of the territory of Slovenia. The test of field positional control of these data was also implemented.

In terms of organization, the system of registering public infrastructure began to be established.

The information support for the administration and updating of the Consolidated Cadastre of Public Infrastructure was created. In 2006, 460 analyses for registration were received and more than 200,000 objects of public infrastructure were registered.

The professional activities in the modernization of the national geodetic and topographic system were implemented in line with the provisions of the INSPIRE directive.

The instructions and manuals for work in the new coordinate system were prepared, both in the standard fashion and with the use of GNSS satellite technology.