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MAINTAINING LENGTH AND ANGLE STANDARDS IN THE REPUBLIC OF SERBIA WITHIN THE GEODETIC METROLOGICAL LABORATORY

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1. Introduction

Measuring represents a basic part of geodetic works.

Metrology is the scientific study of measurements.

Geodetic metrology is a science on geodetic measuring.

Such a system of metrological quality assurance cannot be imagined without a well organised and equipped geodetic laboratory.

The metrological laboratory of the Department for Geodesy (ML-160) started its work in 1985.



2. Historical facts

Metrological quality assurance of geodetic reference position networks

13 parts of First Order Triangulation Network of the former SFR of Yugoslavia (595 tr.)

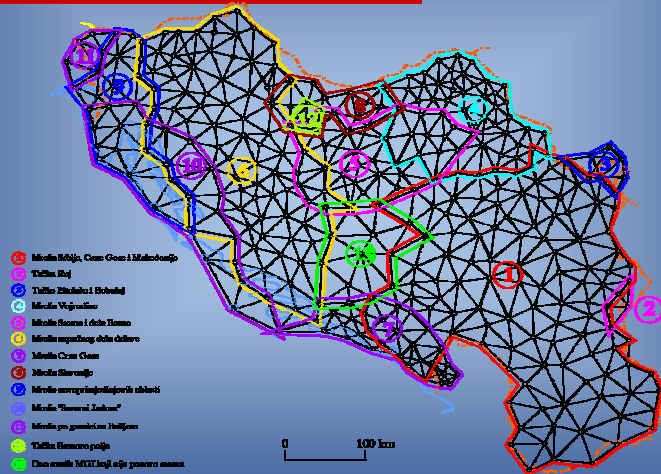


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2. Historical facts

Metrological quality assurance of geodetic reference altitude networks

The works on the creation of reference altitude network was carried out during four periods



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2. Historical facts

Metrological quality assurance of astrogeodetic determinations, of gravimetric measuring and Local reference networks



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3. State of metrology in Serbia

Serbian Accreditation Body

Bureau for Measures and Precious Metals in Belgrade

Department for Geodesy and Geoinformatic –
Faculty for Civil Engineering in Belgrade



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4. State of measuring standards in Serbia

The system of legal units of measurement in our country is the SI system.

Serbian primary standards of main and derived units of measurement are realised by the Bureau for Measures and Precious Metals.

For all the measuring dimensions in geodesy (except acceleration), the national primary standards have been compared with international ones and are kept in BIPM database.



4. State of measuring standards in Serbia

Length standards

The national length standard



4. State of measuring standards in Serbia

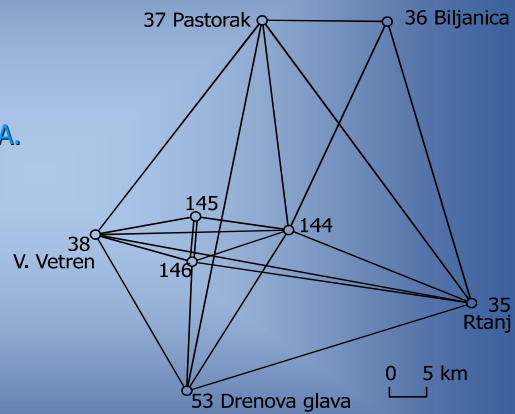
Length standards

Length standards in geodesy:

- Mekometer ME 5000,
- Wild DI 5,
- Laser measuring system HP 5528A.

Field calibration bases:

- Paracin (base 145-146)
- Palic
- Kovin



4. State of measuring standards in Serbia

Angle standards

The national angle standard



4. State of measuring standards in Serbia

Other standards

Time and frequency standards

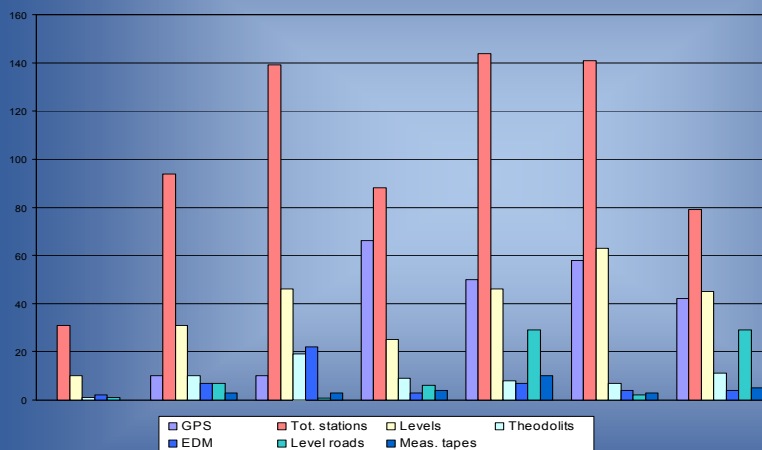
Acceleration standards

- "small" base Avala-foot - Avala-top



5. Metrological laboratory ML160

Tested instruments



Year	Total
2002	45
2003	162
2004	239
2005	202
2006	294
2007	278
2008	219



5. Metrological laboratory ML160

Activities of the metrological laboratory

- Ensuring and examining metrological regulations, instructions, procedures and internal documents;
- Testing metrological properties and establishing measuring uncertainty;
- By establishing a standard hierarchy and a method of transferring units, an unbreakable chain of traceability to national and primary standards on the international level is also established.



5. Metrological laboratory ML160

Laboratory equipment and work polygons

- a) Laser interferometer system HP 5528A
- b) Frequency meter Philips PM6612
- c) Distance meter of high accuracy Wild DI5
- d) Level Carl Zeiss Ni 002
- e) Theodolite Wild T3
- f) Collimator Topcon TC3
- g) bi-frequent GPS system
- h) Work polygon for metrological testing:
 - polygon of fixed angles
 - two polygons of fixed lengths, and
 - GPS polygon



5. Metrological laboratory ML160

Characteristics of the measuring methods

- It is necessary to conduct analysis of the method and previous accuracy assessment, detailed elaboration of the method, result processing and accuracy assessment from the measuring data.
- The main characteristics of a measuring method in terms of metrology are the realisation of **repeatability and reproducibility** of measuring.
- EAL recommendations to accredited metrological laboratories are related to **increased measuring uncertainty**.
- Testing and verification finally have to provide an answer as to whether metrological characteristics of measuring instruments are as those defined in the manufacturer declaration.



6. Impacts on geodetic community

- The noncompliance of instrument conditions are more frequently: vertical index and collimation with total stations and inclination angle with levels.
- The owners obtain information on reasons of instrument conditions.
- The owners ask for calibration of the equipment more frequently, realizing their responsibility of measuring data forwarded to investors.
- The owners contribute to quality assurance system in the national level.
- By comparing methods between laboratories, laboratory specific methods are verified within the international level.



7. Conclusions

- Hierarchy of measuring standards and methods of comparison units has been established.
- The realization of primary length, angle, frequency and time standards has been performed at the national level.
- The national primary standards have been compared with the international standards and are kept in the BIPM database, and thus it is possible to realise metrological traceability for all geodetic measuring instruments.
- There are instruments of high class accuracy that can be used as secondary length and angle standards.



7. Conclusions

- The field on calibration bases and test networks with regular maintenance could provide conditions for their incorporation in the system of metrological quality assurance.
- Forming information system of geodetic metrology should be initiated.
- It is necessary to form a common service for testing and standardisation of geodetic measuring instruments at the national level.



Thank you! Tack så mycket

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SIDA (Swedish International Development Agency)
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Faculty for Civil Engineering, Belgrade
<http://www.grf.bg.ac.yu/>



Metrological Laboratory ML-160, Belgrade
<http://ig.grf.bg.ac.yu/metrolab/>

