TWO STANDARDS ON DIGITAL MAPS AS PART OF THE HUNGARIAN NSDI

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1. INTRODUCTION

Based on the standardisation of geoinformation in frame of CEN TC 287 and partly ISO TC 221 and taking into account the Hungarian conventions as well as the Hungarian Law on Surveying and Mapping (1996) two standards on digital maps has been issued in Hungary last 4 years.

The first standard is the conceptual model on digital basic map (on multicadaster map) issued by the Hungarian Board of Standards nomenclatured as MSZ 7772-1:1997. The standard has been realised in life using also the digital base map instructions. The MSZ 7772-1:1997 standard and its instructions has been applied and proved fully appropriate for the practice during 3 years of surveying practise in the frame of the National Cadastre Program.

The second standard is the conceptual model of Digital Topographic Data Base. The Hungarian Board of Standards issue number is MSZ 7772-2:2000. Recently the connected digital topographic data base instructions are elaborated in draft. Next year digital cartographic database conceptual model is expected to be issued.

2. ANTICEDENTS TO HUNGARIAN MAP STANDARDS

In Hungary the cadastral maps have been functioning from the middle of 19th century. Beginning with 1950s the, so called, multicadastral maps become practical with both legal and technical features on it, called surveying maps. In 1970-s the cadastral maps have been integrated with the land registry data as well as a unique projection system EOV (Egységes Országos Vetület, Unique Hungarian Projection) introduced with scales 1:1000 and 1:2000 for built-in areas and 1:4000 for rural ones. Till now the country is covered with these surveying base maps, sometimes mixed with the earlier 1:1440 and 1:2880 scale cadastral ones. They are continuously maintained by the civilian Mapping Agency as the land registry data are changing.

Another type of the maps – the topographic ones with large, medium and small scales have been covering all the country from a long time ago. Till the middle of 20th century these topographic maps have been maintained by the Hungarian Defence and then divided also for the civilian Mapping Agency.

Naturally, for both the large scale surveying base maps and the topographic maps of different scales well functioning instructions were elaborated and used. They reflected

the wishes and purposes of the data owner/provider and the technical possibilities and means of the age by data capture organisations. They have been agreed with the ministries of interest (as summit or centralised, rather than user-oriented) but these instructions did not get a national-wide effective standard level, as well as no law but ministry order level on surveying and mapping was in effect which would provide right accommodation of the instructions in the economic life of the country.

First time in surveying history of Hungary in 1996 the Law on Surveying and Mapping (LSM) has been legislated. This LSM prescribes to use the state base map for any GI database in Hungary as mandatory. The LSM divides the state obligation task of the geodetic control networks, of the state surveying base maps and the state topographic maps of 1:10 000 scale to the civilian Mapping Agency, and the state topographic maps of the scales smaller than 1:10 000 to the Hungarian Defence Forces.

Meanwhile, end of 1980s the era of computers and information society started. Digital base map became necessary for geographic information. The same time a world-wide GI standardisation has been began mainly from a structural point of view of the GI data bases, first in dominant mapping agencies of the world, second in the frame of international standard organisations (CEN, ISO, OGC). It becomes necessary to convert the analogue maps into digital ones. After some years of trying to do that in sporadic ways with different methods, commercial software and approaches the surveyors and GI professionals established in frame of Hungarian Board of Standards the Technical Committee 818 on GI-standardisation. A series of digital map standards have been started to develop. The first in the series was the digital base map (likely a digital version of the state surveying base map), and the second was the digital topographic map standard.

3. REQUIREMENTS TO MAP DATABASE STANDARDISATION

Requirements for these (and further) map standards have been formulated as

a) to follow the national legislation and practice in their content;
b) to use the international geoinformation structural standards (or prestandards)
c) to provide continuity with the respective analogue maps of the earlier times;
d) to provide communicative transparency between the map data bases of different resolutions (scales) by their projection system, database structure, content, portrayal;
e) as a consequence coming from the above paragraph, to get the content of the map data base of lower resolution (smaller scale) such that generalising the adequate part of the content of higher resolution (larger scale) and including the result into the map data base of lower resolution (smaller scale);
f) to solve the technical regulation of map data base at two levels:
   - level of national standard giving the conceptual level, less sensitive to technological changes, not containing any institutional and economical relations, and reflecting those elements and technical matters which are common for the user community, data owner/provider and data capture considerations,
   - level of instruction giving the physical model, containing the technical details, the institutional and possibly the economical relations, reflecting those elements and overall matters which are common for the data owner/provider and data capture considerations rather than those of the users as well as being able to be

subjected to changes and modifications which surely are needed as the time is going ahead;

g) to have the map data base consisting of such primitive data elements which are suitable for compiling user required tailored products and for clearly defined counting the supplied data elements when financial accounts are to be invoiced;
h) to have the GI standard based map data bases such that serving for geoinformation systems as prescribed by the Hungarian Law on Surveying and Mapping;
i) to have the standards, the instructions, the data of the map data bases as well as the interoperability between the different organisations and between the different data sources such that forming the basic part of the Hungarian NSDI.

The international GI structural standard used too derive the Hungarian map data base content standards were those of CEN and ISO which got readiness to be used and which have been coincidancing to each other, namely: prestandards on spatial schema, quality, metadata and position.

4. TWO HUNGARIAN STANDARDS ON MAP DATA BASES

Based on selected international structural GI prestandards two Hungarian content standards on map databases have been defined as it follows in chapters 4.1.and 4.2.

4.1. Standard on Digital Base Map

In process of standardization from 1995-96 the Institute of Geodesy, Cartography and Remote Sensing (FÖMI) developed the standard on digital base map. By its content it is built such that providing a well-harmonized continuity with respect to the earlier large scale map prescription. During development of the DAT-standard all the user-types, data capture organizations and the institutions of data owner Land and Mapping Agency organization network represented themselves in 10 nation-wide meetings, altogether 450 persons. These meetings have been managed by FÖMI with help of the National Commitee on Technological Developments (OMFB) and the GI-standardization committee TC-818 of the Hungarian Body of Standards (MSzT) as well as supported by Lands and Mapping Department (LMD) of the Ministry of Agriculture (MoA). The MoA/LMD (as national mapping agency headquarters for Hungarian Lands and Mapping activity) accepted the standard preparation results and the MSzT issued the first volume of map data base standard series at the beginning of 1997:

MSZ 7772-1:1997 Digital Maps: Part one: Digital Base Map Conceptual Model
This standard is referred to in Hungarian as "DAT-Standard" by its Nick-name.

The DAT-Standard gives prescription of the following main groups of information:

- Cadastral and Real estate data,
- Natural and Man-made features.

Prescriptions are formulated as adequate to resolution available in scale band 1:1000–1:4000. The data handling unit is the settlement.

4.2. Standard on digital topographic data base

Later, in 1999-70 the FÖMI and Topographic Office of the Hungarian Defence Forces (MH TÉHI) prepared the standard on digital topographic data base fulfilling the requirements as given in chapter 3. During development all the data owners represented themselves in 3 nation-wide panel discussions, altogether 180 persons. As a result the second volume of map data base standard has been elaborated, discussed, accepted and issued by the GI-standardisation committee TC-818 of the Hungarian Body of Standards:

MSZ 7772-2:2000 Digital Maps: Part two: Definition of Digital Topographic Data Base.
This standard is referred to in Hungarian as “DITAB-Standard” by its Nick-name.

The DITAB Standard gives prescription of the 1:10 000 scale/resolution classical topographic, providing data base for later cartographic portrayal (the cartographic portrayal will be later standardised as “Digital Cartographic Data Base", DIKAB for different smaller scales). The data handling unit is the 1:10 000 scale map sheet.

4.3. Description of the conceptual model of the standards

The following chapters of DAT- and DITAB-Standards are describing conceptual model:

- Terminology
- Data model of the digital base map
- Position (spatial referening): Map projection system (Hungarian EOV), Reference system (Hungarian Datum, HD-72), Height system (Baltic see level, ortometric).
- Classification of objects and thematical structure
- Spatial schema: Geometrical primitives, Topological primitives, Spatial view
- Attributes
- Relations: between nodes, between edges, faces and rings
- Data quality: Source, Extent of application of data, Quality of geometric data, Quality of attribute data, Actuality, Completeness, Consistency of data, Technology for data collection, Data protection, Verification.

In case of DAT-Standard the following annexes are given:

- Tables of objects of the digital base map
- Tables of attributes of the digital base map
- Metadata describing the digital base map

In case of DITAB-Standard the following annexes are given:

- Tables of objects of the digital topographic data base
- Tables of attributes of the digital topographic data base
- Transformation from the Hungarian reference and projection system to the EUREF’89
- Sheet nomenclature of the Unified Hungarian Mapping System EOTR
- Metadata describing the digital topographic data base.

4.4. Structure and Object Classification of Map Database Standards

The digital maps are represented in object-oriented relational database. The specific objects are described by their attributes, relations and data quality parameters.

At conceptual model level the specific objects are represented by their generic objects. Those objects for which the attributes are common are grouped into one object group. The object groups having common attributes at higher level are grouped into one object classes.

Three object types are distinguished by its geometry: point, line, surface objects. The objects are managed by full-topology requirement. The topology elements distinguished are: node, edge and face. The nodes are divided into more specific types.

By geometry, the digital base map databases are 2-dimensional with planimetric coordinates. The hights are or can be given as attributes.

The attributes, relations and quality parameters are defined in the standard as generic. Their values are given in supplementary instructions.

The "Thematic Structure", the "Object Classification" and the "Example Attribute Table" are annexed, for the DAT-Standard and for the DITAB-Standard. In the DITAB-Standard the objects and attributes are harmonised with the DAT-Standard as well as with the DIGEST standard for NATO-compatible actions of the Hungarian Defence Forces.

4.5. Physical Model to the Standards

4.5.1. Physical model of the digital base map

Based on the DAT-Standard a series of instructions has been elaborated for physical model of Digital Base Map which are detailed prescriptions of how to develop the map itself. During the elaboration by FÖMI, the instructions have been critically discussed by representatives of land offices, MoA/LMD and data capture organizations.

Finally, end of 1996 the following DAT-Instructions have been issued by MoA/LMD:

DAT1. Instruction on "Planning, producing, renewing, documenting, checking, quality-checking, certifying and state acceptance of Digital Base Maps". Budapest, 1996.

DAT1-M2. Supplement Instruction on "Structure, data tables, exchange format and handling rules of Digital Base Maps". Budapest, 1996.

DAT1-M2. Supplement Instruction on "Legends for printing the Digital Base Maps".

DAT1-M3. Supplement Instruction on "Checking and certifying the inner consistencey of data of Digital Base Maps". Budapest, 1996.

DAT2. Instruction on "Digitizing the multipurpose analog cadastral maps and its quality checking." Budapest, 1996.

DAT2-M1. Supplement Instruction on "Transformation between different projection systems used in Hungary, with special emphasis on transformation to the regular projection system EOV." Budapest, 1996.

4.5.2. Physical model of the digital topographic data base

Based on the DITAB-Standard a series of draft instructions has been elaborated for physical model of Digital Topographic Data Base which are detailed descriptions of how to develop the data base itself. The instructions have been elaborated by the civilian FÖMI and the MH TÉHI of the Defence Forces. The instructions are:

- Instruction on structure, data tables, exchange format and handling rules of the DITAB
- Instruction on surveying procedure, data capture, quality check, acceptance of DITAB
- Examination of conformity and inner consistency of DITAB.
- Legends and their description for simplified printing the content of DITAB (Remark: it serves not for a cartographical print!).

5. EXPERIENCES

5.1. Experiences of Using the DAT-Standard and -Instructions

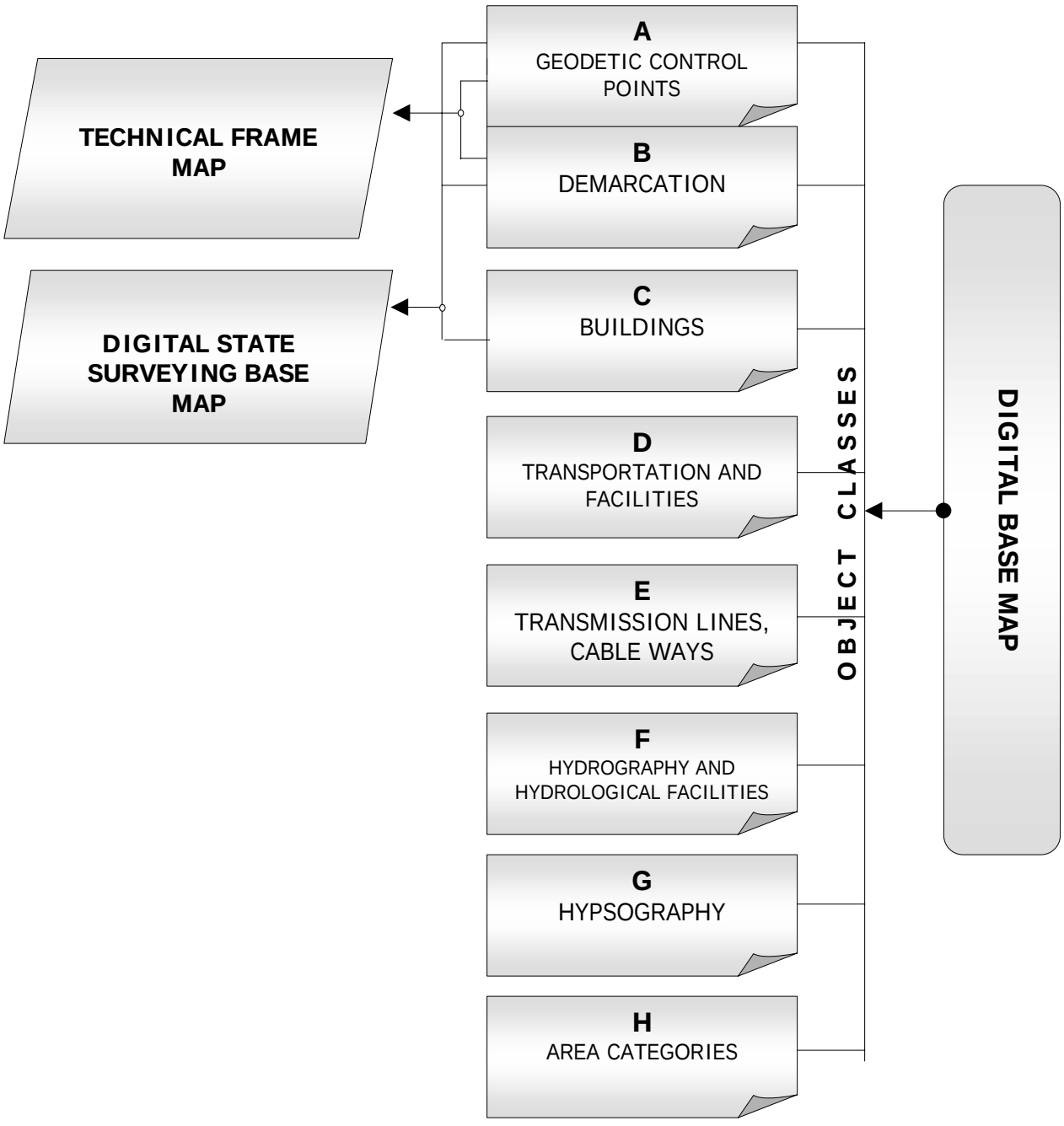
During 1997-2000 the DAT-Standard and -instructions have been experienced in the National Cadastre Program of Hungary.

- DAT-based data collection software used:
  - Microstation-based (TAKAROS system of Land Offices),
  - Autocad-based and others
- DAT-harmonised land office data handling software (nation-wide unique TAKAROS)
- Survey of 31 settlements in the frame of National Cadastre Program:
  - basicly cadastral data (state data),
  - new survey and digital conversion,
  - included are villages, towns, cities
- Excellent performance, with some modifications
- No needs to modify the MSZ 7772-1:1997 standard
- The DAT-Instructions however are under modification at some detailed level (no general and structural changes are needed)
- Practical data handling software types are to be elaborated yet.

5.2. Experiences of Using the DITAB-Standard and –Instructions

The DITAB-Standard has been issued just at the end of 2000 as well as the DITAB-Instructions have only been prepared in draft version. Finalisation and issue of DITAB-Instructions are expected in 2001 by the Ministries concerned.
As a consequence, no experiences have been obtained with the DITAB. This year a pilot is planned to be surveyed and handled in the digital topographic data base.

THEMATIC STRUCTURE
DIGITAL BASE MAP STANDARD MSZ 7772-1:1997



OBJECT CLASSIFICATION
DIGITAL BASE MAP STANDARD (MSZ 7772-1:1997)

A GEODETIC CONTROL POINTS
- AA HORIZONTAL AND 3D GEODETIC CONTROL POINTS
- AB VERTICAL GEODETIC CONTROL POINTS
- AC SURVEY POINTS

B DEMARCATION
- BA ADMINISTRATIVE UNIT BOUNDARIES
- BB ADMINISTRATIVE SUB-UNIT LIMITS
- BC PARCELS I. (PUBLIC DOMAIN)
- BD PARCELS II. (NON-PUBLIC DOMAIN)
- BE SUBPARCELS AND BRANCHES OF CULTIVATION
- BF QUALITY CLASSES OF ARABLE LAND

C BUILDINGS
- CA BUILDINGS
- CB ACCESSORIES OF BUILDINGS
- CC FENCES, SUSTAINING WALLS
- CD GROUND OBJECTS, SPECIAL BUILDINGS
- CE STATUES, MONUMENTS, MEMORIAL PLACES

D TRANSPORTATION AND FACILITIES
- DA IDENTIFICATION POINTS OF TRANSPORTATION FACILITIES
- DB ROADS AND FACILITIES OF BUILT-IN AREAS
- DC ROADS AND FACILITIES OF RURAL AREAS
- DD RAILWAYS AND FIXED TRACK WAYS
- DE FACILITIES OF AIR TRAFFIC
- DF CONSTRUCTION WORKS (I.)
- DG CONSTRUCTION WORKS (II.)

E TRANSMISSION LINES, CABLEWAYS
- EA AXIS OF CONDUITS, CABLEWAYS
- EB CONSTRUCTION WORKS OF CONDUITS, CABLEWAYS

F HYDROGRAPHY AND HYDROLOGICAL FACILITIES
- FA FLOWING AND STILL WATERS
- FB WATER PUBLIC UTILITIES
- FC HYDROLOGICAL ENGINEERING STRUCTURES

G HYPSOGRAPHY
- GA CONTOUR LINES
- GB RELIEF CONFIGURATIONS
- GC DIGITAL TERRAIN MODEL

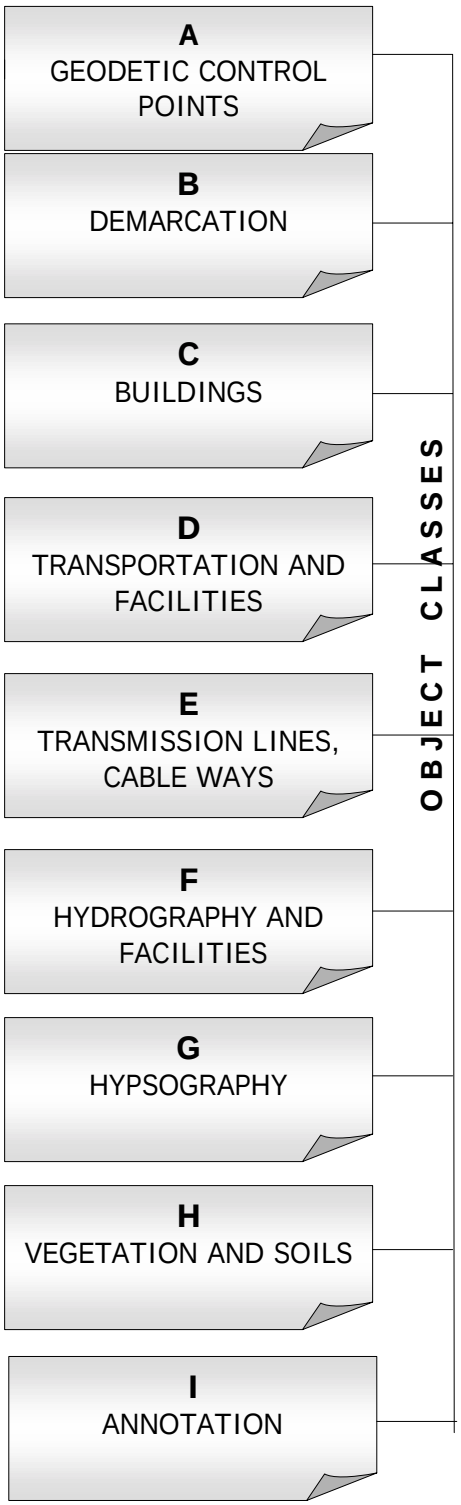
H AREA CATEGORIES
- HA AREAS OF DATA CAPTURE ACTIONS
- HB BASE MAP HANDLING UNITS
- HC SPECIAL AREAS

EXAMPLE ATTRIBUTE TABLE
DIGITAL BASE MAP STANDARD MSZ 7772-1:1997

Code of attribute table: ATTRBC
ATTRIUBUTE TYPES OF PARCELS (PUBLIC AREAS)

Identifier	***Name of the attribute type***
1	Object indentifier number
2	Code of object type
3	Geometry description identifier of the object
4	Parcel number
5	Postal address
6	Name of enframing settlement
7	Code of enframing administrative subunits
8	Code of area type
9	Volume of registered land (m^2)
10	Land valuation value
11	Market value of the parcel when acquiring
12	Economical sector code
13	Legal type code
14	Easement descripter
15	Legal status descripter
16	Data relating to the legal title of acquiring
17	Data relating to charges, mortgage
18	Line of cultivation (also area out of cultivation)
19	Name and address of the owner organization
20	Property share of the owner organization
21	Name and address of trustee or land user
22	Legal status of demarcation procedure (preliminary, final)
	Data relating to changes producing the parcel:
23	▪ Date
24	▪ Registry number of the decision
25	▪ Form of change (e.g. union, sharing, easement)
26	▪ Storage address of sketch of updating
27	Date of abolition
28	Code of vizualization legend
29	Identifier of the related unit of data capture action
30	Centroid of the parcel (x, y [H])

THEMATIC STRUCTURE
DIGITAL TOPOGRAPHIC DATA BASE STANDARD MSZ 7772-2:2000



OBJECT CLASSIFICATION
DIGITAL TOPOGRAPHIC DATABASE STANDARD MSZ 7772-2:2000

A GEODETIC CONTROL POINTS (ZB)[1]
- AA MONUMENTED SUTES (ZB)[1]
- AB NON-MONUMENTED POINTS (ZB)[1]

B DEMARCATION (F,A)[1]
- BA ADMINISTRATIVE BOUNDARIES (FA)[1]
- BB ADMINISTRATIVE SUB-UNITS AND AREA CATEGORIES (FA, AL)[1]
- BC FENCES (AL)[1]
- BD LIMITS OF DATA CAPTURE ACTIONS

C BUILDINGS (A,B)[1]
- CA BUILDINGS (AL)[1]
- CB CONSTRUCTION TYPES OF BUILDINGS (AC, AD, AF, AJ)[1]
- CC STORAGES (AM)[1]
- CD RECREATIONAL BUILDINGS AND CEMETARY (AK, AL)[1]
- CE STATUES, MONUMENTS, MEMORIAL PLACES (AL)[1]
- CF MISCELLANEOUS OBJECTS (A,B)[1]

D TRANSPORTATION AND FACILITIES (A,G)[1]
- DA IDENTIFICATION POINTS OF TRANSPORTATION FACILITIES (AP)[1]
- DB ROADS AND ASSOCIATED FACILITIES (AN, AP)[1]
- DC RAIL ROADS AND CABLE WAYS (AN, AT, AQ)[1]
- DD AIR TRAFFIC CONSTRUCTIONS (GB)[1]
- DE WATER TRANSPORTATION (B)[1]
- DF CONSTRUCTION WORKS (I.) (AQ, AP)[1]
- DG CONSTRUCTION WORKS (II.) (AQ, AN)[1]

E TRANSMISSION LINES AND CABLEWAYS (A)[1]
- EA AXIS OF TRANSMISSION LINES AND CABLE WAYS (AQ, AT)[1]
- EB CONSTRUCTION WORKS OF TRANSMISSION LINES AND CABLE WAYS (AA, AD, AQ, AT)[1]

F HYDROGRAPHY AND FACILITIES (B, A, D)[1]
- FA INLAND WATERS (BH)[1]
- FB WATER PUBLIC UTILITIES (B, n.a.)[1]
- FC HYDROLOGICAL ENGINEERING STRUCTURES (B, A, D)[1]

G HYPSOGRAPHY (D, C, B)[1]
- GA CONTOUR LINES (CA)[1]
- GB RELIEF CONFIGURATIONS (DB)[1]

H VEGETATION AND SOILS (E, D)[1]
- HA VEGETATION (E)[1]
- HB SOILS (DA, n.a.)[1]

I ANNOTATION (ZA)[1]
- IA GEOGRAPHICAL NAMES (ZA)[1]
- IB OTHER ANNOTATION (ZA)[1]

[1] = DIGEST categories

EXAMPLE ATTRIBUTE TABLE
DIGITAL TOPOGRAPHIC DATABASE STANDARD, MSZ 7772-2:2000

Code of attribute table: ATTRDB
ATTRIBUTE TYPES OF ROADS AND ASSOCIATED FACILITIES

Identifier	***Name of the attribute type***
1	Object indentifier number
2	Code of object type
3	Geometry description identifier of the object
4	Typical material of the road or facility (DIGEST: MCC)
5	Operation attribute (DIGEST: EXS)
6	Location of the object (DIGEST: LOC)
7	Number of lanes (DIGEST: LTN)
8	Use of the object (DIGEST: USE)
9	Minimal width of the road segment (DIGEST: WD1)
10	Full width of the road segment (DIGEST: WD2)
11	The lowest obstacle in the road segment (DIGEST: HCA)
12	Passableness of the road segment (DIGEST: WTC)
13	Peculiarities and/or performance data of the road segment, three as maximum (e.g. weight-bearing capacity, permeability, accomodation)
14	Code of visualisation legend

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Practical experience: Satellite geodetic techniques and GPS, elaboration of satellite geodetic adjustment software systems, elaboration and nationwide harmonisation of the Hungarian “Digital base map” standard and “Digital topographic map database” standard, coordination and successful realization of numerous national and international

R+D project, database modelling, National Spatial Data Infrastructure, coordinate system transformation.
Publications: lecture notes, monographs, more than 90 papers published in proceedings and registered journals, similar amount of internal reports, a big part of it on GIS and digital cadastre.
Recent membership: Geodetic Scientific Committee of HAS (subcommission chairman), Chairman of GI Standard's WG of Hungarian Office of Standars, Representative to Eurogeographics, Hungarian representative to FIG Commission 3.
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