

## Presentation of build-up areas on topographic maps of selected European countries\*

**Abstract.** The authors present a comparative analysis of presentation of build-up areas with conventional symbols on 60 civil European topographic maps. The above-mentioned maps are in different scales, from 1:10,000 to 1:100,000, and have been published in nineteen European countries and the autonomous community of Catalonia. The analysis has proved that the scope of characteristics of build-up areas presented on the analysed maps was very diverse, from qualitative and quantitative point of view (e.g. there were between 2 and 25 different categories on 1:10,000 maps). The 1:10,000 and 1:50,000 maps generally contain more information on the characteristics of build-up areas than 1:25,000 maps. The characteristics themselves are also very diversified (e.g. only 6 of them appear on more than half of the analysed maps – most often churches).

Polish maps stand out due to the fact that they contain particularly rich and consistent representation of both physiognomic characteristics and general functional characteristics of buildings and build-up areas at all the analysed scales.

**Keywords:** topographic maps, build-up areas, European topographic maps, comparative analysis

### 1. Introduction

The topographic maps have always been an expression of society's spatial awareness (W. Żyszkowska 2005). Preparation of such maps means structuring and arranging the space by depicting only those individual elements of it which are considered to be significant (T. Zarycki 2004). The organization and structuring have evolved over time, following developments in the management and organization of social life and the subsequent changes in the perception of geographical space.

The development of computer technology has modified somewhat the method of presentation and selection of the presented attributes of objects, but in many countries major changes occurred mainly in the last decade of the last century and were associated with political changes taking place in the countries of Central and Eastern Europe. They led to development of (usually completely new) concepts of topographic maps. Western European countries also introduced changes concerning the scope of the content of these maps (e.g. United Kingdom, Switzerland and Germany), but these changes consisted only in certain modifications

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of the maps' scope and graphic form which were meant to increase their legibility (H.-U. Feldmann, N. Kreiter 2006, R. Harbeck 1985, A.J. Kent 2007, D. Schmidt 1987). Thus, the concept of West European maps constitutes both a continuation and a result of their gradual modernisation, while Eastern European countries tended to opt for completely new approaches to creation of topographic maps. The new concept of Polish maps developed in the 1990s is a good example of this trend (M. Kacprzak, W. Ostrowski 1994).

Apart from the afore-mentioned historical and political conditions, the content of topographic maps is also influenced, on the one hand, by objective geographical conditions, and, on the other hand, by subjective approaches assumed by creators of topographic maps concepts of individual countries (W. Ostrowski 2008).

## 2. Aim and scope of the analysis

The aim of the study was to conduct a comparative analysis of how topographic maps depict one of the most important categories of elements, build-up areas. The research included 60 series of contemporary editions of civil topographic maps at the scales of 1:10,000 (and 1:12,500), 1:25,000 (and 1:20,000), 1:50,000, and 1:100,000, published in nineteen European countries and in the autonomous community of Catalonia. They were series of maps of eight Western European countries (Austria, Belgium, France, Netherlands, Luxembourg, Germany, Switzerland and United Kingdom), four Central European countries (Czech Republic, Estonia, Latvia, Poland), four Northern European countries (Denmark, Finland, Norway, Sweden) and Spain, as well as its autonomous community of Catalonia, Croatia and Portugal, which represented Southern Europe. The analysis was carried out on the basis of maps listed in table 1.

In the case of the Czech, Catalan, German, Norwegian, Polish and Swiss maps, the analysis included all four of the above-listed major map scales. In the case of Belgian, British, Danish, Finnish, French, Luxembourgian, Latvian and Swedish maps, the analysis was conducted for three scales, and the Austrian, Croatian, Estonian, Spanish, Dutch and Portuguese maps were analysed at two scales (tab. 2). In total, the analysis was carried out for twelve 1:10,000 maps and one map at the scale of 1:12,500, thirteen 1:25,000 maps and two at the scale of

1:20,000, nineteen 1:50,000 maps and thirteen 1:100,000 maps.

All characteristics of build-up areas on the analysed maps are divided into two basic, conventional categories: physiognomic characteristics and functional characteristics. Physiognomic characteristics include depiction of distinctive architectural forms of buildings, their state (e.g. destroyed buildings, ruins), their heights and (in relation to residential buildings) their character – single-family or multi-family buildings. Functional characteristics were further divided into two subcategories for buildings' general functions (public and industrial buildings, outbuildings, agricultural and residential buildings) and detailed functions (e.g. schools, hospitals, town halls, post offices). Religious buildings were distinguished as a separate subcategory (e.g. churches, chapels), because of their specificity and the particularly long tradition of their presence on topographic maps. Even though their physiognomy is usually also distinctive, their classification is defined primarily by their function.

Only those signs which were listed in the legends of the analysed maps were included in the analysis of the maps' thematic scope. However, it should be noted that sometimes legends did not include signs whose meaning was assumed to be obvious, e.g. signs of individual buildings or built-up areas. What is more, the explanatory abbreviations may have a significant influence on the scope of topographic maps' content. This applies first of all to depictions of detailed functions of buildings, which for example on Polish topographic maps are presented almost exclusively by means of explanatory abbreviations.

The comparative analysis does not include additional information concerning objects classified as tourist attractions. They are widely used only on some maps: at the 1:25,000 scale in the case of the British and French maps, at the 1:50,000 scale in the case of the British, French, Catalan, Luxembourgian and Norwegian maps, and at the 1:100,000 scale, only on the Catalan map.

## 3. Results

### 3.1. 1:10,000 and 1:12,500 maps

The analysis was carried out on the basis of the legends of topographic maps from twelve

Table 1. List of maps used as a basis for the analysis

| Country     | Publisher   | City              | Name of the map                              | Map scale      |
|-------------|---|-------------------|--|----------------|
| Austria     | Bundesamt für Eich- und Vermessungswesen  | Vienna            | Österreichische Karte                        | 1:25, 000V UTM |
|             |   |                   |  | 1:50,000V UTM  |
| Belgium     | L'Institut Géographique National / National Geografisch Instituut               | Brussels          | topo10                                       | 1:10,000       |
|             |   |                   | topo50                                       | 1:50,000       |
|             |   |                   | topo100                                      | 1:100,000      |
| Catalonia   | L'Institut Cartogràfic i Geològic de Catalunya                                  | Barcelona         | Mapa topogràfic de Catalunya                 | 1:10,000       |
|             |   |                   |  | 1:25,000       |
|             |   |                   |  | 1:50,000       |
|             |   |                   |  | 1:100,000      |
| Croatia     | Državna Geodetska Uprava  | Zagreb            | TK25   | 1:25,000       |
|             |   |                   | TK100  | 1:100,000      |
| Czech Rep.  | Český Úřad Zeměměřický a Katastrální, Zeměměřický úřad                          | Prague            | Základní mapa České republiky (ZM 10)        | 1:10,000       |
|             |   |                   | Základní mapa České republiky (ZM 25)        | 1:25,000       |
|             |   |                   | Základní mapa České republiky (ZM 50)        | 1:50,000       |
|             |   |                   | Základní mapa České republiky (ZM 100)       | 1:100,000      |
| Denmark     | Kortsyningen, Styrelsen for Dataforsyning og Effektivisering                    | Copenhagen        | Danmarks Topografiske Kortværk – DTK/kort25  | 1:25,000       |
|             |   |                   | Danmarks Topografiske Kortværk – DTK/kort50  | 1:50,000       |
|             |   |                   | Danmarks Topografiske Kortværk – DTK/kort100 | 1:100,000      |
| Estonia     | Eesti Maa – amet  | Tallin            | Eesti põhikaart                              | 1:10,000       |
|             |   |                   |  | 1:50,000       |
| Finland     | Maanmittauslaitos   | Helsinki          | Taustakarttarasteri                          | 1:10,000       |
|             |   |                   | Maastokarttarasteri                          | 1:20,000       |
|             |   |                   |  | 1:50,000       |
| France      | L'Institut national de l'information géographique et forestière                 | Saint Mandé       | TOP25  | 1: 25,000      |
|             |   |                   | TOP50  | 1:50,000       |
|             |   |                   | TOP100                                       | 1:100,000      |
| Germany     | Bundesamt für Kartographie und Geodäsie and provincial (Lands) mapping agencies | Frankfurt am Main | DTK10-V                                      | 1:10,000       |
|             |   |                   | DTK25-V                                      | 1:25,000       |
|             |   |                   | DTK50-V                                      | 1:50,000       |
|             |   |                   | DTK100-V                                     | 1:100,000      |
| Latvia      | LĢIA – Latvijas Ģeotelpiskās informācijas aģentūra                              | Riga              | Latvijas Republikas Topogrāfiskā Karte       | 1:10,000       |
|             |   |                   |  | 1:50,000       |
|             |   |                   |  | 1:100,000      |
|             |   |                   | TOP50NL                                      | 1:50,000       |
| Luxembourg  | Administration du Cadastre et de la Topographie                                 | Luxembourg        | Carte topographique                          | 1:20,000       |
|             |   |                   |  | 1:50,000       |
|             |   |                   |  | 1:100,000      |
| Netherlands | Administration du Cadastre et de la Topographie                                 | Apeldoorn         | TOP25NL                                      | 1:25,000       |
|             |   |                   | TOP50NL                                      | 1:50,000       |
| Norway      | Statens Kartverk  | Hønefoss          | Økonomisk Kartverk – ØK                      | 1:10,000       |
|             |   |                   |  | 1:20,000       |
|             |   |                   | N50 Kartdata UTM33                           | 1:50,000       |
|             |   |                   | N100 Kartdata UTM33                          | 1:100,000      |

| Country        | Publisher  | City        | Name of the map              | Map scale |
|----------------|--|-------------|------------------------------|-----------|
| Poland         | Główny Urząd Geodezji i Kartografii  | Warsaw      | Mapa topograficzna           | 1:10,000  |
|                |  |             |                              | 1:25,000  |
|                |  |             |                              | 1:50,000  |
|                |  |             |                              | 1:100,000 |
| Portugal       | Direção Geral do Território  | Lisbon      | SCN10K                       | 1:10,000  |
|                |  |             | SCN50K                       | 1:50,000  |
| Spain          | Instituto Geográfico Nacional  | Madrid      | Mapa Topográfico Nacional    | 1:25,000  |
|                |  |             |                              | 1:50,000  |
| Sweden         | Lantmäteriet   | Gävle       | Fastighetskartan             | 1:12,500  |
|                |  |             | GSD Terrängkartan            | 1:50,000  |
|                |  |             | GSD Fjällkartan              |           |
|                |  |             | GSD Vägkartan                | 1:100,000 |
| Switzerland    | Office fédéral de topographie / Bundesamt für Landestopographie / Ufficio federale di topografia / Uffizi federal da topografia, Swisstopo | Wabern      | Carte nationale de la Suisse | 1:10,000  |
|                |  |             |                              | 1:25,000  |
|                |  |             |                              | 1:50,000  |
|                |  |             |                              | 1:100,000 |
| United Kingdom | Ordnance Survey  | Southampton | Scale Raster                 | 1:10,000  |
|                |  |             | Pathfinder                   | 1:25,000  |
|                |  |             | Landranger                   | 1:50,000  |

countries and the autonomous community of Catalonia, which included 158 categories of objects related to build-up areas, that is, 12 on average (fig. 1). The Belgian map definitely contained the highest number of categories (25), while the British map had the least categories – only 2. The physiognomic characteristics clearly dominate on the maps of these scales – they represent 56% of all the characteristics. The British and Catalan maps include only physiognomic characteristics, and such characteristics are definitely dominant on the Latvian (85%), Swiss (75%), Estonian (67%) and Norwegian (60%) maps. Most symbols concern distinctive buildings which are shown for orientation purposes. The maps from all the countries (except United Kingdom) contained symbols of towers (the German map included 4 types of towers), while greenhouses were presented on maps from nine countries and windmills on maps of eight countries.

The Estonian, Finnish, Catalan, Latvian and Swedish maps of this scale already contain phys-

iognomic characteristics concerning not only individual buildings and structures, but also built-up areas. Detached houses are additionally shown on the Latvian map, while the Swedish map contains categories of compact dwellings and high-rise buildings. The more unusual physiognomic characteristics include large domes with diameters exceeding 15 m which were presented on the Belgian map, roofed areas and underground structures shown on the Estonian map, city towers with a wall presented on the German map, and annexes on the Norwegian map. The Estonian, Catalan, Latvian and Portuguese maps show buildings under construction, while the Estonian map presents also foundations. On the other hand, the Belgian and Portuguese maps included ruins and remains of buildings. The latter employs also a separate symbol for barracks. High-rise buildings were shown on the maps of three countries: Belgium (buildings higher than 15 m), Switzerland (buildings higher than 25 m) and Poland (buildings with more than 11 storeys or higher than 30 m).

Table 2. Number of content categories concerning build-up areas on the maps included in the analysis

| <b>Country,<br/>autonomous region</b> | <b>1:10,000</b> | <b>1:12,500</b> | <b>1:20,000</b> | <b>1:25,000</b> | <b>1:50,000</b> | <b>1:100,000</b> |
|---------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| Austria                               | –               | –               | –               | 7               | 7               | –                |
| Belgium                               | 25              | –               | –               | –               | 10              | 10               |
| Catalonia                             | 6               | –               | –               | 5               | 6               | 11               |
| Croatia                               | –               | –               | –               | 16              | –               | 18               |
| Czech Rep.                            | 14              | –               | –               | 13              | 9               | 7                |
| Denmark                               | –               | –               | –               | 8               | 14              | 14               |
| Estonia                               | 12              | –               | –               | –               | 13              | –                |
| Finland                               | 12              | –               | 12              | –               | 12              | –                |
| France                                | –               | –               | –               | 9               | 10              | 8                |
| Germany                               | 18              | –               | –               | 10              | 13              | 14               |
| Luxembourg                            | –               | –               | 11              | –               | 8               | 6                |
| Netherlands                           | –               | –               | –               | 12              | 14              | –                |
| Norway                                | 5               | –               | –               | 13              | 20              | 10               |
| Poland                                | 16              | –               | –               | 16              | 17              | 15               |
| Portugal                              | 16              | –               | –               | –               | 10              | –                |
| Spain                                 | –               | –               | –               | 6               | 6               | –                |
| Sweden                                | –               | 12              | –               | –               | 13              | 8                |
| Switzerland                           | 7               | –               | –               | 4               | 7               | 4                |
| United Kingdom                        | 2               | –               | –               | 7               | 9               | –                |

Only the Polish map has separate symbols for single-family and multi-family houses. This is surprising because this distinction (which is applied consistently on Polish topographic maps, including ones with smaller scales) and the height of buildings constitute the basic criteria for determining the built-up density and in consequence also population density<sup>1</sup>. The distinction between single-family houses located on private properties with one or two storeys and multi-family buildings which usually have more than two storeys is the most important physiognomic difference between buildings – one which also influences their function.

The built-up density level is also a result of the ratio of the area covered by buildings to the undeveloped area. On 1:10,000 maps, despite the necessity of enlarging the smallest (usually non-residential) buildings, this relation is pre-

sented in a visible method by means of drawings of individual buildings which most of the time preserve their basic dimensions and proportions. Therefore, the fact that the Swedish and Latvian maps depict areas with compact dwellings may be surprising.

The Belgian, Finnish, German and Swedish maps include more functional characteristics than physiognomic ones. Eight out of the thirteen analysed 1:10,000 maps present the general functions of buildings or related areas. Residential, industrial and public buildings are shown as a rule. Industrial and storage areas (Poland, Germany), industrial areas (Belgium, Estonia), industrial areas and storage areas (Finland), as well as industrial, commercial and transport areas (Czech Republic), and last but not least commercial areas (Finland), are all functional areas related to buildings.

The Belgian map contains the highest number of detailed functional characteristics of buildings. This map is distinguished by the colourful diversity of symbols of buildings which present

<sup>1</sup> The distinction between single-family and multifamily dwellings is commonly used on those Polish maps which are used in spatial planning.

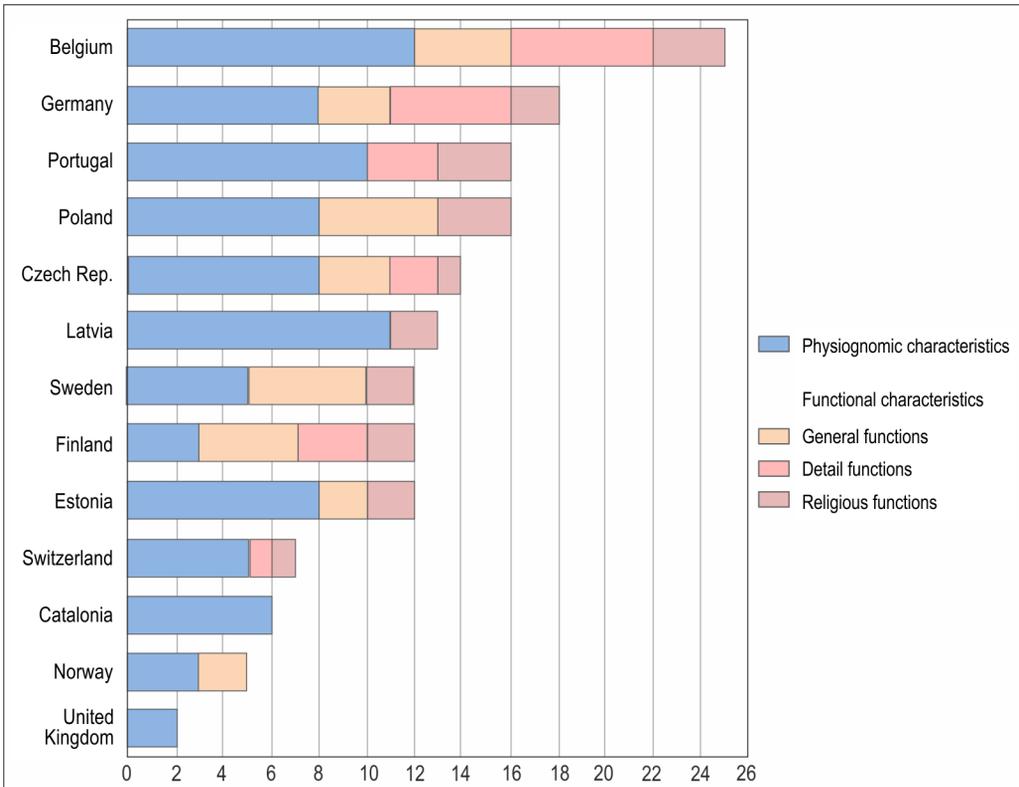


Fig. 1. The number of characteristics of buildings, structures and build-up areas on 1:10,000 maps, divided into different types

their selected detailed functions. Halls, shopping centres, schools, hospitals (with a separate distinction for university hospitals) and fire stations were shown in such a way. Outside of Belgium, the highest number of this type of characteristics can be found on the German map which included also police stations, sanatoria and greenhouses. Most often, the maps of this scale have separate symbols for hospitals, greenhouses and fire stations. On the other hand, the Portuguese map contains bullfighting arenas and petrochemical plants.-

On the vast majority of 1:10,000 maps, the religious function of objects is usually signalled by means of symbols. Churches and chapels are usually shown separately, but only the Polish map contains separate symbols for Christian and non-Christian temples. The Swedish map includes a unique classification of religious

buildings which is based on differentiation between parish churches, other churches and belfries.

It is worth noting that the Belgian maps depict also unused buildings, i.e. buildings which have no functions, and inactive churches.

### 3.2. 1:25,000 and 1:20,000 maps

In comparison with the above-analysed 1:10,000 maps, 1:25,000 and 1:20,000 maps from the fifteen European countries are much less diverse in terms of the number of the shown characteristics of built-up areas (from sixteen, in the case of the Polish map, to four, on the Swiss map – fig. 2).

In contrast to the 1:10,000 maps, the 1:25,000 (and 1:20,000) maps are dominated by functional characteristics (55%). It is true foremost

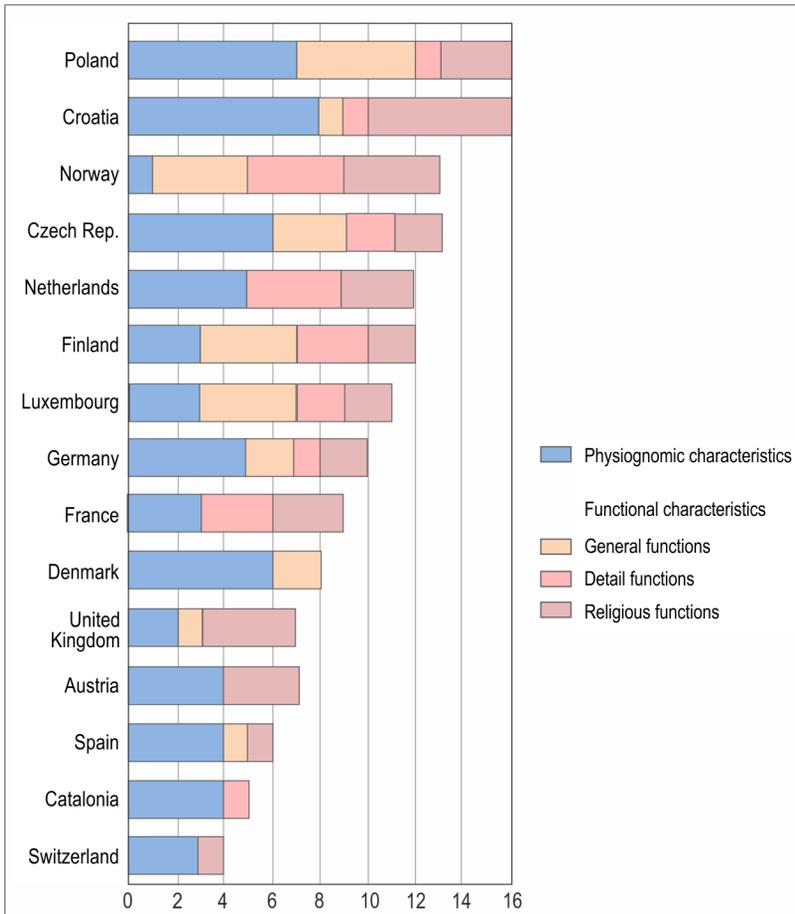


Fig. 2. The number of characteristics of buildings, structures and build-up areas on 1:25,000 maps, divided into different types

in the case of the Norwegian (92%), Luxembourgian (78%), Finnish (75%), United Kingdom (71%) and French (67%) maps. On the other hand, physiognomic characteristics are most numerous on the Catalan (80%), Danish and Swiss (75%), as well as Spanish (67%) maps.

When it comes to the distinctive buildings presented on 1:10,000 maps, greenhouses are included on the majority of 1:25,000 (and 1:20,000) maps, while towers and windmills are shown on five maps. Historic buildings and ruins are presented only on the Croatian map. Built-up areas are shown on nearly half of the analysed maps using the afore-mentioned scale.

In addition, the Danish map present also the area of the city centre. On the Polish map, only areas with single-family dwellings are represented as built-up areas, and all residential buildings and larger outbuildings are shown against the background of such areas.

Similarly as in the case of the 1:10,000 maps, the maps of most countries shown destroyed buildings. The Spanish map presents only ruins of religious buildings, while the Catalan map includes build-up areas under construction and the areas with ruined dwellings. High-rise buildings are shown on the Croatian, Danish, Dutch and German maps.

Just as the 1:10,000 maps, the 1:25,000 maps contain more characteristics concerning general functions than detailed ones. General functional characteristics are in this scale generally similar to the ones depicted on the 1:10,000 maps, although there are some surprising differences. For example, on the Czech map, the category of industrial, commercial or transport areas (one category) has been replaced with the category of animal farm lands or food industry plants. On the Norwegian map, the functional characteristics of buildings were broadened, from the level of two general functions (residential buildings and other buildings) to the level of four general functions (including agricultural buildings) and four detailed ones (including garages and holiday houses). As in the case of 1:10,000 maps, the highest number of general functions is presented on the Polish map. Five functions were presented on the Luxembourgian map (residential, agricultural, public and commercial buildings). The Dutch map includes only the detailed functions of selected objects (city hall, hospital, pump station). The hospital is the most frequently shown element which appears on the maps of four countries (Netherlands, Luxembourg, Germany and Norway). The most general and at the same time synthetic functional characteristics of the buildings are presented on the United Kingdom map which includes only important buildings.

In comparison with the 1:10,000 maps, characteristics of religious functions stand out among all functional characteristics shown on 1:25,000 (and 1:20,000) maps, as they appear on fourteen of the analysed maps, constituting 35 categories in total. Additional physiognomic characteristics of religious buildings are added to the typical categories of churches and chapels (presented on the Austrian, Czech, German and Polish maps). The Dutch and Estonian maps include places of worship with towers. In the case of the Austrian map churches with one and two towers were distinguished. At the United Kingdom map there are the separate categories for places of worship with a tower, and places of worship with a spire, minaret or dome. The Croatian, Finnish and Norwegian maps also show belfries. The Croatian map contains the richest depiction of objects with religious functions, including such categories as churches, belfries, chapels, mosques, synagogues and monasteries.

### 3.3. 1:50,000 maps

While 1:25,000 maps have significantly less diverse content than 1:10,000 maps (on average about 10 categories, where the latter group of maps had 12), which is understandable, considering the significant scale difference, this tendency does not hold true for the analysed 1:50,000 maps on which the number of categories is not much smaller than in the case of the 1:10,000 maps (on average: 11.5 categories, fig. 3). If we compare the maps of thirteen countries whose maps are analysed at both 1:10,000 and 1:50,000 scales, it turns out that for six of them (Estonia, Latvia, Norway, Poland, Sweden and United Kingdom) the 1:50,000 maps contain more categories than the 1:10,000 maps, and that the number of these categories is even several times greater in the case of the British and Norwegian maps (tab. 2).

The analysed 1:50,000 maps show a similar number of physiognomic and functional characteristics (on average about five and a half). Physiognomic characteristics definitely dominate on the Czech (89%), Swiss (71%), Belgian (70%) and German (69%) maps, while functional characteristics are most prominent on the Luxembourgian (88%), Finnish (75%) Norwegian (65%), Danish (64%) and Swedish (62%) maps.

Clusters of buildings and structures are most often presented as built-up areas on the 1:50,000 maps. Such areas are listed in the legends of the twelve analysed maps. Different subcategories distinguished on the basis of building density are shown only on the Polish, Latvian and German maps. The Polish map contained separate categories for compact multifamily dwellings, dense multifamily dwellings and single-family dwellings. Compact and dense dwellings are shown on the Latvian maps, while the compact dwellings and scattered housing are included on the German maps. The Norwegian map presents urban dwellings, and while the Danish one shows the city centre dwellings.

The average number of physiognomic characteristics of buildings is more than 20% higher than on the 1:25,000 maps, but at the same time smaller by a quarter than the one presented on the 1:10,000 maps. Towers (3 types on Belgian and German maps), windmills and greenhouses belong to the most commonly

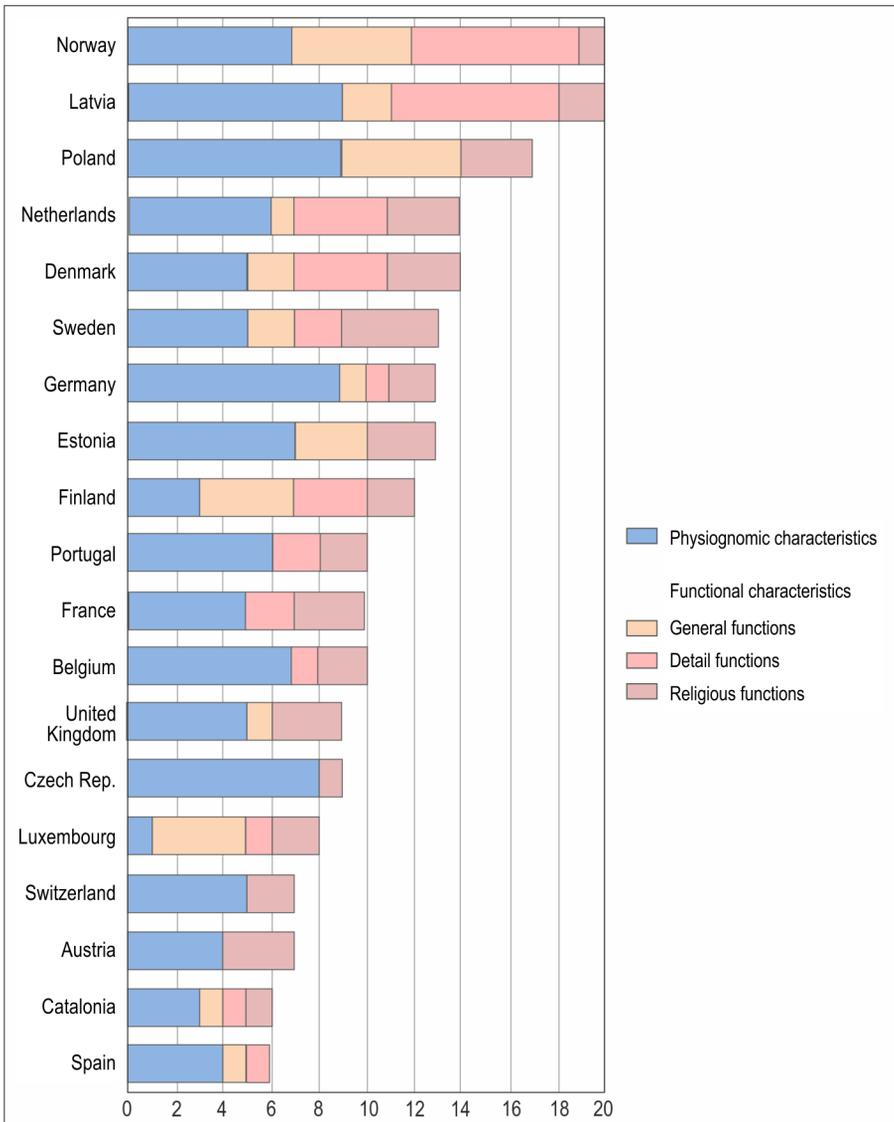


Fig. 3. The number of characteristics of buildings, structures and build-up areas on 1:50,000 maps, divided into different types

represented elements, just as in the case of larger scale maps. The French, Norwegian and Portuguese maps include also a symbol for forts, while the Danish map has a symbol for halls, and the Norwegian one presents also locations of mountain cabins and sheds. The Estonian map contains information about the

ruins and foundations of houses, as well as roofed areas.

Despite the relatively small scale, the maps of several countries (Denmark, Norway and Germany) show also high-rise buildings, or areas with high-rise buildings, as in the case of the Swedish map. The latter includes also

a category of closed built-up areas, which is very important from the point of view of the map's users.

It should be stressed that 1:50,000 maps depict more detailed functions of buildings than the 1:25,000 and 1:10,000 maps. The Latvian and Norwegian maps contain the highest number of such detailed functional subcategories (7 each). Hospitals are the most frequently occurring functional objects (they are presented on the Danish, Dutch, Catalan, Latvian, German, Norwegian, and Portuguese maps); other common ones are town halls (Denmark, France, Netherlands, and Latvia) and schools (Denmark, Latvia, and Norway). It should be emphasized that the Norwegian map includes special subcategories for meeting houses, welfare institutions, public transport buildings and farms, The Belgian map shows hangars and garages, and the Swedish map – areas with single-family dwellings.

Just as on maps at other scales, Polish maps contained the richest range of categories concerning general functions of buildings. The industrial development areas or industrial and storage areas are the most commonly distinguished elements of this type on the maps of the remaining countries (Denmark, Netherlands, Catalonia, Latvia, Germany, Norway and Sweden). The Luxembourgian map includes public and industrial buildings, outbuildings, as well as agricultural and residential buildings. The Danish map contains not only industrial areas, but also technical areas, while the Finnish and Spanish maps shows agricultural or industrial buildings, and the Estonian map has a category of production buildings.

The scope of characteristics concerning religious functions is generally similar to the scope presented on the 1:25,000 maps. Additional physiognomic characteristics of religious buildings are presented also on the Austrian, British,

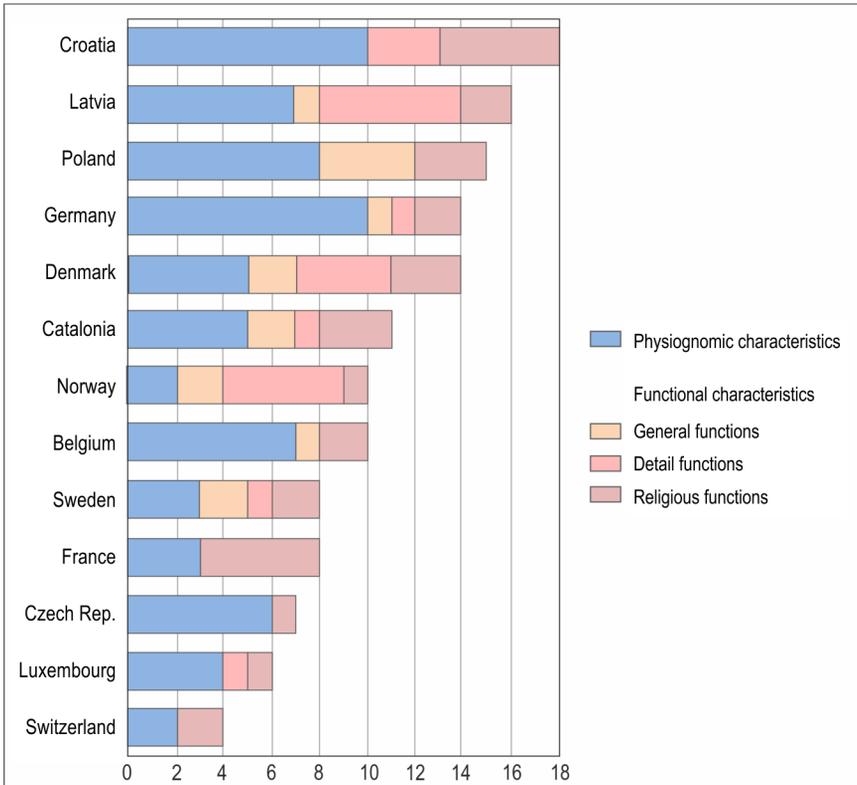


Fig. 4. The number of characteristics of buildings, structures and build-up areas on 1:100,000 maps, divided into different types

Estonian, Dutch and Luxembourgian 1:50,000 maps. The Estonian map has separate subcategories of churches with towers and churches without towers. The Norwegian maps at the scale of 1:50,000 no longer distinguish between church buildings and belfries.

The major (important) buildings are represented on the Swedish and Norwegian maps.

### 3.4. 1:100,000 maps

The average number of characteristics shown on the analysed 1:100,000 maps is 16% lower than on the topographic 1:50,000 maps of the same countries, 17% lower than on the 1:10,000 maps and 6% higher than on the 1:25,000 maps (fig. 4). Within the set of the Catalan and German maps, more categories related to buildings and built-up areas can be found on the 1:100,000 maps than on the 1:50,000 maps (tab. 2).

The presentation of characteristics of built-up areas definitely dominate on the 1:100,000 maps. Just as on larger scale maps, the Danish map presents additionally also the city centre areas. The Latvian, German and Polish 1:100,000 maps, just as well as 1:50,000 maps, shows the level of building density. While the Latvian 1:50,000 map includes compact and dense dwellings, 1:100,000 map presents 3 levels of building density instead: compact dwellings, scattered and low-density housing, and scattered housing. Both dense and scattered housing is presented on the Polish 1:100,000 map with the same areal symbol. This map, just as the 1:50,000 version, distinguishes between single-family and multifamily dwellings.

Similarly to the larger-scale maps, the 1:100,000 maps include towers (10 countries), windmills (8 countries), and – in the case of Croatian, Estonian, Catalan, German and Polish maps – greenhouses. Forts are presented with a separate symbol on the Belgian, Croatian, French and Portuguese maps, while the Croatian map includes additionally not only ruins of forts and fortresses, but also palaces and manor houses (and their ruins), as well as huts and ruins of residential buildings.

High-rise buildings are included only on the German map, but the Danish map indicates areas with high-rise buildings instead of individual buildings. Courtyards and patios are taken into account on the Portuguese map.

Detailed functions have been included on eight of the analysed maps. They are most broadly represented on the Latvian, Danish and Norwegian maps. All eight of them show hospitals, and the Croatian map includes also clinics and warehouses. The Danish map takes into account town halls, and the Latvian town halls, post offices, forest district offices and forester's lodges. The Latvian map is the only one which indicates the detailed function of the built-up area – holiday and leisure houses, as well as allotment houses. The Norwegian map stands out because of its inclusion of accommodation facilities, mountain cabins and holiday homes.

General functions of buildings and built-up or built-up-related areas are presented on the maps of most countries. The most dominant function is by far the industrial one which is depicted in the form of symbols of industrial buildings (Norwegian map), industrial buildings or outbuildings (Catalan, Polish and Swedish maps), industrial and storage areas (Catalan, German, Polish maps), industrial built-up areas (Belgian and Danish maps), or industrial areas (Norwegian map). Technical areas are identified on the Danish map, just as they were on larger-scale maps. Public buildings are shown on the Polish and Latvian maps with separate symbols, whereas the Swedish map presents the major (important) buildings.

The characteristics of objects which perform religious functions are included on all the analysed maps of this scale. Again, only the Swedish map contains separate symbols for parish churches, while the Croatian map shows a wide range of symbols, for churches, mosques, synagogues, monasteries and chapels, and the Danish map includes synagogues. In contrast to 1:25,000 and 1:50,000 maps, the physiognomic characteristics of religious buildings were not taken into account. However, religious buildings which are tourist attractions were noted on the Catalan and foremost French map. On the latter, these objects were divided into subcategories of churches, chapels and other temples.

## 4. Conclusions

The carried analyses has proved that the scope of characteristics of built-up areas presented on topographic maps published in selected countries is very diversified. The highest

average number of characteristics was found on the Croatian (17), Latvian and Polish (16), Belgian (15), German and Portuguese (14), Dutch (13), Estonian, Finnish, Danish and Norwegian (12) maps, as well as the Czech and Swedish (11) maps. The top three includes two countries (Latvia and Poland) which, as mentioned in the introduction, completely changed their approach to topographic maps in 1990s. Previously, their approach to map development was based on the concept of Soviet military maps, distinguished by a particularly wide range of content which was largely meant to serve military purposes. The built-up-area-related content is especially diverse in the case of German maps and the maps of two Benelux countries which have rich traditions in topographic cartography. Finally, the third group consists of the Scandinavian countries (Denmark, Finland, Norway and Sweden) which share a specific, original approach both to the scope of content and the graphic form of topographic maps.

The smallest number of categories was found on Austrian and Catalan maps (7 on each), as well as British, Spanish, and Swiss maps (6 on each). On the one hand, these are countries with highly-developed topographical cartography and dominant mountain areas, which place special emphasis on the characteristics of roads and natural objects (Switzerland, Austria), and on the other hand, the Spanish and Catalan maps, just as maps of other Southern European countries, reflect approaches which have been shaped by the specificity of natural conditions and cultural development. It should be emphasized that Spain's neighbour, Portugal, has topographic maps with much richer content.

One could expect that the 1:10,000 maps would contain the highest number of characteristics of buildings and built-up areas, and that their number would get lower as the scale decreases. However, it turns out that the largest number of characteristics is presented both on the 1:10,000 and 1:50,000 maps (on average: around 12), and the smallest range is shown on the 1:25,000 maps (10).

The Catalan and Norwegian maps can serve as clear illustrations of the fact that there is no relation between maps' content range and their scales. On Catalan maps, the highest number of categories concerning built-up areas and buildings can be found on the 1:100,000 map (11), and the smallest number of the catego-

ries, on the 1:25,000 map (5). On the other hand, on the Norwegian maps, the highest number of categories appear on the 1:50,000 map (20) and the lowest on the 1:10,000 map (only 5). Such large discrepancies in the content of maps at different scales are most likely caused by the fact that concepts for maps of particular scales were developed independently, not as a uniform series of scales. This lack of dependence between the number of characteristics and the the scale is also a consequence of the fact that smaller-scale maps (1:50,000 and 1:100,000) of some countries (e.g. Norway) cover also characteristics which are relevant for tourists, while larger-scale maps allow for greater use of explanatory abbreviations.

When it comes to consistency in the scope of content presented on map of particular scales, Polish maps (from fifteen to seventeen categories) definitely stand out, as do, to a lesser extent, German (from ten to eighteen categories) and Swedish maps (from eight to thirteen). The uniformity of content may be attested by the share of categories repeated on the maps of a given country in all the analysed scales in relation to the number of categories on the map which contains the lowest number of categories. The maps of four countries stand out in this respect: Denmark (75%), Belgium and Portugal (70% each), and Poland (67%).

Generally speaking, the analysed maps maintain a balance between physiognomic and functional characteristics, especially at smaller scales – 1:50,000 and 1:100,000. As already mentioned, physiognomic characteristics dominate on the 1:10,000 maps, while functional characteristics are more prominent on the 1:25,000 maps.

The 1:10,000 maps of three countries contain already not only individual buildings, but also symbols of built-up areas whose number of characteristics (understandably) increases visibly as the scale decreases. The highest number of such characteristics is presented on the Polish maps – the 1:25,000 maps include only single-family dwellings, while the smaller scale maps offer categories of multi-family and single-family dwellings, as well as compact and dense dwellings. The only other map which represents single-family and multi-family dwellings separately is the Latvian 1:50,000 map, and the compact, dense or scattered dwellings are shown separately only on the Latvian and

German maps. The 1:100,000 Luxembourgian map includes also compact dwellings. The fact that the city centre is presented already on the Danish 1:25,000 map, as well as on smaller-scale maps of that country, and that urban buildings are included on the Norwegian maps, is surprising, considering the subjective character of the scope estimations. The Swedish 1:10,000 and 1:50,000 maps contain unusual characteristics of built-up areas, as they differentiate between high-rise and low-rise buildings. The same can be said for the Catalan maps which includes also areas under construction.

The most frequently noted physiognomic characteristics of individual buildings and structures are symbols for greenhouses, towers and windmills, as well as destroyed buildings or ruins, which are included on the majority of the analysed maps.

Due to the use of explanatory abbreviations, information on the functions of buildings is presented in the form of separate symbols to a wider extent only on the maps of four of the analysed countries: Norway (1:25,000, 1:50,000 and 1:100,000), Latvia (1:50,000 and 1:100,000), Belgium and Germany (1:10,000). The highest number of characteristics of detailed functions of buildings can be identified on the 1:50,000 maps, and only slightly smaller number is included on the 1:100,000 maps, which is a consequence of the fact that such maps are often used for tourism purposes. It is particularly true for the Norwegian maps and to a lesser extent for the Swedish and Latvian ones. What is more, the use of explanatory abbreviations is limited on smaller-scale maps in urbanised areas.

General functions of buildings and built-up areas are presented on just over a half of the analysed maps. Industrial areas or industrial and storage areas are most common. Presentation of general functions of buildings is particularly diverse on the Polish maps and, to a lesser extent, on the Finnish (1:10,000, 1:25,000 and 1:50,000), Norwegian (1:25,000, 1:50,000), Belgian (in all the analysed scales), Swedish (1:10,000) and Luxembourgian (1:100,000) maps. Buildings are classified according to their basic functions – as residential, public, and industrial buildings or outbuildings – in all the analysed scales only on the Polish maps. The latter two functions, just as on the Catalan and Swedish maps, become combined when the scale is changed to 1:100,000. Apart from

Polish maps, public buildings are presented as a separate category only on the Latvian maps at two of the smaller of the analysed scales and on the Belgian 1:10,000 map.

Of the three distinguished types of functions (general, detailed and religious), religious functions are definitely represented most frequently (except for the 1:10,000 maps). Almost all of the maps show churches and chapels. The Swedish maps include also separate categories of parish churches and belfries, while Croatian, Danish, French, Luxembourg and Polish maps depict temples of other religion than Christian. As already mentioned, some physiognomic features of churches are presented on several maps (Austrian, Estonian, Dutch and British). Churches which are also tourist attractions are singled on French and Catalan 1:100,000 map.

In total, 666 categories of buildings, structures and build-up areas shown with the help of conventional symbols have been identified on the sixty analysed maps. Some of these characteristics are presented on only one map (e.g. domes with diameters exceeding 15 m, welfare institutions, closed built-up areas), whereas others are used on many maps. The analysis revealed that the number of such widely-used categories is surprisingly low, because

Table 3. The number and percentage of maps with the most commonly recurring categories of build-up areas

| Categories of content                          | Maps   |                |
|--|--------|----------------|
|  | Number | Percentage [%] |
| Church   | 51     | 85             |
| Tower  | 35     | 58             |
| Ruin / ruined building                         | 32     | 53             |
| Building                                       | 32     | 53             |
| Greenhouse                                     | 31     | 52             |
| Chapel   | 30     | 50             |
| Windmill                                       | 28     | 47             |
| Hospital                                       | 25     | 42             |
| Built-up area                                  | 23     | 38             |
| Industrial and storage area or industrial area | 22     | 36             |
| Public building                                | 17     | 28             |
| High building                                  | 14     | 23             |
| Town hall                                      | 9      | 17             |

only 10 are included on more than thirty percent of the analysed maps, and only 6 (churches, towers, ruins or decrepit buildings, buildings, greenhouses, and chapels) are used on at least half of these map (tab. 3). Christian churches are definitely the most often shown category, which is a consequence of the centuries old tradition and thus was a predictable result. The second most frequently used category were towers which are important for orientation, and the third (which may be a surprise) – ruins or destroyed buildings. However, as already mentioned, it should be remembered that legends of some topographic maps do not include symbols whose meaning is assumed to be obvious, e.g. buildings or built-up areas.

## Literature

- Feldman H.-U., Kreiter N., 2006, *Neuaufbau der schweizerischen Landeskarte: Inhalt und Kartographie*. „Kartogr. Nachr.” Jg. 56, H. 3, pp. 115–121.
- Harbeck R., 1985, *Topographische Landeskarten an der Schwelle zu neuen Gestaltungsformen*. „Zeitschr. für Vermessungswesen” Bd. 110, H. 12, pp. 572–575.
- Kacprzak M., Ostrowski W., 1994, *Koncepcja ideowa nowej edycji cywilnych map topograficznych w skali 1:10 000 i 1:50 000*. In: *Polska kartografia map topograficznych. IX Szkoła kartograficzna, Komorowo, 10–14 października 1994*, Warszawa, pp. 130–135.
- Kent A.J., 2007, *An analysis of statistic diversity in European state 1:50,000 topographic maps*. Paper presented on XXIII International Cartographic Conference, 4–10 August 2007, Moscow.
- Ostrowski W., 2008, *Semiotyczne podstawy projektowania map topograficznych na przykładzie prezentacji zabudowy*. Warszawa: Uniwersytet Warszawski, Wydział Geografii i Studiów Regionalnych.
- Schmidt D., 1987, *Developments in the design of topographic maps in Federal Republic of Germany – activities and suggestions*. „Nachr. aus dem Karten- und Vermessungswesen” Series II, No. 46, pp. 139–164.
- Zarycki T., 2004, *Struktura mapy w ujęciu pragmatycznym*. „Polski Przegl. Kartogr.” T. 36, nr 2, pp. 75–81.
- Żyszkowska W., 2005, *Funkcja map w cywilizacji*. In: *Spoleczna i edukacyjna rola kartografii w Polsce. XXXI Ogólnopolska Konferencja Kartograficzna, Warszawa, 20 i 21 października 2005*. „Materiały Ogólnopolskich Konferencji Kartograficznych” T. 26, Warszawa, pp. 11–20.

Finally, it should be emphasized that the analysed maps contained a few unique and original characteristics of buildings and build-up areas which could be useful for map users. They included the following categories: closed built-up areas (Swedish 1:50,000 map); holiday and leisure houses area (Swedish 1:50,000 map, Latvian 1:100,000 map); animal farm lands (Czech 1:25,000 map); areas under construction (Catalonian 1:25,000 map); buildings under construction (Estonian, Catalonian, and Latvian 1:10,000 maps, Estonian 1:20,000 map); foundations of buildings (Estonian 1:10,000, and 1:20,000 maps); shopping centres (Belgian 1:10,000, and Luxembourgian 1:10,000 and 1:20,000 maps).