Chapter 6
Analysing the Symbology of Soviet Military City Plans

This chapter comprises a summary of the results from the analysis of the symbology of the Soviet military city plan series according to specification documents and the same symbology in the context of a 1% sample of the plans, as previously explained. The latter concludes with an analysis of the relationship between symbology and the characteristics of cities which were previously used to construct, as far as possible, a balanced and representative sample of the series. These two components are addressed in turn and, together, aim to address the first research objective, regarding the implementation of the Soviet city plan symbology across a variety of socio-cultural and physical environments. Naturally, as it would be expected that the nature of the symbology applied to plans at 1:10,000 and 1:25,000 may differ, these scales are frequently separated in the following presentation of data, although overall trends will be nonetheless apparent.

6.1 Analysing a Comprehensive Record of the Symbology of Soviet Military City Plans, 1966–1978

The first phase of the analysis focussed on the specification documents which coincide with the period of peak city plan production in the early 1970s. The 1968 edition of *Conventional Signs for Topographic Maps of the USSR* (at 1:10,000) [3] contains a total of 562 symbols, 58 of which are annotations, leaving 504 graphical symbols. The section of the 1966 edition of *Conventional Signs for Topographic Maps of the USSR* [1] relevant to maps at 1:25,000 contains 382 symbols, 25 of which are annotations, leaving 357 graphical symbols. The supplementary table of symbols included in the 1978 edition of the compilation manual for city plans [2], which lists symbols for use on city plans but not any other topographic map, includes eight symbols for plans at 1:10,000, eight symbols for plans at 1:25,000 and 28 symbols which may be used

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at either scale. None of the scale-specific symbols are annotations, although five non-scale-specific symbols are annotations, reducing the included number of such symbols to 23. Therefore, a total of 39 symbols from the supplementary table has been included. Consequently, the symbology of Soviet military city plans, based on these three sources, constitutes 988 symbols, in terms of total gross symbol count. Of these, 88 are annotations, leaving precisely 900 graphical symbols; 535 which may be used on maps at 1:10,000 and 388 which may be used on maps at 1:25,000. As both of these counts include the 23 non-scale-specific symbols from the 1978 edition of the compilation manual for city plans, they total 923, despite the existence of only 900 discrete graphical symbols. However, some of these symbols are graphically identical, or graphically similar but with an identical description in their respective source specifications. In these cases, symbols which appear in more than one of the three specifications listed above have been considered the same symbol for the purposes of this study. Where graphically identical or similar symbols have different descriptions in different specifications, they have been considered different symbols. Using these criteria, 254 symbols from the 1968 edition of *Conventional Signs for Topographic Maps of the USSR* (at 1:10,000) are considered identical to symbols included in the 1966 edition of *Conventional Signs for Topographic Maps of the USSR* (section dealing with 1:25,000 maps), excluding annotations [1, 3]. Such repetition is considered here as an endorsement of the possibility of using these symbols at either scale.

In addition, nine of the scale-specific symbols and three of the non-scale-specific symbols in the 1978 edition of the compilation manual for city plans [2] are also included in the 1968 edition of *Conventional Signs for Topographic Maps of the USSR* (at 1:10,000) [3], excluding annotations, with eight of these 12 symbols also appearing in in the 1966 edition of *Conventional Signs for Topographic Maps of the USSR* (section dealing with 1:25,000 maps) [1]. In addition one non-scale-specific symbol and two scale-specific symbols in the 1978 edition of the compilation manual for city plans are also included in the 1966 edition of *Conventional Signs for Topographic Maps of the USSR* (section dealing with 1:25,000 maps) but not the 1968 edition of *Conventional Signs for Topographic Maps of the USSR* (at 1:10,000). Some of the repeated scale-specific symbols from the *compilation manual for city plans* are repeated in the edition of *Conventional Signs* which does not correspond with the scale specified in the compilation manual. In addition, two of the scale-specific symbols in the compilation manual for city plans are considered identical in this study. As a result, the symbology of Soviet military city plans, based on these three sources, is considered in this study to comprise a net total of 630 graphical symbols. Of these 630 symbols, 104 are presented in the source specifications, or their relevant parts, in a manner which indicates that they are solely for use on maps at 1:25,000; likewise 252 solely for use on maps at 1:10,000 and 274 suitable for use on maps at either scale. In the following analysis, only graphical symbols are referred to, unless stated otherwise.

6.1.1 Symbology by First-Level Feature Class

Figure 6.1 shows the number of symbols in each First-Level feature class by scale and gives an insight into the relative prominence of each class within the Soviet symbology as a whole. The data displayed in Fig. 6.1 include the 23 non-scale-specific symbols from the 1978 edition of the compilation manual for city plans in the values for both 1:10,000 and 1:25,000, given that these symbols may be used at either scale. Additionally, in instances where an identical or similar symbol is included in more than one specification, or part thereof, dealing with different scales, the symbol has been included in the counts for both scales.

The rank order of the classes is similar at both scales, although not identical. The class with the highest number of symbols in the 1:10,000 symbology is 'Hydrography and Coasts' (84 symbols) followed closely by 'Vegetation and Soils' (80 symbols). In the 1:25,000 symbology, this order is reversed with 62 and 66 symbols in these classes respectively. Similarly, 'Religious and Burial Sites' and 'Industry and Communications' are also reversed, due to the lack of distinction between the construction materials of places of worship at 1:25,000. At both scales, 'Road Transport' is the largest of the three transport classes and is the third largest class overall at both scales. 'Agriculture and Animal Enclosures' and 'Boundaries' are the smallest two classes at both scales, both including 17 and 11 symbols at 1:10,000 and 1:25,000 respectively. As would be expected, symbol counts at 1:10,000 are higher in each class than at 1:25,000, due to increased generalisation at the latter, smaller scale.

6.1.1.1 Settlements

At both scales, there are more symbols for individual building footprints and specific types of building than aggregated blocks. Moreover, a large number of symbols in both of these Second-Level classes is included in the supplementary table of symbols included in the 1978 edition of the compilation manual for city plans, with those from the two editions of *Conventional Signs* being of more relevance to the topographic map series. Due to increased generalisation at 1:25,000, the number of symbols for 'Blocks' is higher at this scale than at 1:10,000, whereas the reverse is true for individual buildings. The pale orange and yellow buildings included in the 1968 edition of *Conventional Signs* for 1:10,000 maps rarely feature on city plans. Instead, the brown building footprints, along with the purple, blue and black classified buildings, which are an important stylistic characteristic of the city plan series, are all derived from the compilation manual for city plans. Despite this, these symbols are frequently included in the small legend in the margin of city plans, as they are unique to this series. Several other symbols relating to individual structures, such as ruins, yards and yurts derive from *Conventional Signs* (Fig. 6.2).

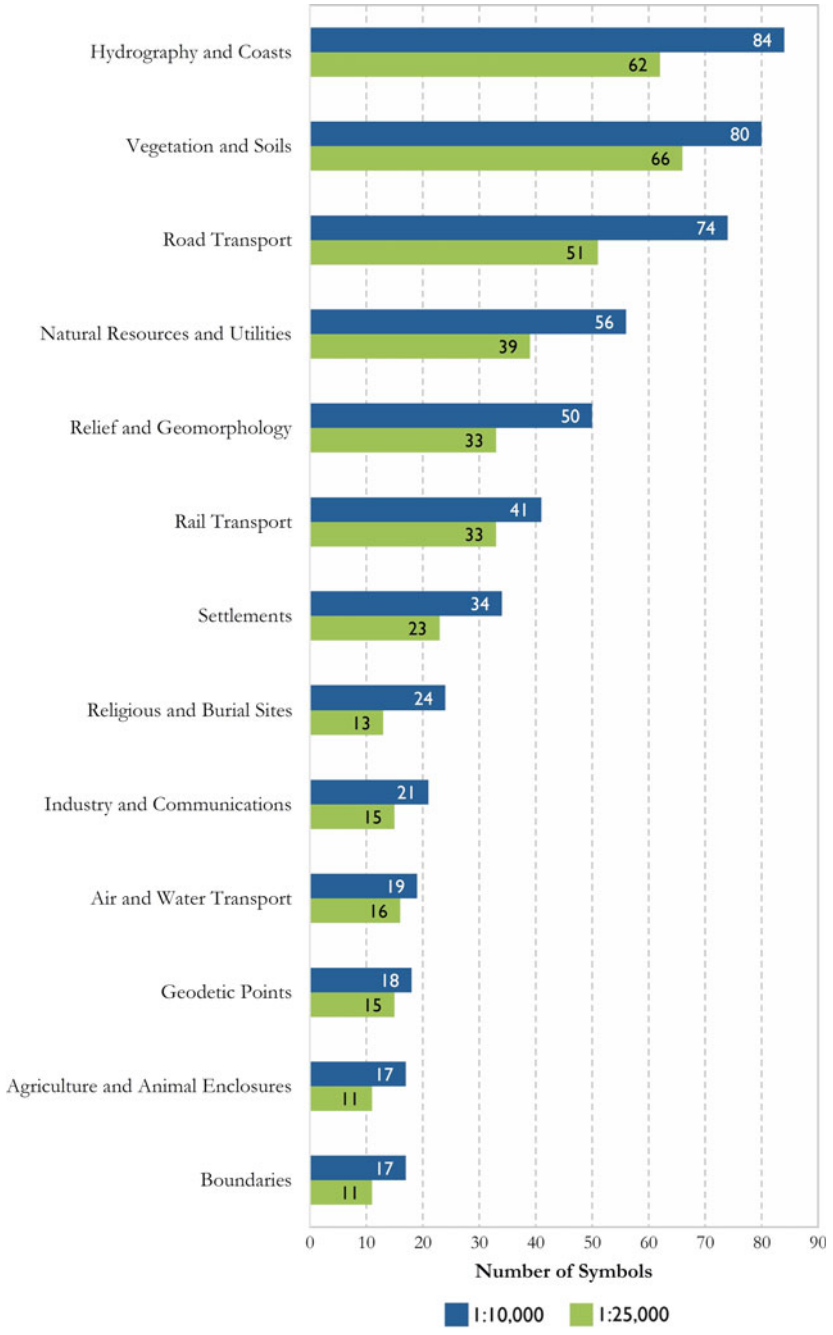

Fig. 6.1 Symbol counts for first-level feature classes, by scale (ordered by 1:10,000 rank)

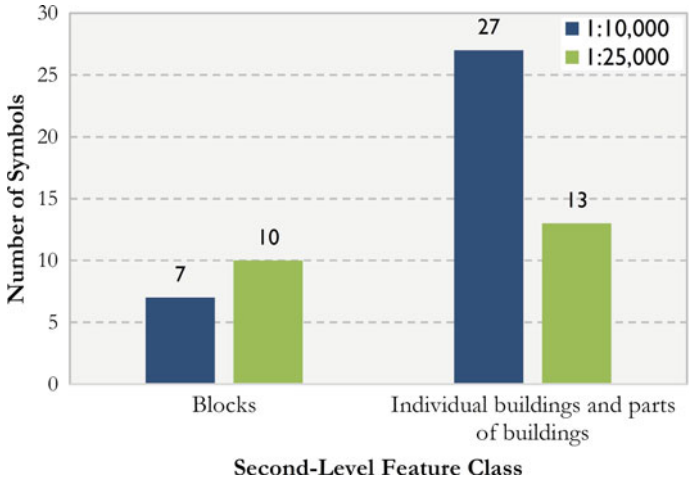

Fig. 6.2 Symbol counts for second-level feature classes within 'settlements', by scale

6.1.1.2 Road Transport

A total of 34 types of road are included in the 'Road Types' Second-Level class, ranging from the highly distinctive orange motorways and highways to more obscure road types such as 'Causeways exposed at low tide or roads along river beds' or a 'Trail on eaves/ledges over a ravine'. Naturally, more road types are included in *Conventional Signs* at 1:10,000 than 1:25,000, although many are repeated in both. None derive from the compilation manual for city plans, indicating that this element of symbology is identical in both the city plan and topographic series. The 'Other road features and information' class includes six symbols which are repeated in both editions of *Conventional Signs.* 'Bridges and Tunnels' is a sizeable class at both scales, though many of the symbols at 1:10,000 stipulate particular lengths of bridges and therefore cannot be considered identical to the similar symbols at 1:25,000 which carry a more general description. Most symbols in the 'Roadside features' class appear in *Conventional Signs* at both scales, with cuttings and embankments also appearing in the compilation manual for city plans (Fig. 6.3).

6.1.1.3 Rail Transport

Railway lines are depicted similarly at both scales, with the number of tracks depicted intuitively by the relevant number of lines across the track, with an additional perpendicular line signalling an electrified line. Whereas, at 1:25,000, distinction between 'Railway buildings and parts of stations' extends only to ordinary, narrow gauge and metro stations and depots, a wider selection is included at 1:10,000, including smaller booths and patrol huts. At both scales, the 'Other railway features' class, including

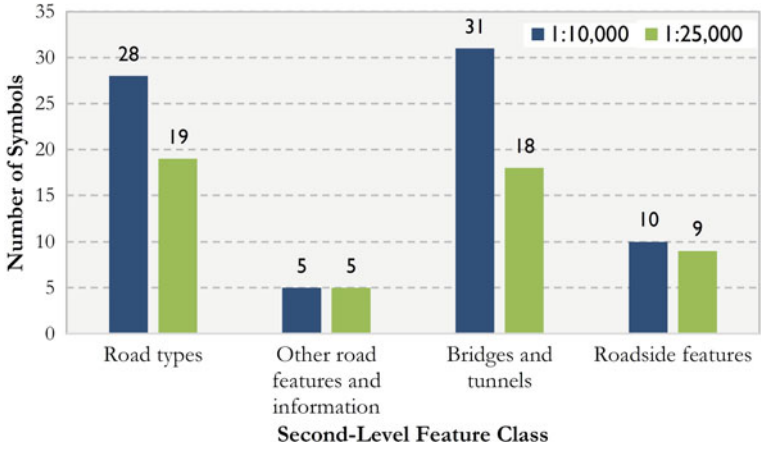

Fig. 6.3 Symbol counts for second-level feature classes within 'road transport', by scale

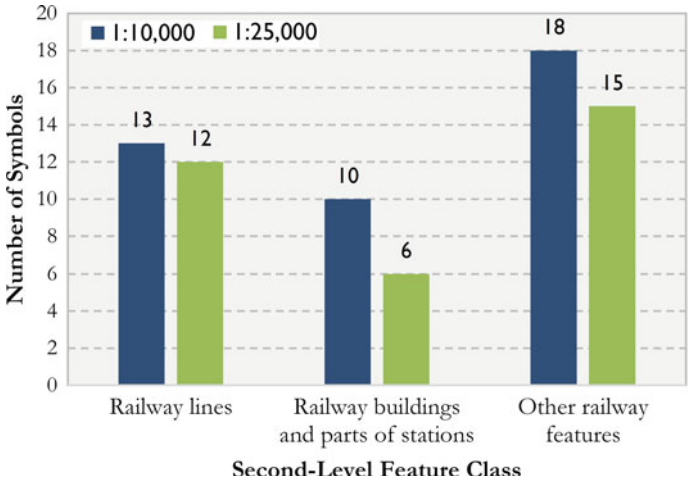

Fig. 6.4 Symbol counts for second-level feature classes within 'rail transport', by scale

signals, cuttings embankments and dead ends, includes more symbols than either of the other classes (Fig. 6.4).

6.1.1.4 Air and Water Transport

At both scales, sites suitable for landing aircraft are marked identically, with distinction being made between whether the site is an aerodrome or less formal landing site, but not whether it is on land or water (although the context of the symbol on the map

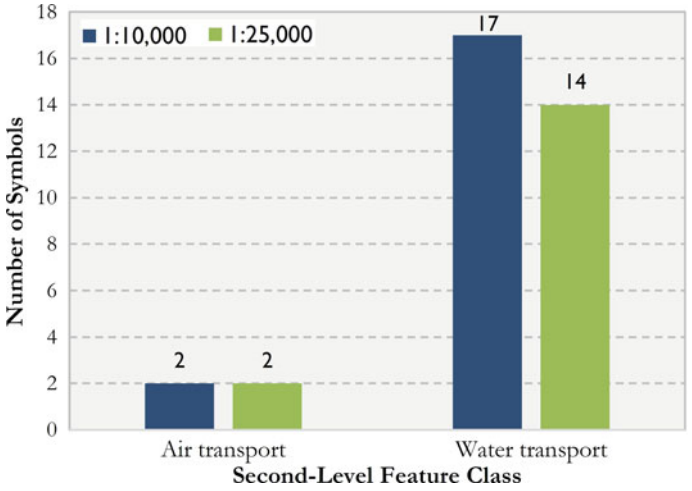

Fig. 6.5 Symbol counts for second-level feature classes within 'air and water transport', by scale

would make this clear). Interestingly, there is no symbol at either scale for a helipad. 'Water transport' is dealt with much more comprehensively at both scales, with the 1:10,000 symbology frequently facilitating 'to scale' and 'not to scale' options for the same feature. Other symbols are also given more detailed treatment at 1:10,000. For example, a single symbol for a 'Light ship or floating light' at 1:25,000 (for nautical navigation) is distinguished at 1:10,000 by whether it possesses one or two lights, with a generic symbol available for cases in which this level of detail is unavailable (Fig. 6.5).

6.1.1.5 Natural Resources and Utilities

By a significant margin, the largest Second-Level feature class in this category is 'Fossil fuels and mining—buildings and structures', with 34 symbols at 1:10,000 and 19 at 1:25,000. Once again, distinction is made at 1:10,000 between 'to scale' and 'not to scale' symbols. At the larger scale, the placement of some symbols on the map is stipulated in greater detail. For example, a symbol denoting a mine at 1:25,000 should be more specifically placed at the entrance to the mine at 1:10,000. Although the symbologies at both scales differentiate between operational and non-operational mining sites, an additional distinction is made at 1:10,000 between the 'main lift' and 'auxiliary lifts'. There is little difference between the specific types of natural resources referred to; oil, gas, salt and peat are all referred to by name in the symbologies at both scales, although there is further reference to 'mineral mining' at 1:10,000. 'Water' and 'Electricity' follow fossil fuels and mining, with little difference in symbol counts between the scales. Although the construction material of power line supports is denoted at both scales, the 1:10,000 symbology additionally

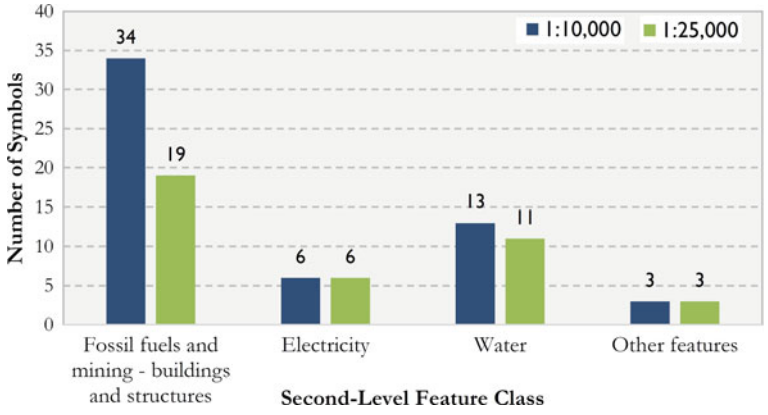

Fig. 6.6 Symbol counts for second-level feature classes within 'natural resources and utilities', by scale

distinguishes power lines which are at least 14 m high. The 'Water' Second-Level feature class includes several, lesser-known features; namely an 'Artesian well', 'Sakia' and 'Kariz' (Fig. 6.6).

6.1.1.6 Religious and Burial Sites

The places of worship in the symbologies relate to Christianity, Islam and Buddhism, reflecting the three major world religions with a significant presence within the sphere of influence of the Soviet Union. A variety of 'Burials and shrines' are also included, with individual graves and monuments included at 1:10,000 (Fig. 6.7).

6.1.1.7 Agriculture and Animal Enclosures

As pasture is generally left blank on Soviet maps, a much smaller number of symbols is allocated to livestock (paddocks and apiaries) than to crops. The divide between the 'Fruit and vegetables' and 'Cereals and industrial crops' Second-Level feature classes is almost even. A fill for generic 'Arable land' is given at 1:10,000 but not 1:25,000, whereas the reverse might have been expected (Fig. 6.8).

6.1.1.8 Boundaries

Five of the six symbols for 'Artificial physical boundaries' at 1:10,000 are incorporated in the single symbol 'Stone/brick wall or metal fence' at 1:25,000. Conversely, a more comprehensive approach is taken at both scales with regard to political or administrative boundaries, the only features not included at 1:25,000 being

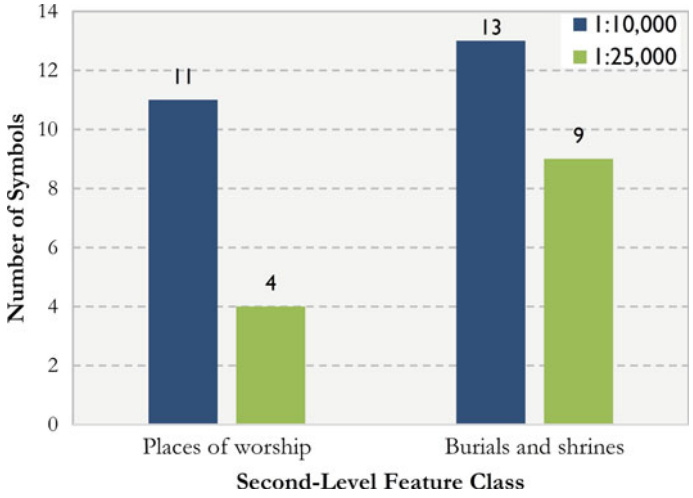

Fig. 6.7 Symbol counts for second-level feature classes within 'religious and burial sites', by scale

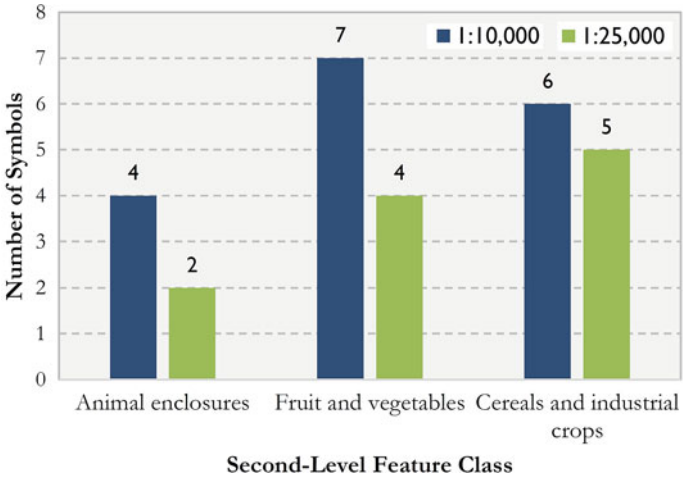

Fig. 6.8 Symbol counts for second-level feature classes within 'agriculture and animal enclosures', by scale

'Boundary marker of value as a landmark' and 'City limits'. The inclusion of 'Border of polar possessions of the USSR' in the compilation manual for city plans is surprising, given the lack of cities in these areas, but may be a politically important inclusion (Fig. 6.9).

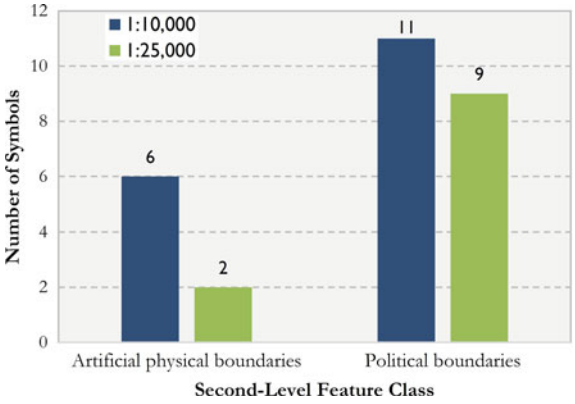

Fig. 6.9 Symbol counts for second-level feature classes within 'boundaries', by scale

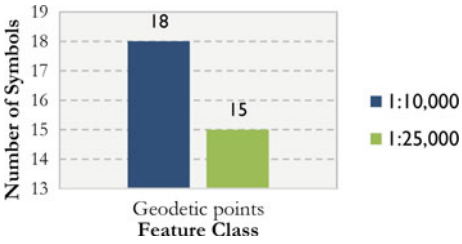

Fig. 6.10 Symbol counts for the first-level feature class 'geodetic points', by scale

6.1.1.9 Geodetic Points

Given the importance of geodetic points on maps at any scale, it is unsurprising that there is little variation in symbol counts between scales. *Conventional Signs* at 1:10,000 gives a small number of examples of geodetic points on various features, which are not provided in *Conventional Signs* at 1:25,000 symbology. However, many of the examples in the 1:10,000 edition are repeated (or elaborated on) in the compilation manual for city plans; endorsing the importance of geodetic points to this series (Fig. 6.10).

6.1.1.10 Hydrography and Coasts

In addition to being the largest First-Level feature class, 'Hydrography and Coasts' also exhibits broad consistency between the two scales, with few features being included at one scale but not the other, but with additional detail sometimes included at 1:10,000. The majority of features fall within the 'Maritime hydrography, coasts and coastal cliffs' and 'Rivers, streams and canals' Second-Level feature classes, with higher symbol counts in the latter. 'Rivers, streams and canals' also exhibits greater discrepancy between the scales, with stipulation of the widths of rivers and canals at 1:10,000 largely accounting for this. The symbol 'Irrigation canal/ditch

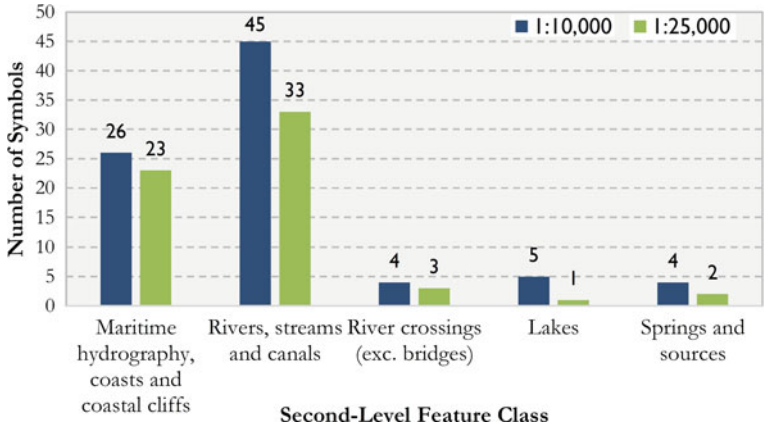

Fig. 6.11 Symbol counts for second-level feature classes within 'hydrography and coasts', by scale

in reinforced concrete trays on supports' is unusually included in the compilation manual for city plans but neither edition of *Conventional Signs*. The three smaller Second-Level feature classes are characterised by the distinction between mechanical and non-mechanical ferries (in 'River crossings [exc. bridges]'), the inclusion of only one, generic symbol for a lake at 1:25,000 (in 'Lakes') and the separation of types of springs at 1:10,000 (in 'Springs and sources') (Fig. 6.11).

6.1.1.11 Relief and Geomorphology

Across all Soviet topographic map series, elevation is indicated by contour lines. This fact is evidenced by the simplicity of the 'Elevation' Second-Level feature class, which straightforwardly includes contours and their direction indicators at 1:25,000 and introduces a limited hierarchy for contours at 1:10,000. 'Geomorphology and glaciology' is far more extensive, incorporating elements of cliffs and ravines, volcanic, karst and glacial areas (Fig. 6.12).

6.1.1.12 Vegetation and Soils

Over half of the symbols in 'Vegetation and Soils' fall within the 'Woodland, forest, trees and shrubs' Second-Level feature class. The greater detail within this class at 1:10,000 is largely explained by a more thorough treatment of clearings, as well as the inclusion of 'Individual bushes' and small 'Subshrub vegetation (sagebrush, eurotia, sarzasan etc.)'. In 'Other vegetation', two types of lawn are included in the compilation manual for city plans, given the ubiquity of lawns within most cities. The conventional signs for 'Soils and sand' are virtually identical at both scales, although some descriptions of features are subtly different (Fig. 6.13).

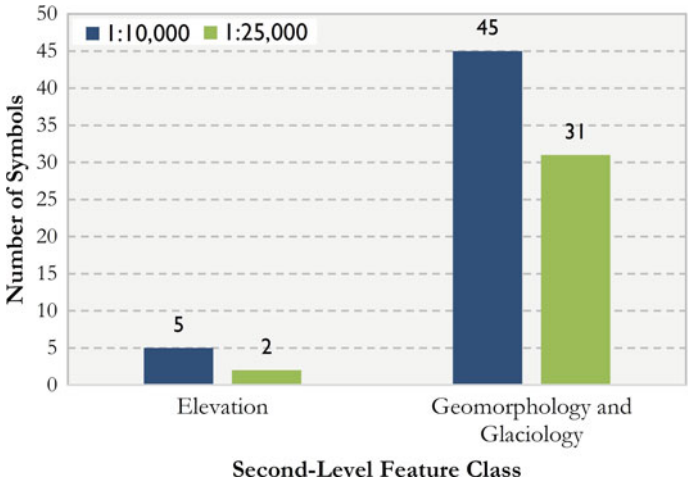

Fig. 6.12 Symbol counts for second-level feature classes within 'relief and geomorphology', by scale

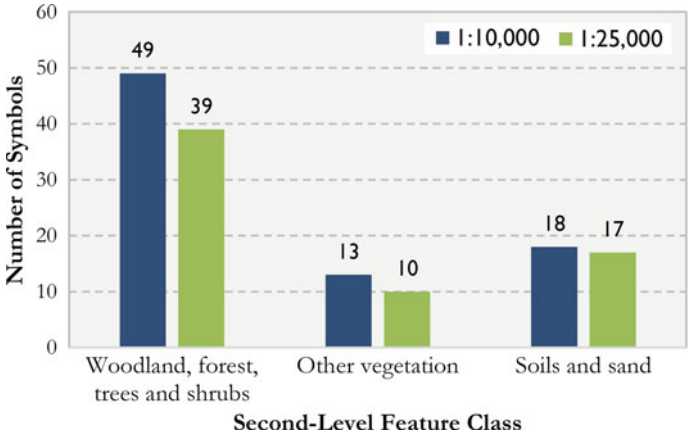

Fig. 6.13 Symbol counts for second-level feature classes within 'vegetation and soils', by scale

6.1.1.13 Industry and Communications (Excluding Natural Resources)

The 'Buildings and structures' and 'Communications' Second-Level feature classes are very similar in content at both scales, with the small number of differences arising from issues directly regarding the scale of features, or subtle differences in descriptions (Fig. 6.14).

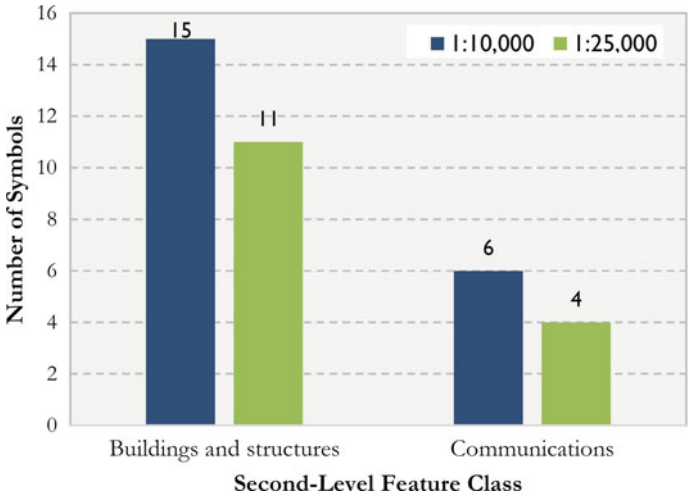

Fig. 6.14 Symbol counts for second-level feature classes within 'industry and communications (excluding natural resources)', by scale

6.2 Analysing the Symbology of Soviet Military City Plans in Context

Comparing the total numbers of different graphical symbols used in each of the 19 city plans in the sample will, firstly, highlight the plans which exhibit a greater richness of 'fabric of difference' through which the reader may assign meaning to elements of the map. It also provides, in the broadest sense, an indication of the variance in the application of the Soviet military city plan symbology to the maps for which they were intended. As a result, this will provide an initial insight into data that will contribute to the consideration of the research objective of examining 'the extent to which the symbology of Soviet military city plans was successfully implemented across a variety of socio-cultural and physical environments across the globe.' The second step towards identifying variance in symbology application around the globe is to consider in more detail the focus afforded to different feature classes on different city plans and how this variance corresponds with the characteristics of the mapped cities.

6.2.1 Trends Across the Sample

Of a total of 630 graphical symbols in the Soviet city plan specification as a whole, 302 (47.9%) are used at least once in this sample. Of the 378 symbols suitable for use at 1:25,000, 158 (41.8%) are used across the sample and of the 526 suitable for use at 1:10,000, 274 (52.1%) are used. Some 130 symbols are used on plans at both scales.

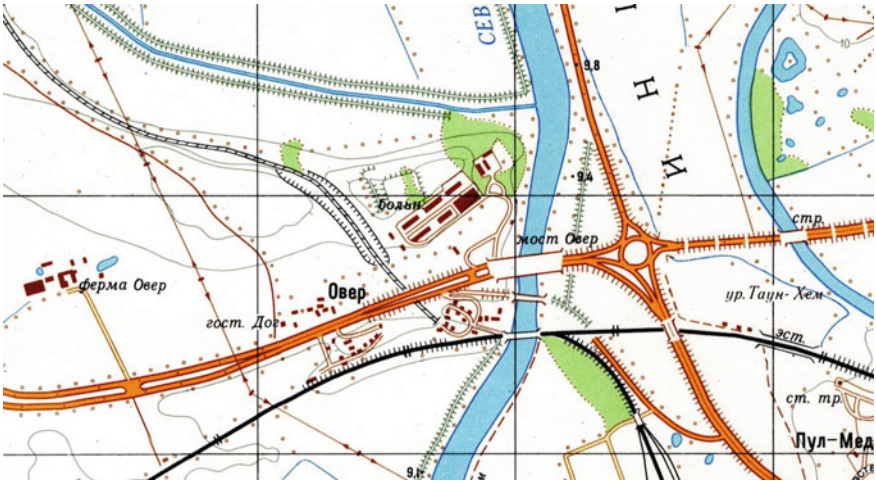

Fig. 6.15 Extract from the city plan of Gloucester, UK (1989, 1:10,000) showing the five symbols common to all 19 plans in the sample used in this study. Note that the road on the right is an 'improved motorway' (dotted); the 'highway' symbol is used on the roundabout (private collection)

Furthermore, only five symbols (0.79%) appear on all 19 plans in this sample and are shown in Fig. 6.15. Two of these, 'General fire-resistant building' and 'Highway', constitute the distinctive dark brown polygons and orange roads which contribute to the distinctive aesthetic of the plans. The 'Contour slope direction indicator' is also found on all of the plans, despite the absence of the standard contour on the plan of Miami in favour of 'supporting' (dashed) contours. One of the smallest symbols in the symbology, 'Individual tree with no value as reference point', also appears on all plans, along with the dotted 'Outline of vegetation and soil' which is typically used to separate vegetation from 'blank' space.

However, the analysis of this sample has also revealed that the symbology of city plans is not limited to that which is recorded in the specifications which are expressly for the particular scale of the plan. In this sample, a total of 62 symbols appear on plans at 1:10,000 which only appear in specifications for 1:25,000 maps. Of these, 37 only appear on 1:10,000 plans and not on 1:25,000 plans. Likewise, 28 symbols are used on plans at 1:25,000 which only appear in specifications for 1:10,000 maps. Of these, two only appear on 1:25,000 plans and not on 1:10,000 plans. Much greater is the number of symbols in the specifications which do not appear on any of the 19 plans in this sample, which totals 328 (52.1%). Many of these may have been designed for larger scale topographic maps, rather than city plans, as these share the same editions of *Conventional Signs*; for example, many of the numerous means of denoting the density and fire-resistance of buildings are far more commonly seen on 1:10,000 maps from the topographic series. Also numerous in this selection of unused symbols are over 20 types of bridge, many of which stipulate very specific conditions for their use, such as 'Triple-spanned stone, concrete and reinforced concrete bridge – over 13 m – to scale' and 'Footbridge with steps,

wooden, 3–13 m length'. Other features are more feasible, but simply did not appear on any of the plans, such as 'Electrified triple track' (railway), 'Oil pumping station', 'Waterfall' and 'Hydroelectric dam'. Several features which are not marked on any plan in this sample are confined to particular geographical locations and thus may have been included had plans of different locations been selected, such as 'Geyser', 'Border of polar possessions of the USSR', 'Sakia (water lifting device)' (or Persian wheel) and 'Kariz' (an underground water channel in Arabic-speaking areas).

6.2.2 Total Symbology by City Plan

The numbers of different graphical symbols used in each of the 19 city plans in the sample are shown in Fig. 6.16. For each city plan, the larger datum refers to the number of different symbols on the plan which are included in the specifications already discussed, herein referred to as 'specification symbols'. For each city plan, the smaller datum refers to 'additional symbols'; those which are included on the plan but do not appear in the specifications. Such additional symbols include variants on those in the specifications and those which are explained in the margin of the relevant plan. The range in specification symbol counts for the 1:10,000 plans is 126 (Frankfurt am Main) to 56 (La Paz) (Fig. 6.17) and at 1:25,000 is 105 (Halifax/Dartmouth) to 71 (Canberra) (Fig. 6.18). These numbers are striking in that they represent a very small portion of the entire symbology at both scales. Despite including the largest number of symbols of the 1:10,000 plans in this sample, the plan of Frankfurt am Main incorporates only 23.6% of the total graphical symbology at 1:10,000 (535 symbols). Likewise, the plan of Halifax/Dartmouth incorporates only 27.1% of the total graphical symbology at 1:25,000 (388 symbols). The plans of La Paz and Canberra utilise 10.5% and 18.3% of their respective symbologies.

No plan uses more than ten additional symbols (Frankfurt am Main and Cairo) which deviate from the specifications. In total, 38 different additional symbols are used across the 19-plan sample and are listed in Table 6.1, the most common being a yellow fill denoting an urban area (used on 18 plans), a generic bridge (used on 18 plans) and generic vegetation (used on 17 plans). The plan without the yellow urban fill is Miami, which instead uses a more detailed selection of (additional) fills denoting building density and height in different parts of the city. The plans of Tromsø, Canberra and Topar use only five additional symbols each. In many cases, additional symbols have been used where those in the specifications are too specific for the data available in a particular location. Many are therefore more generic variants on specification symbols and may be interpreted without the aid of legend. Others simply combine elements of two or more specification symbols, or alter the variables; for example, a 'Quadruple electrified railway', where only single, double and triple-track railways are included in the specifications. Where additional symbols have been explained in a legend on the plan itself, a translation of this text has been included in Table 6.1. Examples of additional symbols from the sample are shown in Fig. 6.19.

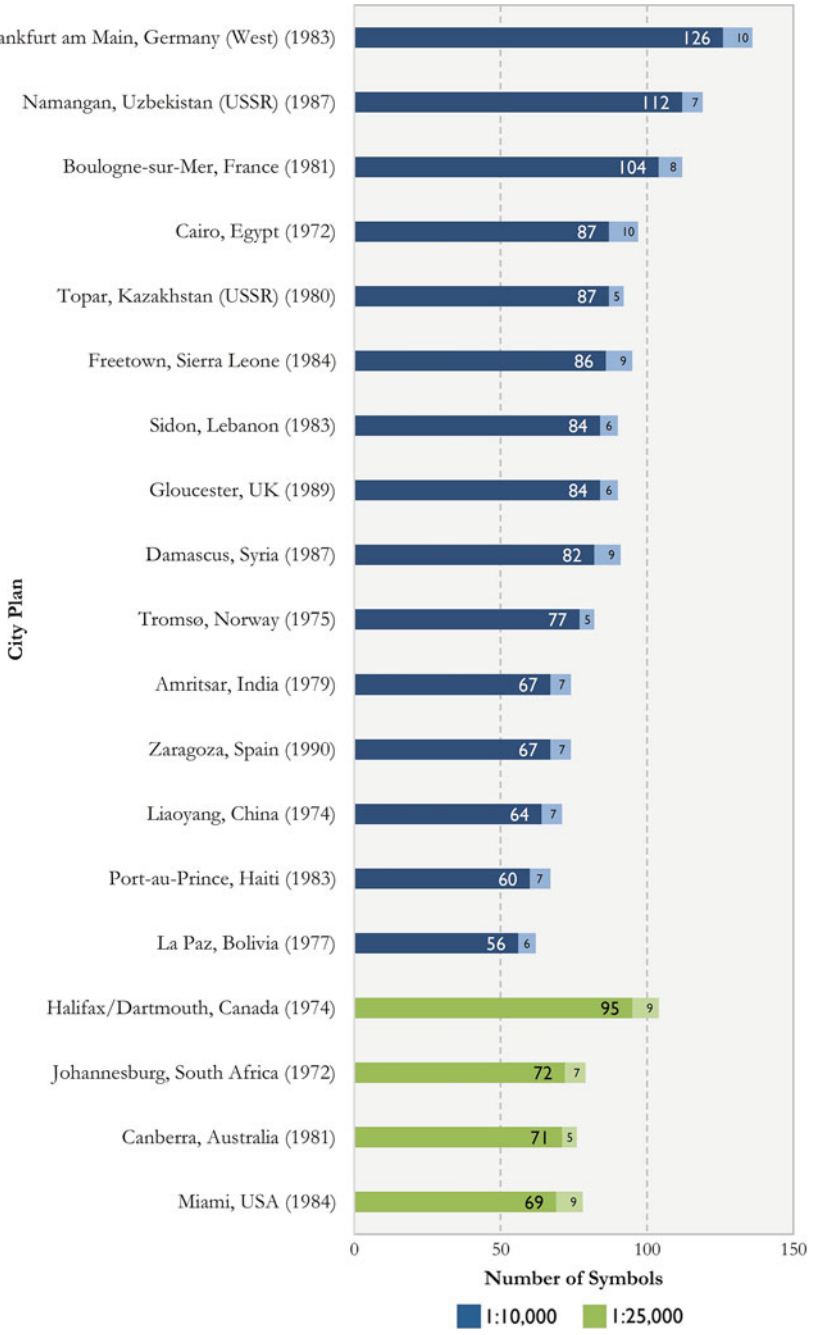

Fig. 6.16 Specification and additional symbol counts for city plans (ordered by specification symbol count rank, by scale)

Fig. 6.17 Extracts from the city plans of Frankfurt am Main, Germany (West) (1983, 1:10,000) (left) (private collection) and La Paz, Bolivia (1977, 1:10,000) (right) (ICGC, RM.165446) which utilise the greatest and fewest number of different symbols in the 1:10,000 sample respectively

Fig. 6.18 Extracts from the city plans of Halifax/Dartmouth, Canada (1974, 1:25,000) (left) and Miami, USA (1984, 1:25,000) (right) which utilise the greatest and fewest number of different symbols in the 1:25,000 sample respectively (private collection)

Table 6.1 Descriptions of additional symbols which are used on city plans in the sample, but do not appear in the specifications

Generic symbols	Other variants on specification symbols			Non-specification symbols	
General vegetation	Isobath direction indicator	Projected road	Stream passing under road/rail	Urban area (yellow fill)	River width arrow
General Church (cross within footprint)	River width markers	Lighthouse—geodetic point (black)	*Reinforced embankment (with dots)*	Densely built blocks in urban areas (brown hachures on yellow)	Fire-resistant urban area (darker yellow fill)
General mosque (crescent within footprint)	*Coastal sand with rocks*	*Pipeline with alternate filled and unfilled dots*	*Sparse forest on pale green fill*	*Densely built low-rise buildings (green hachure)*	*Reservoir section separator*
General bridge	*Quadruple electrified railway*	*Variant on city limits boundary*	*Sand with clusters (dunes?)*	*Sparsely built urban area (yellow fill)*	*Underwater cable*
General impassable marsh	*Sandy reef*	*Haphazard quarters of the city*	*Passable waterlogged ground*	*Unknown (unlabelled circle with central dot)*	*Densely built high-rise buildings (brown hachure on yellow)*
General passable marsh	*Sluice gate in impassable dam*	*Monument—geodetic point (black)*	*Stone church—geodetic point (black)*	*White building with cross over entire footprint*	*Densely built blocks in rural areas (brown hachures on white)*
General railway line				*Unknown (brown line with perpendicular ticks)*	

Descriptions of symbols only used on one plan in the sample are italicised

Fig. 6.19 Examples of additional symbols from the sample (clockwise from top-left): Isobath direction indicator (Boulogne-Sur-Mer), General vegetation (Cairo), General impassable marsh (Freetown), River width arrow (Frankfurt am Main), General bridge (Gloucester), Densely built low-rise buildings (green hachure) (Miami) (private collection)

6.2.3 Analysis of First and Second-Level Feature Classes

Figure 6.20 shows the total number of specification symbols used at least once in the 19-plan sample in each First-Level feature class, separated by scale and ordered by 1:10,000, then 1:25,000 rank. At both scales, the rank order of the First-Level feature classes differs from the order obtained by totalling the symbol counts deriving solely from the specifications (see Fig. 6.1). Notably, 'Rail Transport' is the sixth-largest class at 1:10,000 in the specifications, but is the third-largest class in the sample (26 symbols), surpassing the symbol counts of 'Natural Resources and Utilities' (22) and 'Relief and Geomorphology' (21). Despite a slightly higher symbol count in the specifications, 'Religious and Burial Sites' is the equal of 'Industry and Communications' (14 symbols) in the sample at 1:10,000 but remains the smaller class at 1:25,000. At both scales, 'Agriculture and Animal Enclosures' and 'Boundaries' have equal symbol counts in the specifications. This remains the case in the 1:10,000 sample, although the latter surpasses the former by one at 1:25,000.

Generally, more variation can be seen at 1:25,000 in the sample than in the specifications where, with one exception, the 1:25,000 rank mirrored the 1:10,000 rank. For example, 'Vegetation and Soils' is the largest First-Level feature class in the 1:25,000 specification, but only the third-largest in the sample. Similarly, 'Settlements' becomes a smaller class than 'Industry and Communications' in the sample and 'Air and Water Transport', which has a similar symbol count to 'Geodetic Points'

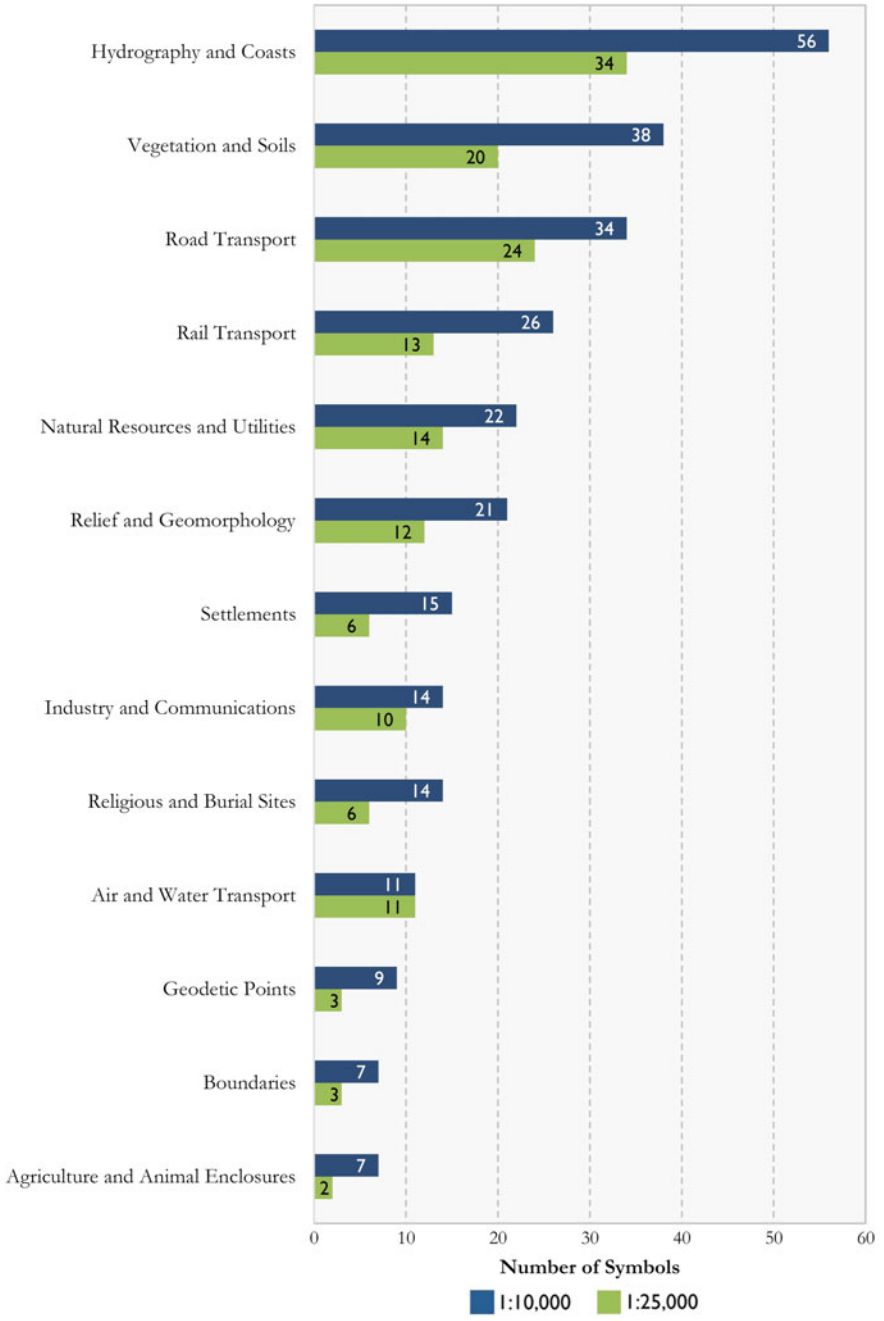

Fig. 6.20 Counts of specification symbols used at least once in the 19-plan sample, by first-level feature class and scale (ordered by 1:10,000 rank then 1:25,000 rank)

in the 1:25,000 specification, is larger by a more significant margin in the sample, equalling its 1:10,000 count. A clearer sense of how these symbol counts compare with the total symbol counts from the specifications can be gained from Fig. 6.21 which shows the specification symbol counts from across the sample (Fig. 6.20) divided by the total symbol counts from the specifications by First-Level feature class (Fig. 6.1), separated by scale and displayed as percentages.

Figures 6.22 and 6.23 show star plots which compare the relative proportions of the First-Level feature classes within the symbology of each city plan. These refer to specification symbols only, as additional symbols have been examined separately. It should be noted that the prominence of any particular feature class in these charts does not necessarily dictate that such features will be visually prominent on the map, as multiple uses of the same symbol are not considered in this analysis. For example, 'Settlements' is not the largest element of any of the star plots in Figs. 6.22 and 6.23, as the number of different symbols utilised from this feature class is typically low, relative to some others. Nonetheless, the same means of representing a building may be repeated hundreds of times across a single plan and thus be visually prominent. As this study is concerned primarily with the application of symbology, rather than issues of aesthetics and design, this is not problematic (Fig. 6.24).

The First-Level class with the highest degree of variance is 'Hydrography and Coasts', with a standard deviation of 5.22 across the sample. This variation is to be expected, given that seven of the 19 cities in the sample are coastal. Although symbols in this class may also be used in the context of inland water bodies, naturally, the coastal cities feature a larger portion of the symbology in this feature class; the largest being Freetown (26 symbols; located on a peninsula on the Atlantic coast) and the smallest being La Paz (six symbols; located over 300 km from the Pacific Ocean). Consequently, 14 of the 26 'Hydrography and Coasts' symbols on the plan of Freetown are in the 'Maritime hydrography, coasts and coastal cliffs' Second-Level class, whereas the six symbols on the plan of La Paz are all in the 'Rivers, streams and canals' and 'Lakes' Second-Level classes (four and two respectively). Although the plan of Gloucester, UK includes more symbols in this First-Level class (9) than the plan of La Paz, the class accounts for an 11% share of the total symbol count on both plans.

Perhaps more surprising is that 'Road Transport' is the First-Level feature class with the second-highest standard deviation across the sample (4.00), despite the more universal nature of the features it includes. Once again, the plan of La Paz utilises the fewest symbols (five symbols, 9%) and Frankfurt am Main the greatest (19 symbols, 15%) with the majority of these (10) within the 'Road types' Second-Level feature class. The plan of Frankfurt am Main also exhibits the joint-largest number of symbols in the 'Bridges and tunnels' Second-Level class (with Gloucester), largely due to the unusually high number of types of footbridges it includes. Despite the plan of Frankfurt am Main exhibiting the greatest number of symbols in this First-Level feature class, 'Road Transport' proportionately occupies a greater share of the symbology of five other city plans in the sample, with the plans of Gloucester, Zaragoza and Canberra exhibiting the highest proportion (21%).

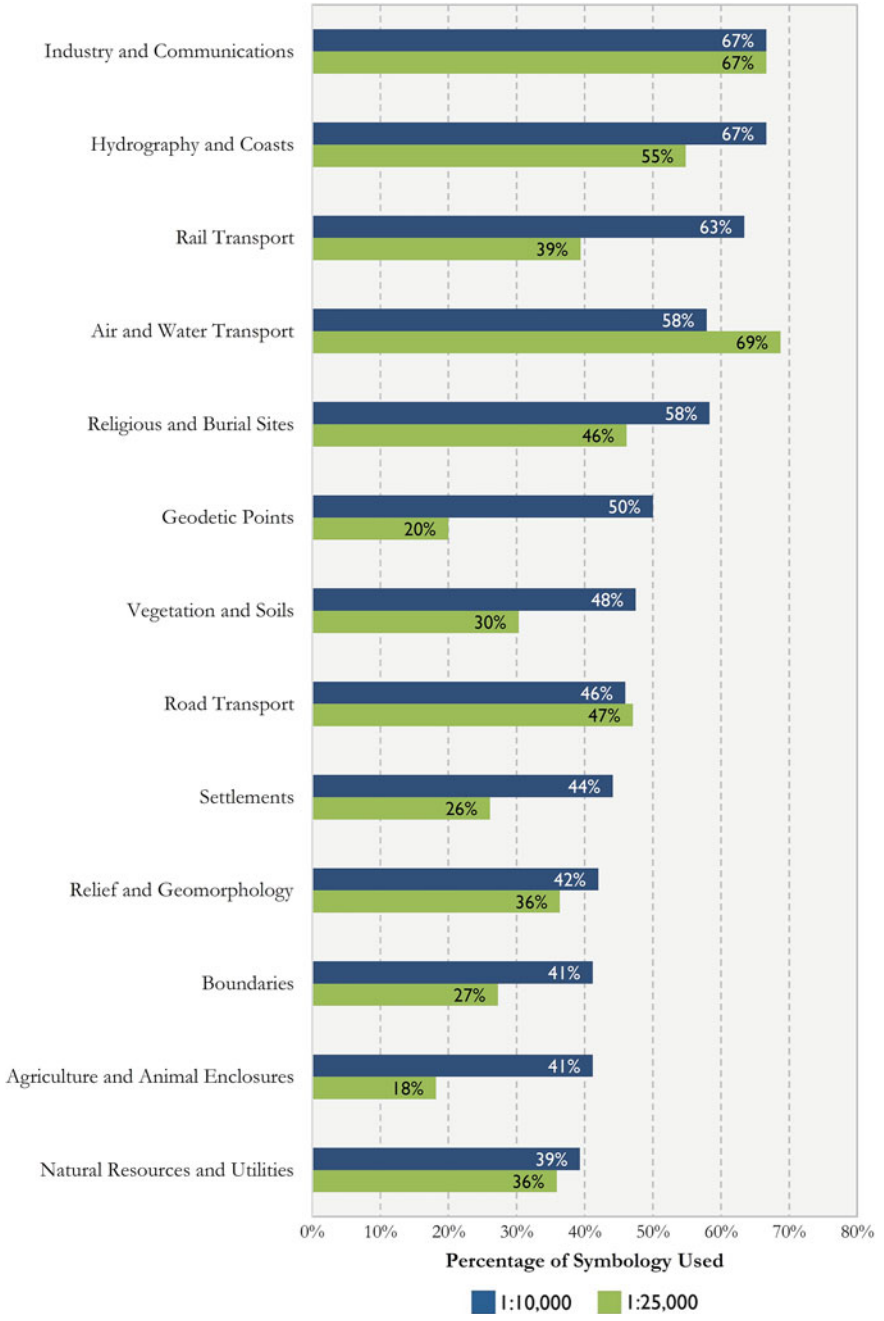

Fig. 6.21 Percentage of the specification symbols used at least once in the 19-plan sample, by first-level feature class and scale (ordered by 1:10,000 rank then 1:25,000 rank)

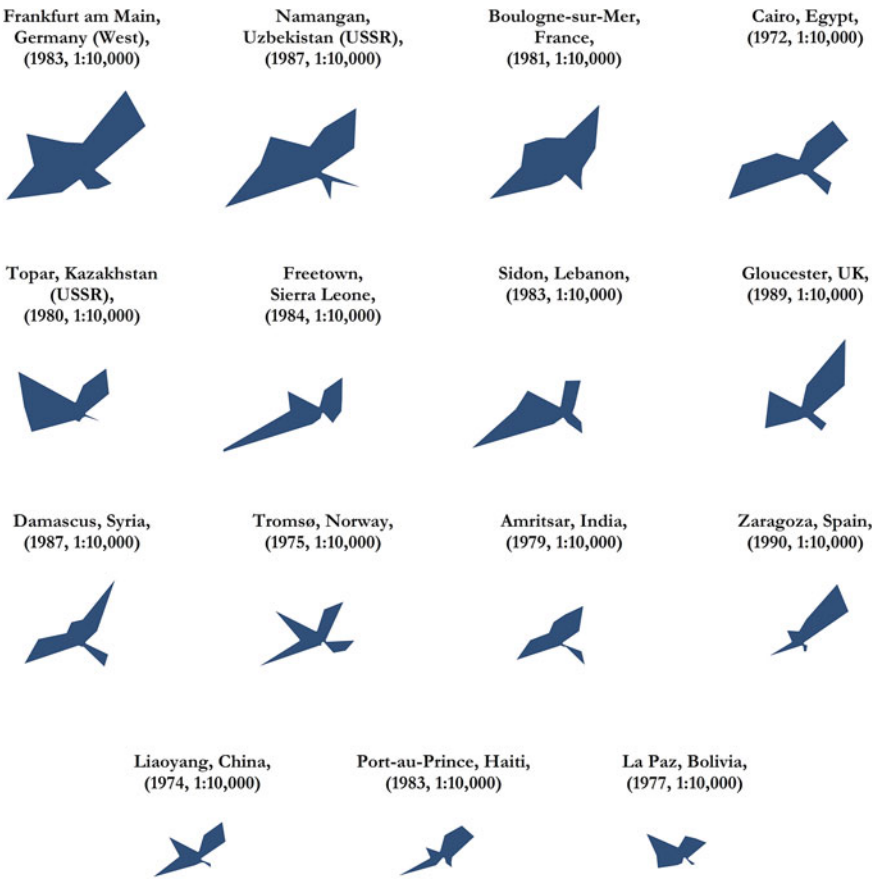

Fig. 6.22 Star plots indicating 1:10,000 city plan symbologies by first-level feature classes, plotted on identical axes (the surface area of each plot reflects the total symbology size)

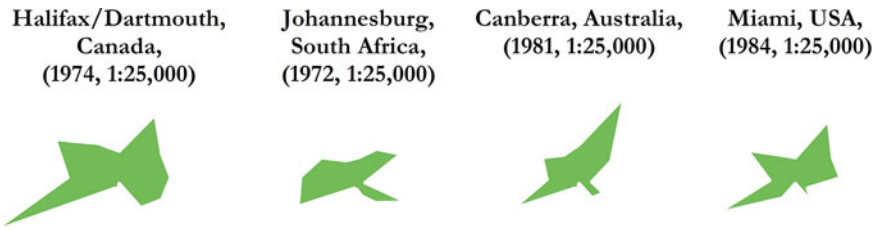

Fig. 6.23 Star plots indicating 1:25,000 city plan symbologies by first-level feature classes, plotted on identical axes (the surface area of each plot reflects the total symbology size)

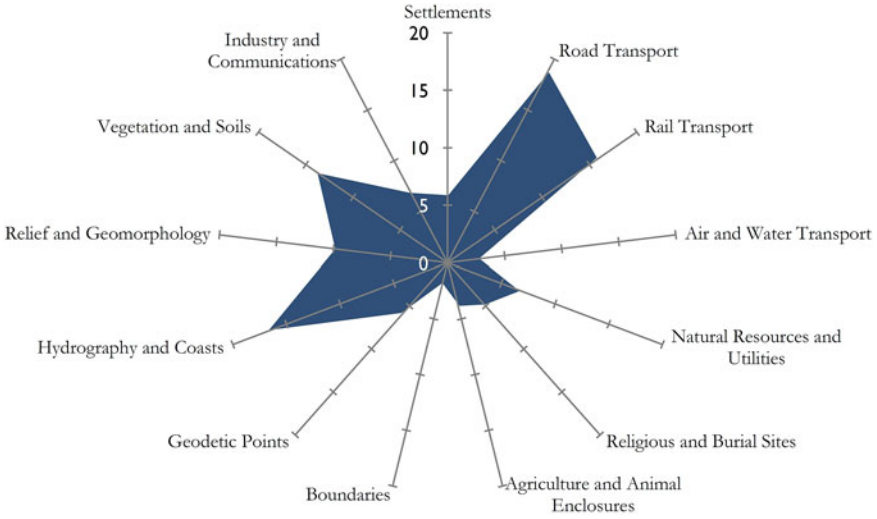

Fig. 6.24 Star plot indicating the symbology of the Soviet plan of Frankfurt-am-Main (1983, 1:10,000) by First-Level feature classes (the ordering of the axes reflects that used in Figs. 6.22 and 6.23)

The standard deviation of the 'Vegetation and Soils' and 'Rail Transport' First-Level classes are similar (3.42 and 3.36 respectively), although the highest symbol counts for each are found on different plans. The highest number of symbols in the former class is on the plan of Topar (16 symbols, 18%), possibly reflecting both the ability of the map-makers to freely access detailed surveys of the area and the fact that the urban extent of Topar is small, meaning that a larger proportion of the area covered by the plan is rural. For example, the plan of Topar includes the joint largest symbol count in the 'Woodland, forest, trees and shrubs' Second-Level feature class (nine, with Frankfurt am Main). 'Vegetation and Soils' also accounts for an 18% share of the symbology of the plan of La Paz, albeit with fewer symbols (10). Although the plan of Frankfurt am Main includes the highest symbol count in the 'Rail Transport' First-Level class (16 symbols, 13%), the class occupies a greater share of the symbology of the plan of Zaragoza (11 symbols, 16%). These two plans, along with those of Cairo and Johannesburg, have symbol counts among the highest in the 'Railway lines' Second-Level feature class, as these four plans exclusively incorporate both electrified and non-electrified lines. Although the plan of Gloucester is the equal of those of Zaragoza and Johannesburg in this respect, this is due to the presence of 'Railways on trestles' and a 'Bed of [a] dismantled line', rather than electrified lines. However, the high 'Rail Transport' symbol count on the plan of Frankfurt am Main is also promoted by the 'Other railway features' Second-Level feature class (six symbols), in which it is the only plan to include detailed footprints of station platforms and the 'Point where metro line emerges at surface' symbol.

Once again, the two plans of Soviet cities in this sample have symbol counts among the highest in the 'Relief and Geomorphology' First-Level feature class (standard deviation, 3.11); Namangan with 13 symbols (12%) and Topar with 12 symbols (14%). The symbol count of the former is matched only by the plan of Cairo (13 symbols) and both are exceeded by the same plan with regard to percentage share (15%). At the opposite end of the spectrum, the plans of Zaragoza and Port-au-Prince include only three symbols each in this class (4% and 5% respectively). However, the prominence of the plans of Soviet cities at the First-Level disguise broad consistency across the sample in the 'Elevation' Second-Level class, which itself has a standard deviation of only 0.79. Being solely comprised of contours and related markings, plans are typically only distinguished from one another in the 'Elevation' class by whether or not they incorporate 'additional' or 'supporting' contours. A much higher level of variance can be seen in the 'Geomorphology and Glaciology' Second-Level class (standard deviation, 2.65), in which the chasm between Namangan and Topar (10 symbols and eight symbols) and Zaragoza and Port-au-Prince (one symbol and zero symbols) can be more clearly discerned. The plan of Namangan provides the sample's only example of 'Gullies along dry ravines and valleys, less than 1 m deep', as well as both to-scale and not-to-scale delineations of pits and mounds (along with Topar, Cairo and Frankfurt am Main). Similarly, the plan of Topar is unique in its inclusion of a 'Cluster of stones', while the plan of Sidon is solitary in depicting the 'Entrance to [a] cave or grotto', despite falling short of the Soviet cities' symbol counts.

Far less Second-Level variance can be seen in the four classes within the 'Natural Resources and Utilities' First-Level feature class (standard deviation, 2.66). Although the highest symbol counts are again found on the plans of Namangan (12 symbols, 11%) and Topar (nine symbols, 10%), the highest percentage share is shared by the plan of Johannesburg (eight symbols, 11%). The plan of Namangan can be most clearly distinguished from the rest of the sample in the 'Water' Second-Level class (five symbols), in which the plans of Tromsø, Liaoyang, Zaragoza, La Paz, Port-au-Prince and Miami are united in their symbol count of zero, while eight other plans share a count of one (a 'Well', in seven cases). Three of the First-Level feature classes include plans with symbol counts of zero. Of these, 'Air and Water Transport' (standard deviation, 2.48) displays the greatest variance, with the plans of Halifax/Dartmouth (eight symbols, 8%) Tromsø (seven symbols, 9%) and Miami (seven symbols, 10%) clearly dominant in terms of symbol count due to the status of each of these cities as a major regional port, thus swelling symbol counts in the 'Water transport' Second-Level class. Unusually, the plans of the two Soviet cities have symbol counts among the lowest in this First-Level class, with a jetty on the shore of Sherubaynurinskoe (lake), outside Topar, preventing only one of them from recording a count of zero.

'Religious and Burial Sites' and 'Industry and Communications' have remarkably similar levels of variance (Standard deviation, 1.91 and 1.93 respectively). While the cemeteries and monuments of the 'Burials and Shrines' Second-Level feature class are broadly universal, with differences in symbols counts generally being dictated by whether such sites are shown to-scale or not-to-scale and whether or not they

incorporate trees, more variation can be seen in the 'Places of worship' Second-Level feature class. In some cases, these variations are consistent with the status of religion in each city. For example, the plan of Damascus, a city which is divided into both Islamic and Christian quarters, has the highest symbol count in this class (five) and reflects the presence of both religions, as well as the construction materials used in many religious buildings. Conversely, Amritsar (three symbols) is a global hub of both Sikh and Hindu populations, although sites important to both of these religions are marked on the plan using the symbol 'Buddhist monastery, temple or pagoda – not to scale', as the Soviet specification does not expressly name either religion (see Fig. 6.25). The use of church and mosque symbols elsewhere on the plan perhaps gives a misleading impression of a region in which Christians and Muslims account for less than 3% of the population (Census Organisation of India, 2011). In light of the state atheism policies of the Soviet Union, both Namangan and Topar have symbol counts of zero in the 'Places of worship' Second-Level feature class, along with (more surprisingly) Zaragoza. Boulogne-Sur-Mer records the highest number and proportion of symbols in the 'Industry and Communications' First-Level class (eight symbols, 8%), with a notable concentration around the port. Conversely, the plans of Freetown, Liaoyang, Sidon, Port-au-Prince and Gloucester only incorporate two symbols in this class, occupying 2–3% of their symbologies.

The remainder of the First-Level feature classes are characterised by very low levels of variation across the sample (standard deviation 1.70 or less). 'Settlements' consists of means of representing buildings which are, naturally, features universal to all cities. The main differentiation factor is between Soviet and non-Soviet cities. While plans of cities within the USSR do not include the triple-class

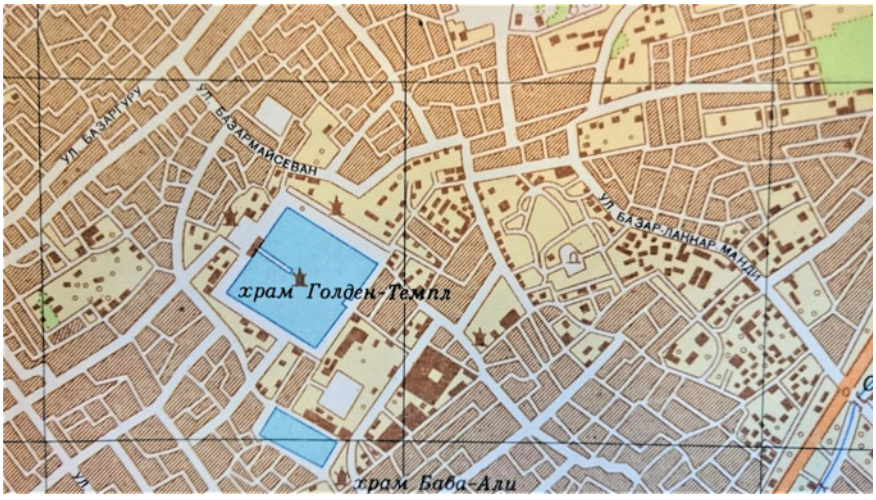

Fig. 6.25 Extract from the city plan of Amritsar, India (1979, 1:10,000) showing the (Sikh) golden temple marked using the symbol 'Buddhist monastery, temple or pagoda—not to scale' (©British Library Board, X.7241)

colour coding system for buildings (administration, military/communications and industrial) common to all other plans in this sample, the plans of Namangan and Topar are the only examples which distinguish non-fire-resistant from fire-resistant buildings. This is despite the dark brown polygon 'General fire-resistant building' functioning as the universally-used standard symbol for a non-classified building, even without its non-fire-resistant counterpart. 'Settlements' accounts for a 5–9% share of the city plan symbologies. Plans at the upper end of this range are typically those which incorporate planned construction, destroyed buildings and 'lightweight' constructions. Namangan stands out in the 'Agriculture and Animal Enclosures' First-Level class (seven symbols, 6%) from the next largest symbol count on the plan of Frankfurt am Main (four symbols, 3%); the result of a near-full complement of orchards, vineyards, greenhouses and industrial crops. Across the sample, a 'Paddock for cattle – not to scale' on the plan of Johannesburg is the only example of a symbol in the 'Animal enclosures' Second-Level feature class. 'Boundaries' and 'Geodetic Points' are by far the smallest First-Level classes. While various walls and fences appear on most plans, only three in this sample include any 'Political boundaries' (Freetown, Halifax/Dartmouth and Canberra), with none of these examples being state borders. The plan of Frankfurt am Main includes the greatest number of 'Geodetic Points' (six symbols, 5%) solely due to its placement of some points on churches and other buildings, which are listed as distinct symbols in the 1978 compilation manual for city plans.

6.2.4 Analysis of Symbology and Characteristics of Cities

Statistical analyses of the above-described characteristics of the symbology of the city plan sample and the characteristics of the cities selected for inclusion have yielded little strong evidence of unequivocal linkages. The strongest link identified is between the specification symbol counts of the city plan sample at 1:10,000 and the current HDI of the countries in which the cities are currently located, which produces a weak positive correlation of 0.341 (Fig. 6.26). Removing the two Soviet cities from this analysis, given the different production circumstances of these plans, produces a slightly stronger correlation of 0.394, although there are greater outliers than these cities. The corresponding figure for the 1:25,000 plans is 0.229. It is accepted that the extent to which this metric is representative of global trends in Soviet city plan symbology is questionable for several reasons. Firstly, HDI data are only available at the national level and therefore mask differences between cities within the same country. Secondly, the city plans included in this study span some 18 years between 1972 and 1990, yet the HDI data used are the most recent available (2016) as no metric exists for this period which is the equal of current HDI in terms of both global standardisation and breadth of measures of development included. This also introduces both the possibility that some cities are today located in a different country than that in which they were located at the time of the production of the corresponding city plan, and that changes in the level of development may have taken place in the

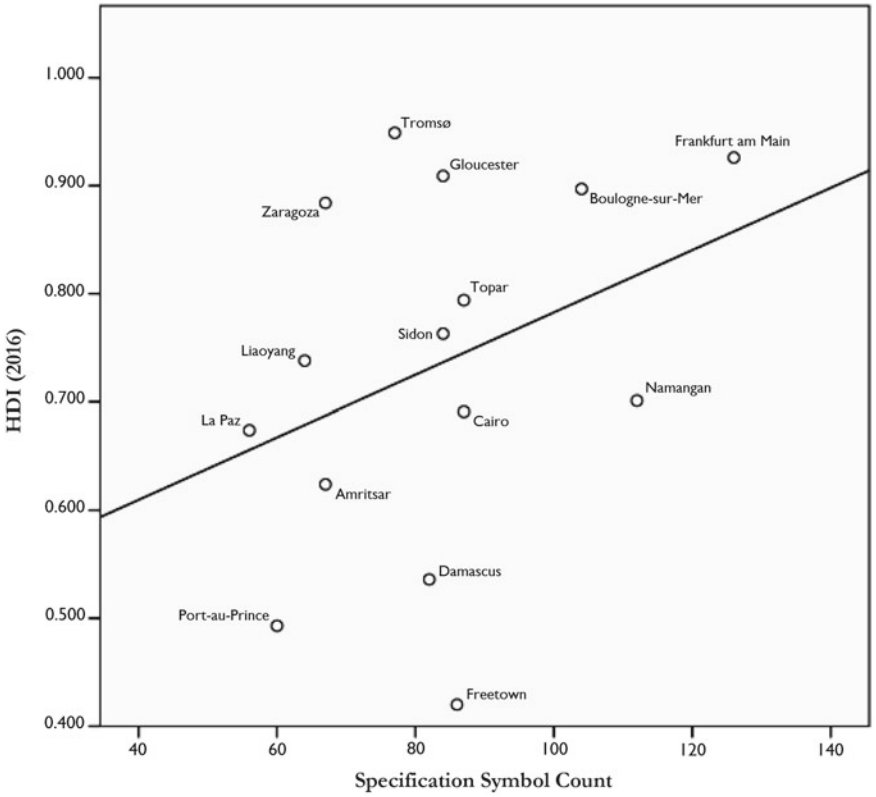

Fig. 6.26 Scatter plot showing the relationship between specification symbol counts of the 1:10,000 sample and HDI values from 2016

subsequent 26–44 years. However, given the presence of a weak correlation despite these limitations, a stronger correlation may be obtainable if these limitations were to be overcome, and if the sample was enlarged to incorporate a greater proportion of the city plan series.

The correlation between the specification symbol counts and population is weaker than that with HDI; with virtually no correlation at 1:10,000 (− 0.009) and a very weak negative correlation at 1:25,000 (− 0.260). However, issues with the age of the data also exist with this metric, exacerbated by the fact that there is no global, standardised source of population data at the city level. Secondly, vast differences between the definitions of city limits in different locations add further inconsistency, with some city population statistics including the wider region in which the city is located and others including little more than the city centre. These issues are currently insurmountable and thus more accurate correlation data are unlikely to be obtainable. In terms of climate, the major trend appears to be a higher mean symbol count for plans of cities within temperate climates (Fig. 6.27). Given the small sample

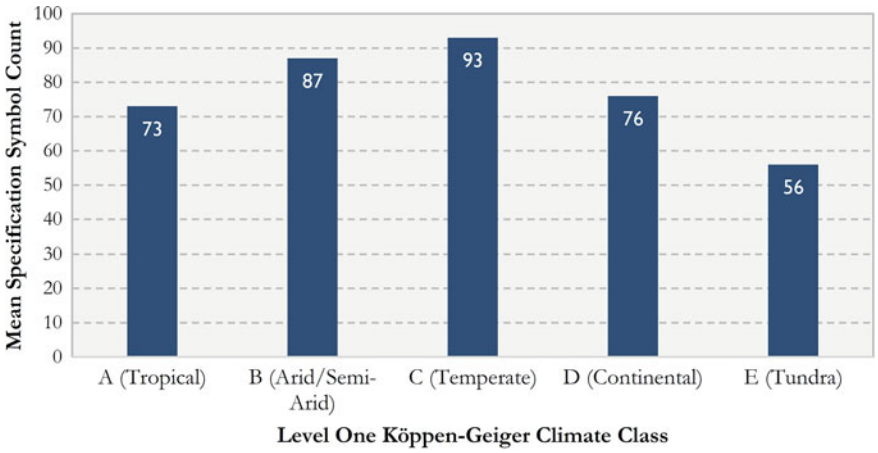

Fig. 6.27 Mean specification symbol counts on plans at 1:10,000 by level-one Köppen-Geiger climate class

size, this conclusion should be treated cautiously. There are also insufficient data to meaningfully analyse variations in Köppen-Geiger climate class at the second or third level, or at all at 1:25,000. Although class E (Tundra) scores lowest with a symbol count of 56, it should be noted that this derives solely from the plan of La Paz, which is the only city within this climatic region to be included in the entire city plan series.

6.3 Comparison of Soviet and *OpenStreetMap* Symbologies

An analysis of the OSM Standard Layer symbology reveals a lower total symbol count than the Soviet symbologies, albeit with a greater emphasis on human features and a far more limited symbology for natural environments. The symbol count for the OSM specification totals 281, whereas the Soviet city plan symbology totals 378 at 1:25,000 and 526 at 1:10,000, including symbols which may be used at either scale. When comparing these figures, it should be remembered that the OSM symbology referred to here is intended to be applied to maps between 1:500,000,000 and 1:1,000, whereas the Soviet specifications deal with each scale separately. In terms of First-Level feature classes, the two additional feature classes introduced in this part of the study are the largest in terms of total symbol count, with 'Retail and Restaurants' (64) the largest and 'Leisure, Tourism and Public Services' (54) the second largest (Fig. 6.28). These classes include features such as 'café', 'ice cream shop', 'library' and 'theatre', none of which appear in the Soviet specifications as graphical symbols. The largest OSM First-Level feature class which is also used by the Soviet city plans is 'Road Transport' (48), which is also a large feature class in the Soviet specifications, although not the largest. The OSM symbology includes

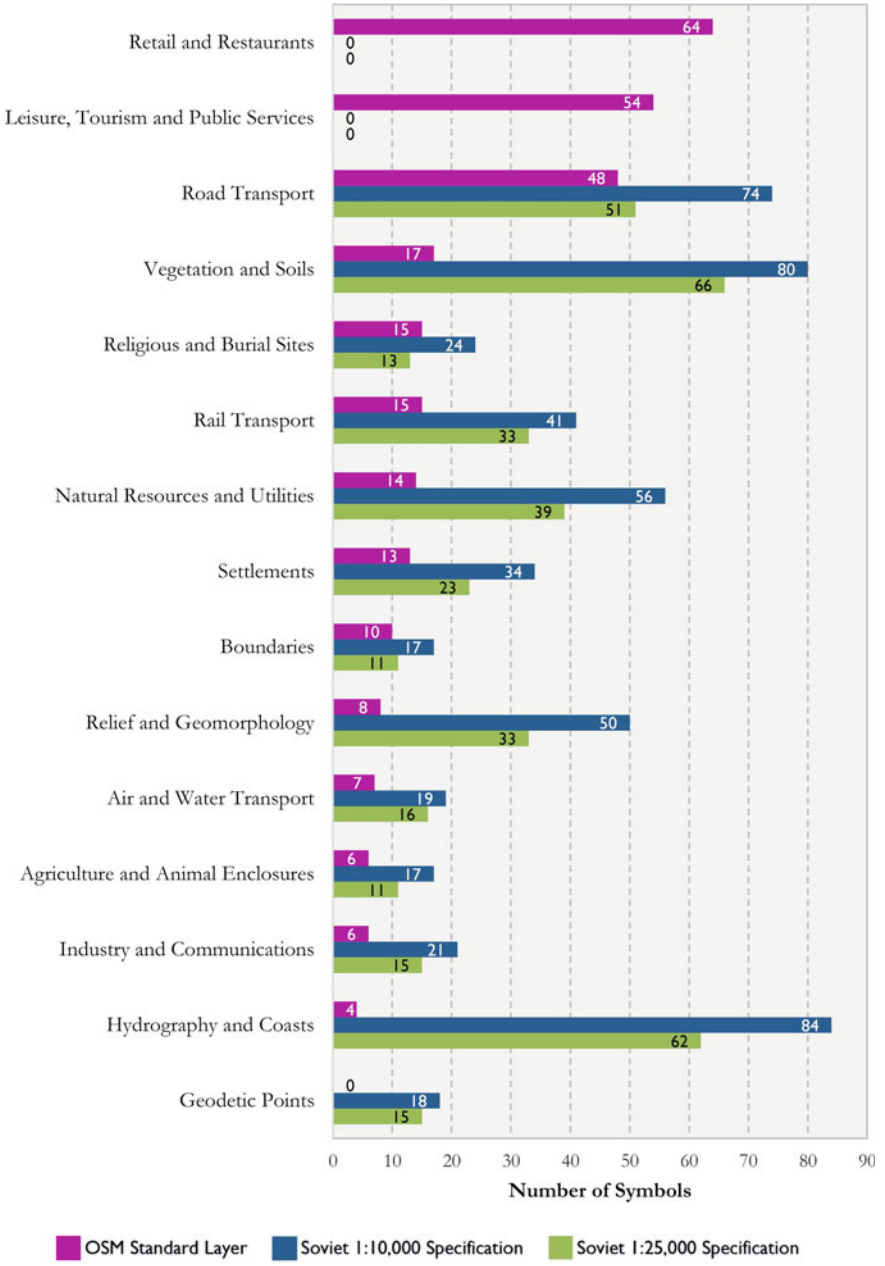

Fig. 6.28 Specification symbol counts for first-level feature classes (ordered by OSM rank)

symbols such as 'car park', 'bicycle parking' and 'taxi rank', which are absent from the Soviet symbology. This symbol count is similar to that from the Soviet 1:25,000 specification (51). These three feature classes comprise the majority (59%) of the OSM Standard Layer symbology.

The next largest feature class in the OSM symbology, 'Vegetation and Soils' (17), has a significantly smaller symbol count than 'Road Transport', despite this being one of the largest feature classes in the Soviet symbology. Furthermore, all of the other feature classes are significantly smaller in the OSM symbology than its Soviet equivalents. Among the most striking of these differences is 'Natural Resources and Utilities' (14), a symbol count which is a quarter of the size of the same feature class in the Soviet 1:10,000 symbology, 'Relief and Geomorphology' (8) and 'Hydrography and Coasts' (4). In addition, the OSM symbology includes no geodetic points.

6.3.1 Mapping Frankfurt am Main

Some major differences are evident between the OSM legend symbology and that which has been applied to Frankfurt am Main at 1:8,000, although the bias towards human features which characterised the specification also broadly manifests itself on the map. Despite being considerably smaller in the specifications, the OSM 'Road Transport' symbol count applied to Frankfurt am Main (35) is larger than the equivalent symbol count from the Soviet plan of the city (19), in addition to being the largest OSM feature class for the city. Although there is little difference in the number of road classes used, the inclusion of smaller features such as 'gate', 'ford' and 'bollard', as well as additional information such as 'one way arrow', contribute to this higher symbol count. Of the 54 'Leisure, Tourism and Public Services' symbols in the specification, 20 are included on the OSM of Frankfurt am Main, retaining its position as the second largest OSM feature class (Figs. 6.29, 6.30 and 6.31).

Although the 'Vegetation and Soils' feature class is much larger in the Soviet specifications than the OSM specification, the symbol counts applied to Frankfurt am Main are much more comparable, as the majority of Soviet vegetation symbols were unused on the 1983 plan of the city. Several of the OSM feature classes have higher symbol counts than the Soviet plan, namely 'Religious and Burial Sites' (10), 'Settlements' (8), 'Boundaries' (5), 'Agriculture and Animal Enclosures' (5) and 'Retail and Restaurants' (3). Although 'Retail and Restaurants' is the largest OSM feature class in the specification (64), the identification of only three of these symbols in this analysis indicates that use of the vast majority of this is confined to larger scales. However, as in the specifications, 'Relief and Geomorphology', 'Hydrography and Coasts', 'Industry and Communications' and 'Geodetic Points' are far more richly presented on the Soviet plan than OSM, despite the slightly smaller scale of the former.

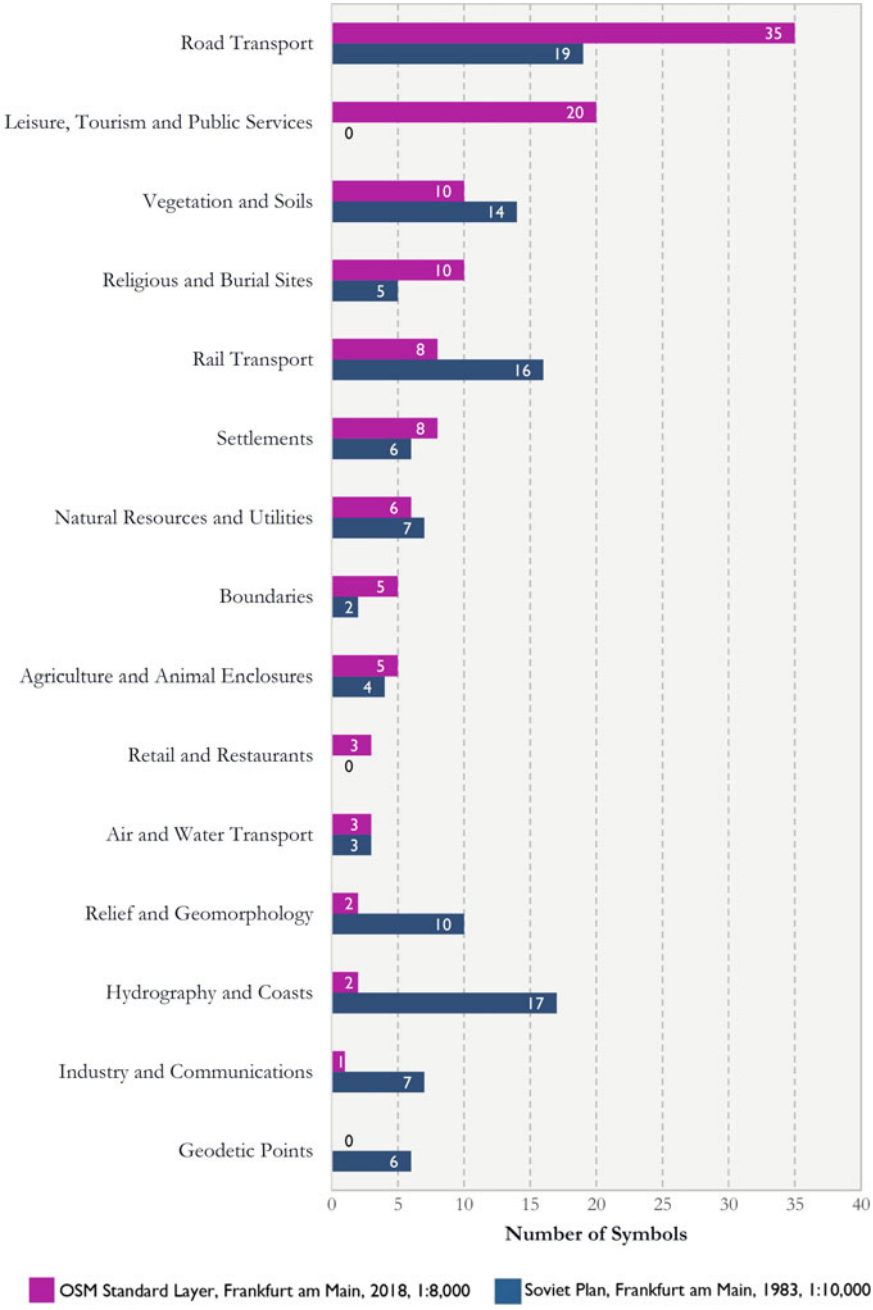

Fig. 6.29 Counts of specification symbols used at least once on the Soviet plan of Frankfurt am Main (1983, 1:10,000) and the equivalent area on OSM at 1:8,000 by first-level feature class (ordered by OSM rank)

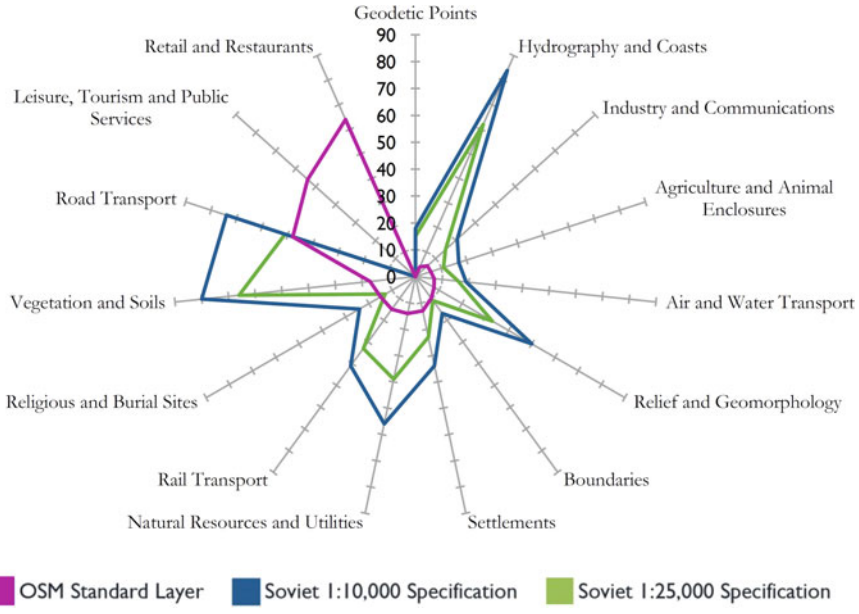

Fig. 6.30 Star plot indicating specification symbol counts for first-level feature classes

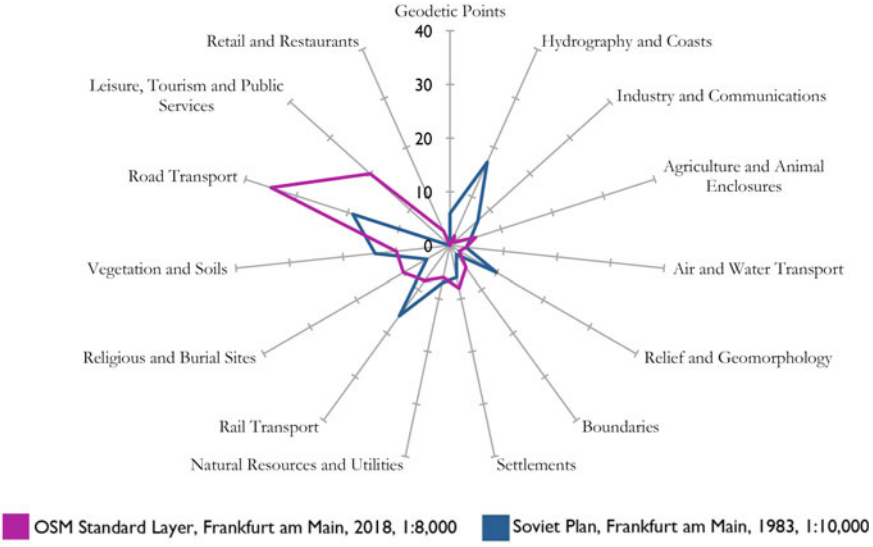

Fig. 6.31 Star plot indicating counts of specification symbols used at least once on the Soviet plan of Frankfurt am Main (1983, 1:10,000) and the equivalent area on OSM at 1:8,000 by first-level feature class

It is possible to summarise the major findings presented in this chapter as follows:

- The specifications dictating the symbology of Soviet city plans include 252 graphical symbols solely for use at 1:10,000, 104 solely for use at 1:25,000 and 274 for use at either scale; totalling 630 graphical symbols across the symbology as a whole.
- In the specifications, 'Hydrography and Coasts' is the largest First-Level feature class at 1:10,000 by symbol count (84) but 'Vegetation and Soils' is the largest at 1:25,000 (66).
- 'Hydrography and Coasts' is the largest First-Level feature class at both scales in the city plan sample although, relative to the specification symbology, a higher proportion of the 'Industry and Communications' symbology is used at 1:25,000 (equal at 1:10,000).
- Of the 630 graphical symbols available in the specifications, 302 (47.9%) are used at least once in the 19-plan sample analysed here, leaving 328 (52.1%) unused.
- Only five symbols (0.79%) are common to all 19 plans in the sample.
- Frankfurt am Main and La Paz exhibit the highest and lowest symbol counts respectively at 1:10,000; Halifax/Dartmouth and Miami likewise at 1:25,000.
- Symbols which only appear in the specification for maps at a particular scale are not confined to use only at that scale.
- Additional symbols are widely used across the sample, commonly to denote features which are more generic than those in the specifications. Completely new symbols are far less common than variants on those in the specifications.
- There is a weak positive correlation (0.341) between the total specification symbol count of the sample's 1:10,000 plans and the HDI value of the relevant modern country.
- The mean total specification symbology for plans at 1:10,000 is highest for cities in temperate climates (93).
- 'Retail and Restaurants' (64) and 'Leisure, Tourism and Public Services' (54) are the largest feature classes in the OSM symbology specification, despite neither of these feature classes appearing in the Soviet city plan symbology.
- On comparable maps of Frankfurt am Main, 'Road Transport' is the largest feature class for both OSM and the 1983 Soviet plan.
- In both the specifications and the maps of Frankfurt am Main, the OSM symbology incorporates many more symbols for human features, while the Soviet symbology is far larger with regard to natural features.

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