The urban layer analysis

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Since the discipline of urban design was founded, the characteristics of urban space have primarily been represented by means of visual abstraction and reduction. Builders and architects use morphological, typological, and topographical structures to describe spaces and buildings graphically. In response to industrial urban growth, drawings and print versions of expansion plans[1] arose in the middle of the 19th century on an unprecedented scale. As a result, spaces could be discussed before being implemented. The accompanying process of scientification and institutionalization of urban planning—based on the field of architecture—transformed urban design and planning experiences into principles and collections of best practices for a budding discipline: This gave rise to the pioneering works on urban design by Baumeister (1876), Sitte (1889), Stübben (1890). Graphic production methods were used to represent and imagine the city in individual layers. Builders draw their plans layer by layer, reducing buildings and urban spaces to depict them in various forms.

Not only was this practical knowledge passed down through graphic products, it also served to establish the method of graphically extracting simple objects in urban planning. This method has since evolved into a basic tool in urban design, without any methodological improvements to note: Urban structural elements with selected characteristics are isolated and compiled in a thematic map. For example, only tree-lined avenues, front yards, and parks are depicted on an urban landscape design in order to understand the street-level greenery. In urban design practice, experts refer to these geographically localized thematic maps as *urban layers* (see Fig. 1 and 2). Graphically reducing urban structural properties on a plan represents a method used to extract properties, correlative arrangements, and logics of space gradually from the barely manageable urban organism.

1 City expansion projects with published plan drawings were organized at virtually the same time in Copenhagen (Seidlin 1857), Barcelona (Cerdà 1859), Madrid (Castro 1860), Berlin (Hobrecht 1862), and Brussels (Besme 1866). A detailed description and plan drawings of the Berlin planning processes can be found in Dolff-Bonekämper et al. 2018.

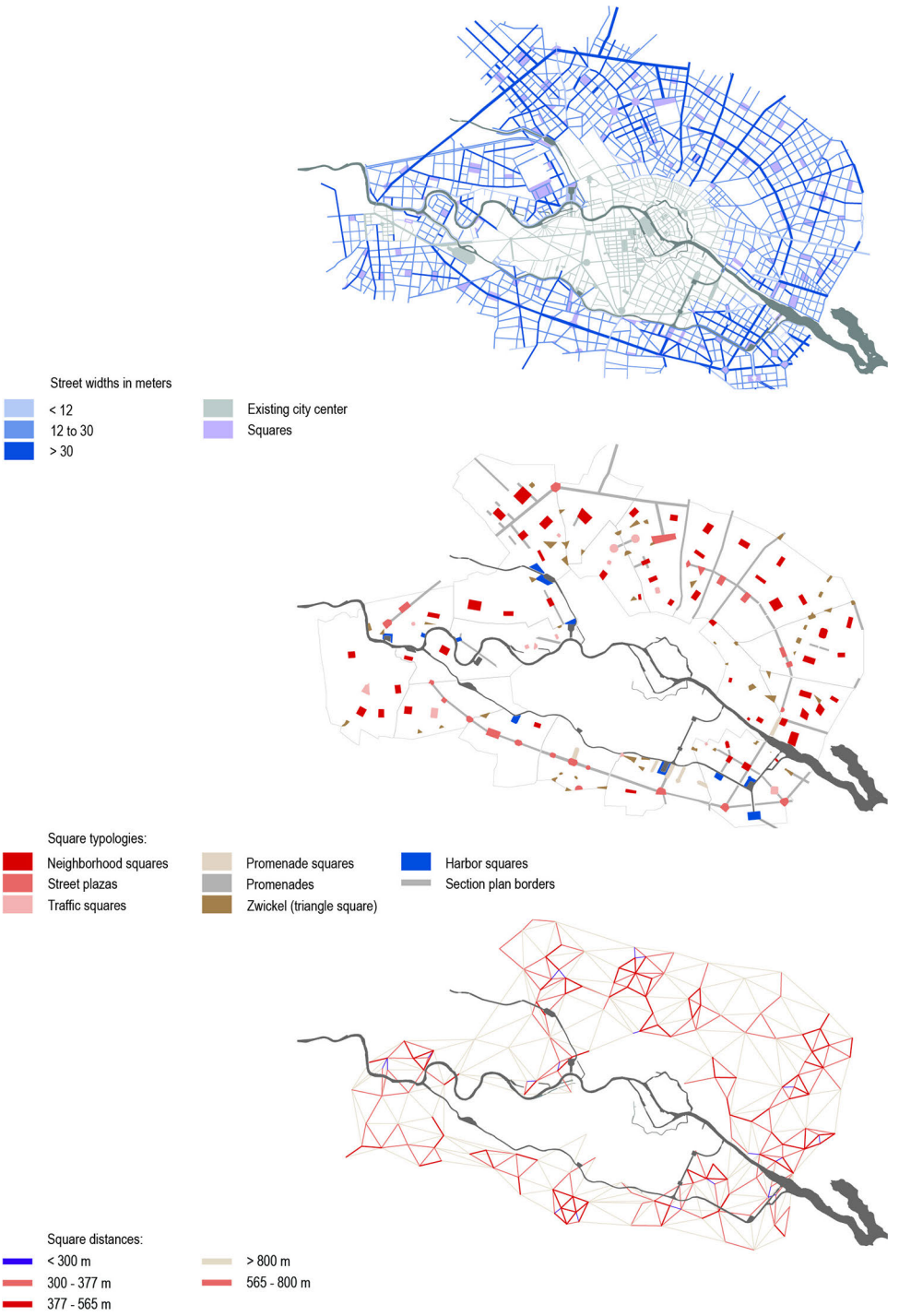

Fig. 1: Example of thematic maps featuring "urban layers": Squares on the 1862 Berlin expansion plan are reduced in relation to the street network, typology, and distances. | © Author's own diagram

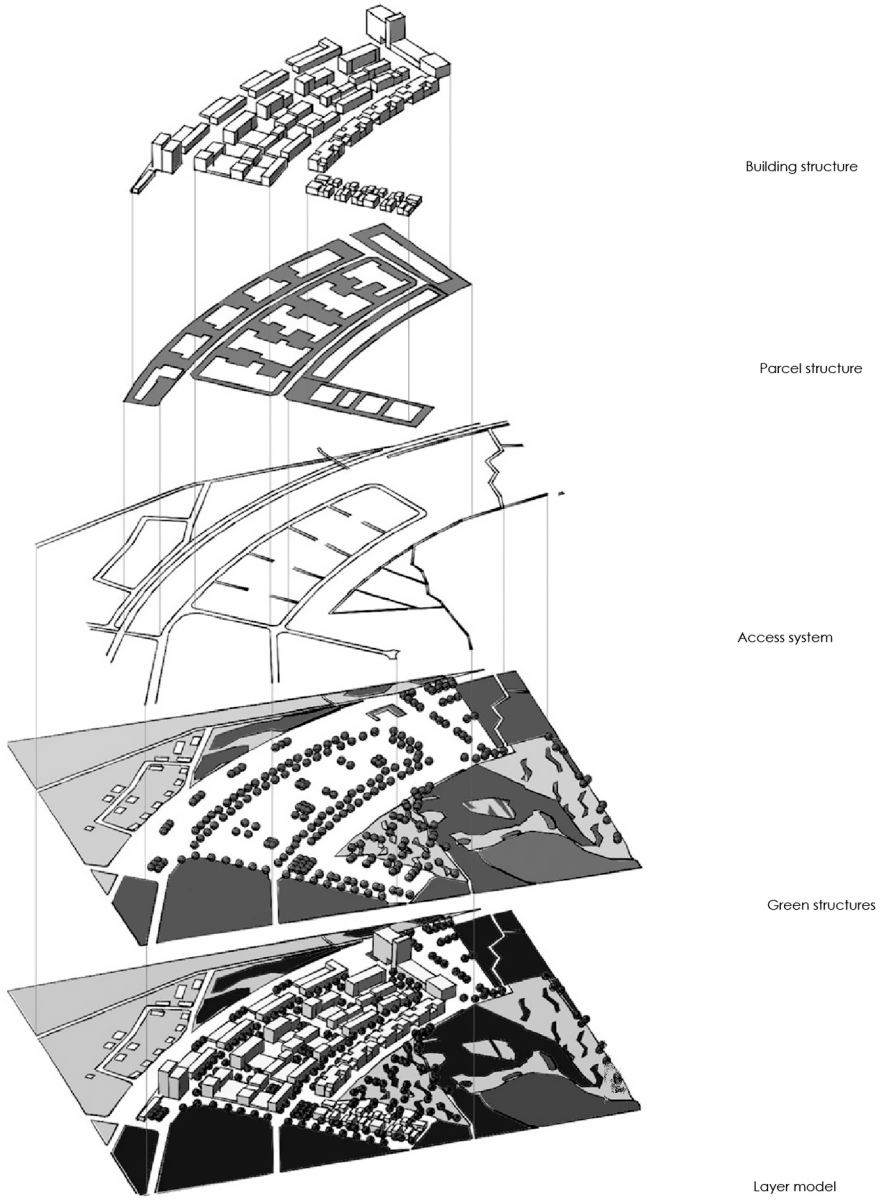

Fig. 2: The layer model developed by Reicher shows individual disjointed layers above the overlay as an exploded axonometric drawing (Reicher 2012: 131).

As an interdisciplinary field, urban design has always relied on this method in its endeavor to meet the high standards of using social, political, and structural parameters as a starting point for the architectonic and urban concept. Overlaying and combining isolated layers offers enormous potential for generating knowledge in the spatial sciences.

The layer analysis is used in basic research, while at the same time serving as a tool for proposing new design concepts—creating a blueprint of the city. Temporal layers and urban spaces are recorded analytically, and new design solutions can be tested in terms of their effectiveness and capacity to be integrated into a typological-morphological context. In order to produce this design and planning knowledge, urban designers break down spaces: Reduction makes it possible to read, interpret, and design the place (Greek *tópos*) and to elaborate on spatial typologies (Greek *týpos*) analytically. In order to facilitate the analysis, the "urban spatial structure is understood practically as a whole composed of layers" (Streich 2011: 351, own translation). Furthermore, knowledge about spatio-structural subareas and principles in the overall urban system offer links for qualitative spatial research. Places can be conceived based on their history, as well as their natural, material, and social qualities. Thanks to this reduction and abstraction work, new contexts are created for spatial interpretations, place-bound innovation, and interventions in the urban environment.

1 Urban theory background: A morphological and typological analysis in urban design

Morphological and typological analyses have served as a basis for knowledge acquisition in the theory of urban design since its advent. They are also closely related to disciplinary and social discourses on the urban and on how physical space should be conceived and transformed. Literary topoi and landscape topographies were paramount in the discourse on architecture even before the studies by Leon Battista Alberti (*De Re Aedificatoria/On the Art of Building*, 1485) and Frank Lloyd Wright (*Fallingwater* house, 1939). Topography is an integral element, while buildings are considered moments or parts of a whole. Numerous theoretical models and structures document how topography and architecture are negotiated in both written and drawn relationships (Song/Cinn 2015). The cartographic analysis of geographic localities does not merely abstract landscape based on contour lines, but rather the topos is in fact the abstraction of physical spatial models.

Hence, the literal meaning of the term morphology can be traced back to the ancient Greek words *morphé* (shape, form) and *lógos* (prose, reason, principle). The term *typos* (mark, impression, type) refers to the examination and theory of the types and classification systems (Lang 2005: 43) used in the architecture handbooks of the 19th century by Jean-Nicolas-Louis Durand and Gottfried Semper. The relationships between urban morphology and building typology are a key subject in attempts at defining terms in architectural theory: At the end of the conference presentation *Typology, Handbooks, and Architecture* from 1965, Aldo Rossi (*L'architettura della città/The Architecture of the City*, 1966) explains the difference between both concepts by referring to the definition by architectural theorist Quatremère de Quincy in the *Dictionnaire historique d'architecture* (1825):

> "The word 'type' presents less the image of a thing to copy or imitate completely than the idea of an element which ought itself to serve as a rule for the model. […] the type [is] an object after which each [artist] can conceive works of art that may have no resemblance. All is precise and given in the model; all is more or less vague in the type." (Rossi 1978: 39, own translation)

Basic principles and key ideas are preserved despite changes. In reference to the definition by Guido Canella:

> "Typology should be conceived as […] a system that explores the invariants of morphology, whereby morphology ought to be understood as a series of events expressed in a historical fact and typology as the categorical aspect resulting from the particular sequence (of events)." (ibid., own translation)

Architectonic perspectives of these terms in particular tend to accept that universal cohesive forces determine whether spatial and material types are generated *a priori*: that is to say, the typological form strongly characterizes space without further verification.

This interpretation of the built environment was established internationally as a typological-morphological approach (Sharr 2007; Lee 2010) calling for more appreciation of and more focus on the traditional gestalts of the historical city (Rossi 1973 [orig. 1966]; Krier 1975). Contrary to the functionalist strategy adopted in post-war planning, architects and urban planners from the second half of the 20th century turned to the wealth of historical urban forms, thus rediscovering the formal analysis of building types and urban figures (Fig. 3) as inspiration for their designs. A comprehensive analysis of urban form as a collection of different yet equal morphologies and types—independently of the historical and modern city—can be found in the trailblazing work *Collage City* (Rowe/Koetter 1984 [orig. 1978]).

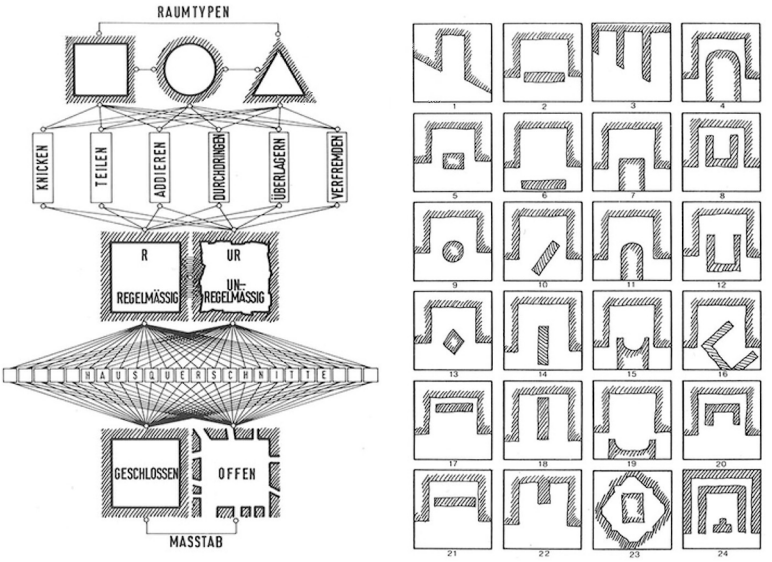

Fig. 3: Morphological categorization of urban space types according to Krier: Overview (left) and collection of example public squares with arranged buildings (right) (Krier 1975: 15, 23).

Morphological collections and typological analyses are not only key tools in architectonic design but also influence the spatial sciences around the world. As a scientific method, morphological analysis consists of exploring the form of objects, while typology is a flexible approach to grouping together common characteristics. This analytical approach compiles the characteristics of, for example, streets, squares, buildings, and monuments that share the same structural features in order to reveal and interpret the history of planning and urban development and the collective memory—and thus the formal intrinsic logic of a city.

The Rome Plan by Italian architect and cartographer Giovanni Battista Nolli (*Nuova Pianta di Roma/Large Plan of Rome*, 1748) is one of the most-cited abstraction drawings in the history of architecture (Führ 2018) and illustrates the basic concepts of abstraction in the urban layer analysis (see Fig. 4). This graphical section of the complete work for the *Topography of Rome* (ital. *La Nuova Topografia di Roma*) is the origin of the term *Nolli Plan*, which is used universally for all figure-ground drawings of cities. The plan depicts the city of Rome in the 18th century in an unconventional manner: It shows not only the outer appearance of the city morphology—the outer edges of the built structures—but also another layer containing the public places within buildings. Church interiors, as well as palace halls, courtyards, and gardens, are classified as public spaces together with streets and squares. This reflected the pope's desire to influence all spaces of the city.

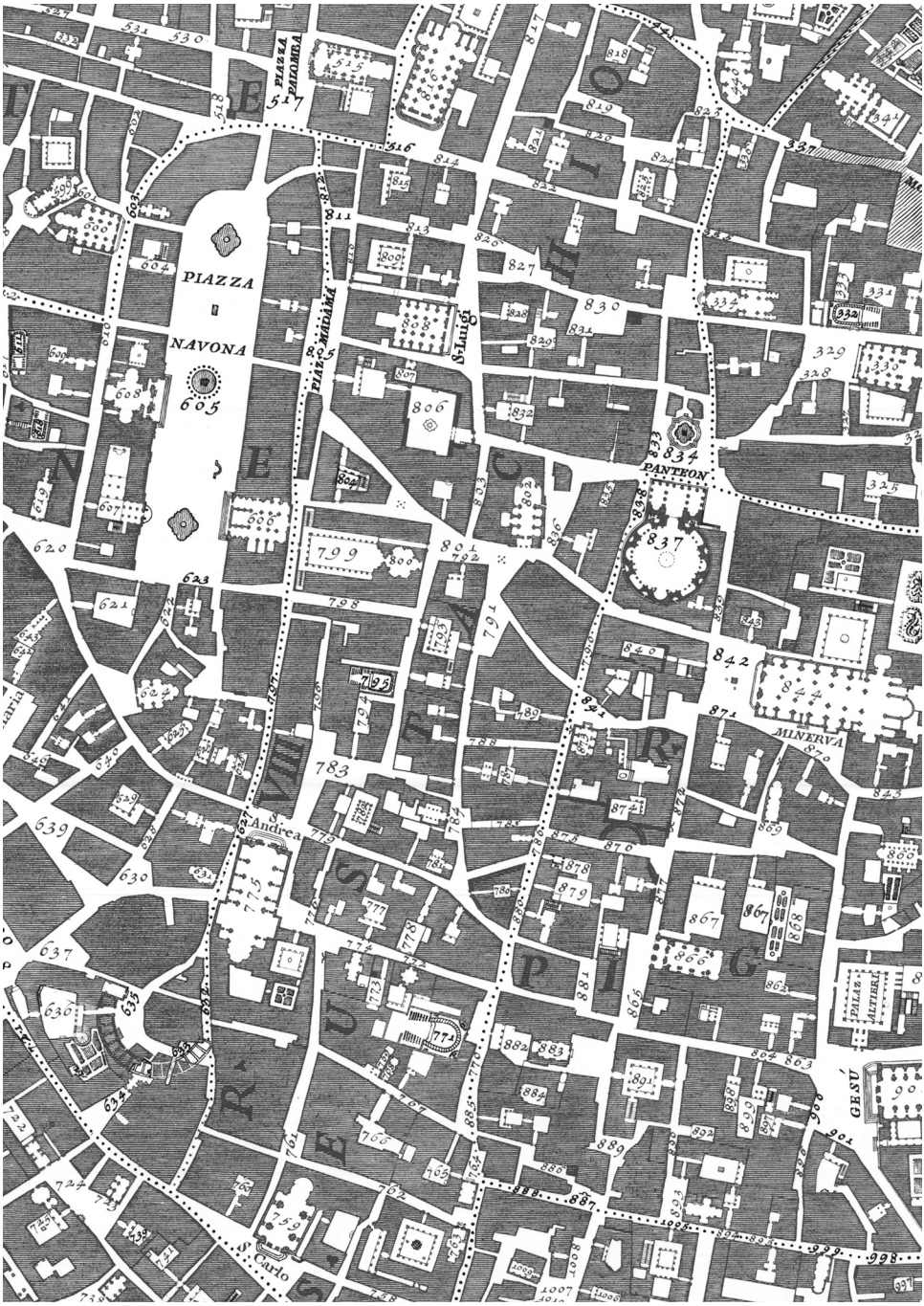

Fig. 4: Section of Nuova Pianta di Roma (1748) by Giovanni Battista Nolli between Piazza Navona and the Pantheon. | ©Photographic Collection of Bibliotheca Hertziana

By representing all ground floor plans of all public buildings, the figure-ground diagram is more complex. As such, the Nolli Plan expanded the concept of urban morphology to include a simple analysis of spatial volume elements by identifying spaces of social interaction.

2 From the birth of the discipline to a tool for planning practice

The first urban design textbooks were published in response to the mass urban expansions of the 19th century in order to categorize and illustrate model urban spaces and design principles (Lampugnani et al. 2017). These works were based on the practical knowledge gleaned from different expansion plans and knowledge about spatial structures (Kegler 1990: 65; Lampugnani et al. 2017: 7). Initially concentrating on the two- and three-dimensional shape of the city, modern morphology takes into account the forms of constantly changing networks, blocks, and buildings in the city, in addition to incorporating other factors that characterize space, such as transport infrastructure, industrial infrastructure, vegetation, and open spaces (Benevolo 1980). In the modern theory of urban design, the built city is perceived as an object and construct with social, economic, ecological, and structural-spatial dimensions, where urban design is considered a subdiscipline of urban and spatial planning (Frick 2011: 13, 193; Düwel/Gutschow 2005: 35–41). Kegler also classifies urban design as part of the discipline of urban planning, referring to "fluid borders" (Kegler 1990: 66, own translation) within the disciplines; notwithstanding, the discipline of urban design primarily arose from the fields of architecture and civil engineering (Albers 1975: 10; Frick 2011: 21; Herold 2018).

An understanding of the internal structural conditions of the physical form is essential for understanding urban development processes and, beyond that, for the successful "manipulation" and design of the urban. In short, the layer method is used as a tool in basic research: an "approach to conceptualizing the complexity of physical form" (Larkham 2005: 22). To this day, this theory purports that urban forms can be characterized by specific, discernible architectural elements and their relationships on different scales (Humpert 1997; Moudon 1997; Dempsey et al. 2010; Kropf 2005, 2011; Eberle/Tröger 2014). This working hypothesis of the urban analysis still defines a significant portion of design practice today (Çalişkan/Marshall 2011; Mohamed et al. 2017; Stojanovski/Axelsson 2018).

In German-speaking countries, the layer method, as an analysis and design tool, is based on the morphological and urban-structural theories of architects Gerhard Curdes (1995, 1997) and Klaus Humpert (1997; Humpert et al. 2002), as well as their academic spheres of activity (especially Christa Reicher and Heinz Nagler).[2] A distinction should be made between the "basic elements of urban structure" according to Curdes and Humpert—such as block, courtyard, and solitary—and the "components of the city" (Reicher 2012). As a student of Curdes, Reicher added several thematic areas to the

2 Heinz Nagler was assistant to Prof. Humpert at the Institute of Urban Planning and Design of the University of Stuttgart from 1983 to 1988. Christa Reicher worked as a research associate at the Chair of Urban Design for Prof. Curdes at RWTH Aachen University.

urban layer model, sorted according to their function in the city: open space, public space, residential, commercial and industrial, social and school infrastructure, trade and care (ibid.: 92–157). Another version of the spatio-structural layer model according to the teachings of Heinz Nagler—a student of Humpert—defines the "layers of the city" as follows: natural surroundings, history, development, parceling, building structure, building typology, open space typology, public space, ecology and environment, and the invisible city. The urban layer model (see Fig. 2) is characterized primarily by the urban and structural layers of building structure, parcel structure, green structure, and access system collectively.

This structural thinking based on basic geometric shapes (line, area, and point)[3] influences the discipline of urban design and the planning sciences to this day: In complex cityscape-forming processes, it is necessary to study relevant linear, planar, and concentric structural models of the city on the one hand (Curdes 1995: 49–57; Streich 2011: 266; Reicher 2012: 42–47). On the other hand, the point elements (building, center), linear elements (traffic routes, networks), and area elements (parcels, area units) form the compositional basis for generating urban units that are organized according to the basic principles and logics of design. Therefore, in analysis and design practice, the complexity of urban form is understood as the development of physical elements according to regulatory systems of different temporal layers (Conzen 2004; Gauthiez 2004; Raith 2000; Koolhaas/Mau 1997; Krier 1979, 2006). Especially in practice, this structural approach in the urban layer technique is combined with analytical or design-related objectives to carry out place-bound and task-specific studies.

3 Performing an urban layer analysis

The abstraction of urban complexity is the main principle of this integrative method: In order to examine certain arguments, relevant elements of the city's spatial appearance are highlighted. The theoretical foundation of this decompositional approach (Hettich 1969: 455–457) to urban structures rests on the ethnomethodological practice of *visual research* with qualitative and quantitative analysis techniques (Emmison/Smith 2000; Rose 2007). On the one hand, breaking down and decoding space can serve to describe, explore, and evaluate specific compositional correlations. On the other hand, adding and removing layers can help to visualize relationships between spatial elements or time periods. These combinations are preferably always depicted on a one-layer analysis plan as the basis. This results in thematic maps and map sections that reduce the diverse range of information on the maps to the key aspects. In addition to empirical indices and qualitative descriptions, this also makes planning processes replicable.

The identification and selection of different layers refers to a specific design task or research question: This means the analysis can serve both as a basis for the urban design

3 The basic forms according to Humpert are derived from three fundamental anthropological principles of human settlement patterns: move (line), occupy (area), and erect (body). The approach is based not only on their own research but also on the contributions and insights of architects Gerd Albers (1919–2015) and Oswald Matthias Ungers (1926–2007).

process and as a basic research tool. Isolated layers first appear in the analytical approximation, abstraction, and then drawing (physical and/or virtual). The draftsperson does not simply select the objects of investigation by means of a place-bound and topic-based definition of the task, but instead incorporates their biographical learning experiences as well (see Bentlin/Klepp in this handbook). The object of analysis, the interpretation, and the biographical expertise are directly related to one another. Therefore, the method used should not be regarded as a predefined sequence of analytical layers but rather as partially parallel and interlocking strands that influence each other iteratively.

3.1 Defining a topic of interest and study area

In order to reduce the amount of information, the method starts by defining the center of interest. The analytical focus on one topic reduces the complex pool of data by removing and simplifying objects of investigation. For example, the analysis of a city district is reduced to green areas, bodies of water, and impervious surfaces to make assertions regarding the microclimate. Selecting a geologically defined study area increases the focus still further. Differentiating between a key study area and an extended study area allows for a comprehensive place-based analysis.

3.2 Creating the pool of data and selecting elements of investigation

Based on the definition of the task and area, urban layers are selected for the mapping: The structural plans for the building development, parcels, and access are the basic elements for the analysis and can be expanded to include spatial, functional, sociological, ecological, and any other conceivable layers (see Fig. 2). The maps to be created consist of geographically localized information and select structural elements in accordance with the topics. For example, the street vegetation is reduced to only trees and front yards, which are depicted in a simplified manner in terms of their size and type. As a result, certain spatial qualities are correlated and evaluated. Depending on the topic, the scaled approach should be revised. Furthermore, the elements of investigation should be compared with the possibilities for querying and collecting data.

3.3 Drawing and presenting layers

Based on the underlying cartographic data, the entire pool of data is examined and broken down into one layer graphically. The graphical analysis by hand or with GIS/CAD tools should be understood as a means of synthesis that can investigate physical-material and other spaces for itself and in its reciprocal relationships. These analytical and synthesizing drawings, as well as their combinations, are also frequently referred to as *mapping* and include different forms of presentation, such as sketches, diagrams, building plans, city maps, or mental maps (also see Million in this handbook). For all layers to be correlated, a uniform section and scale is useful.

3.4 Evaluating individual layers and layer combinations

As soon as the drawings have been created, the graphical preparation and formulation of the acquired knowledge begins. To compare the layers, graphic codes, symbols, and the layout are harmonized. Analytical findings are highlighted so that they can be compared by the human eye. Depending on the planning task at hand, the layers can be evaluated with regard to their potential and defects, meaning every layer is classified according to the urban design expertise of the creator (Fig. 5). These findings can be transferred layer by layer into a spatial SWOT analysis. Doing so makes it possible not only to interpret information and characteristics but also to create or reconstruct abstract planning concepts and processes.

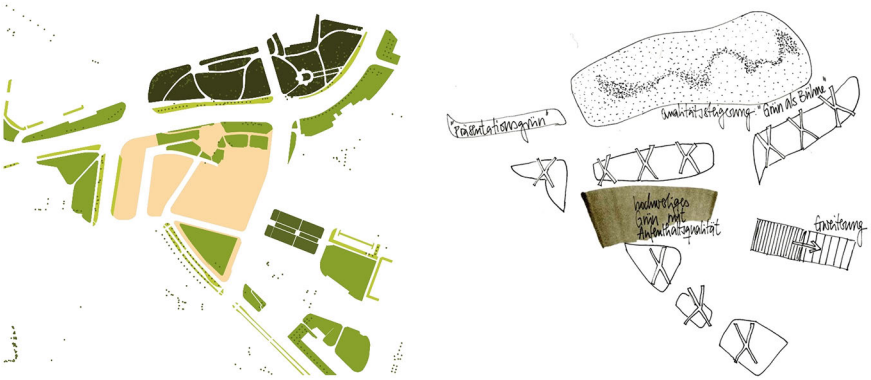

Fig. 5: Graphic knowledge acquisition: Green structures with color-coded quality indicators as digital drawing (left) and inferences for the urban design as a hand-drawn sketch (right). | ©Author's own diagram in cooperation with Svende Albrecht

Georeferencing makes the method more flexible and allows it to be integrated into other analyses. The transferability and comparability of the data beyond the chosen analysis offer a great deal of potential. It is also possible to continue combining layers at will. By comparing them with other studies and documents, the findings can also be contextualized and verified. As a result, it is possible to justify the statements regarding the characteristics of the city; this in turn illustrates the influence and significance of planning steps. Knowledge of built structures and spaces serves as a repertoire in the design process.

4 Basics principles of the analysis

4.1 Creating and selecting the underlying data for the layer model

Visual figures and technical data are used to select a study area and to create an appropriate digital or analog pool of data. However, these are two-dimensional depictions of the city without any portrayal of three-dimensionality, which is indicated by means of coding and modeling. The visual-geographic depiction of the city can be analyzed based on the following representations:

- Orthophotos: Undistorted and true-to-scale illustrations of the earth's surface are created by means of photogrammetry from aerial or satellite photos.
- Plan drawings: The Authoritative Real Estate Cadastre Information System (ALKIS) has been providing georeferenced and precisely measured plans with nationally standardized plots and buildings for all of Germany since 2015.

In general, analog and digital sources are available:

- Public city planning, land surveying, and land registry offices
- Museums, libraries, and archives
- NGOs, websites, and open-source databases
- Companies
- Own production by means of site visits, surveying, and mapping (also see Tabačková in this handbook)

The underlying data serve as a basis for investigating geographic sections, different time segments, and spatial scales. In order to compare the analysis maps better and help observers navigate easily, the extracted layers can be correlated with, for example, landscape elements such as bodies of water, the existing urban structure, or special buildings.

With the help of a geographic information system (GIS)—depending on the software—it is possible to create a digital cartographic basis with a virtual system of layers: In *computer-aided design* processes (short: CAD), *layers* are a common concept used for the process of hierarchizing and structuring data within the drawing files. Because it is easy to show and hide the individual layers, the graphical representation can be customized to suit the purpose of the drawing. The finished data collage makes it possible to access sectoral planning knowledge. This methodology is also used when processing geographic information systems in applied and scientific cartography (Hake et al. 2002: 31, 216).

In the subsequent analysis, the spatial structures to be investigated, as well as their arrangement on different scales, are selected. The selection is based on the design and research objectives, the data sources, and the expertise of the users. In order to study the building structure of a city district, for example, visual axes, construction heights, and building typologies are selected as structural elements in the comparison with the underlying data for a layer plan, then rendered graphically and outlined. The structural decomposition, graphical exploration, and thematic combination underscore striking individ-

ual motifs and recurring motifs in the building structure layer. Within this interplay, it is possible to depict urban design and planning principles layer by layer.

4.2 Graphical analysis of the layers

In order to carry out the graphical analysis, hand-drawn or computer-assisted plan drawings can be created (based on GIS/CAD). Using transparent sketch paper, the draftsperson can collate information from different base maps; or the draftsperson can create a virtual layer database. With the help of GIS and CAD analysis tools, it is possible to calculate, assess, and categorize attributes of the digitized elements according to complex parameters and key figures, such as surface area.

This is where drawing abilities and technological possibilities converge. While handmade plan drawings are characterized by a variety of urban design overtones, graphical inconsistencies, and scale tolerances, the computer-assisted analysis is based on object-specific definitions accurate to the millimeter. This discrepancy represents a methodological challenge. The study includes interpretive decisions and corrections to the drawings, even in the digitization stages.

Both the graphical analysis of the maps by hand and the digitization process are considered iterative processes. In essence, a shift takes place between data and knowledge acquisition using maps and drawings, which resembles the methodological method used in grounded theory (Strauss/Corbin 1996). As with the *concept maps* in grounded theory, maps and drawings in particular—and not just the potentially formulated text—are part of the layer analysis method and are used to illustrate the acquired knowledge. Consequently, the iterative process is described as "thinking with the pen." The sketches created in the process should therefore also be considered a result of the analysis, like the revised presentation drawing.

5 Basic definition of the urban layer model

The categorization into layers forces users to reduce complex forms to their key characteristics. This abstraction of the complexity of the city has also been the subject of criticism (Albers 2000: 27; Kropf 2005). While the generic arrangement of infrastructure networks, blocks, and buildings remains relatively consistent across different planning approaches, structural layers are always the result of social and cultural processes. In this case, a more detailed analysis can demonstrate the diverse range of spatial products within different social environments. Scaling and defining the degree of abstraction are therefore part of the individual analysis process. The flexible and additive approach of the layer analysis offers possibilities for both adjustments and corrections: for example, by adding (socio-spatial) layers or adjusting the section.

Until now, the layer technique in urban design has been based on a structural model without any concrete methodological procedure. The basis for identifying and designing place-bound regularities requires a methodological definition in order to ensure interdisciplinary integration between urban design and qualitative spatial research. In order for the principles of order and design to serve as a starting point and link in urban lay-

ers, I as an urban designer and academic have defined five study areas as the basis for the urban layer analysis within the direct sphere of activity of the Aachen School (Curdes, Reicher) and Stuttgart School (Humpert, Nagler):

- **Building structure**: Built (*solid*) is differentiated from unbuilt (*void*) as a figure-ground diagram in this layer. Spatial configurations in urban design can be identified based on the shape and arrangement of structures. Units, ensembles, and spatio-structural connections indicate characteristics of neighborhoods and city districts: for example, the building history or building typology.
- **Parceling**: Parcels regulate ownership and represent the smallest unit of the urban order and regulatory structure. This layer shows a network of property boundaries. Dimensioning, type, and scale of use refer to the flexibility for public and private builders and show the growth processes and ownership structure of the city.
- **Access**: The access network shows transport areas for all forms of mobility. Link roads and intersections can be identified based on dimensioning, hierarchies, and connectivity. Technological, cultural, and social function descriptions are closely connected to public space.
- **Open space and green structure**: The open space shows the unbuilt areas in the city with public and private use claims. Aspects of the urban ecology and environment are described as a cross between urban functional areas on the one hand and natural and landscaped areas of vegetation on the other. Open space plays a special role as the "stage for the city."
- **Landscaping and settlement structure**: The natural elements of the landscape, such as bodies of water and relief, as well as anthropogenic changes, such as canals and cultural landscapes, reflect the connection between urban development and site specifications.

The method is especially relevant for planning and design practice as users can carry out a spatio-structural inventory survey and generate inspiration for new urban spaces at the same time. The spatio-structural results serve as the basis for the *further design* and *further exploration* of the city. The act of anatomizing in particular provides insight into "designing a new picture, a concise statement initially consisting of one layer" (Reicher 2012: 174, own translation). By breaking down the general context, the method opens up sectoral insights into a previously obscure whole. The complexity and above all the interconnectedness and interdependence of different sub-aspects of the city (e.g., function, form, use) can be made manageable by simplifying them and structuring them thematically. As a tool in planning practice intended to make it easier to understand places and spaces, it establishes a basis for planning interventions and advancements in the spatial sciences, striking a balance between practical application and basic research: capturing, interpreting, and rethinking the place with its history and its natural, material, and social qualities.

References

Albers, Gerd (1975): *Entwicklungslinien im Städtebau. Ideen, Thesen, Aussagen – 1875–1945: Texte und Interpretationen*. Düsseldorf: Bertelsmann.

— (2000): Zur Rolle der Theorie in der Stadtplanung. In: *Deutsche Akademie für Städtebau und Landesplanung (DASL)* (Ed.): Wer plant die Stadt? Wer baut die Stadt? Bericht zur DASL-Jahrestagung in München 2000. Berlin: Edition Stadtbaukunst.

Baumeister, Reinhard (1876): *Stadterweiterungen in technischer, baupolizeilicher und wirthschaftlicher Beziehung*. Berlin: Verlag von Ernst & Korn.

Benevolo, Leonardo (1980): *Die Geschichte der Stadt*. Frankfurt a. M.: Campus.

Çalişkan, Olgu/Marshall, Stephen (2011): Urban Morphology and Design: Introduction. In: *Built Environment*, 37(4), pp. 381–392.

Conzen, M. (2004): *Thinking about Urban Form: Papers on Urban Morphology*, 1932–1998. Bern: Peter Lang.

Curdes, Gerhard (1995): *Stadtstrukturelles Entwerfen*. Stuttgart/Berlin/Cologne: Kohlhammer.

— (1997): *Stadtstruktur und Stadtgestaltung*. Stuttgart/Berlin/Cologne: Kohlhammer.

Dempsey, Nicola/Brown, Caroline/Raman, Shibu/Porta, Sergio/Jenks, Mike/Jones, Colin/Bramley, Glen (2010): Elements of Urban Form. In: Jenks, Mike/Jones, Colin (Eds.): *Dimensions of the Sustainable City*. Dordrecht/Heidelberg/London/New York, NY: Springer, pp. 21–51.

Dolff-Bonekämper, Gabi/Million, Angela/Pahl-Weber, Elke (Eds.) (2018): *Das Hobrechtsche Berlin. Wachstum, Wandel und Wert der Berliner Stadterweiterung*. Berlin: DOM publishers.

Düwel, Jörn/Gutschow, Niels (2005): *Städtebau in Deutschland im 20. Jahrhundert. Ideen – Projekte – Akteure*. Berlin/Stuttgart: Borntraeger.

Eberle, Dietmar/Tröger, Eberhard (2014): *Dichte Atmosphäre: Über die bauliche Dichte und ihre Bedingungen in der mitteleuropäischen Stadt*. Basel: Birkhäuser.

Emmison, Michael/Smith, Philip (2000): *Researching the Visual. Images, Objects, Contexts and Interactions in Social and Cultural Inquiry*. London: SAGE.

Frick, Dieter (2011): *Theorie des Städtebaus. Zur baulich-räumlichen Organisation von Stadt*. Tübingen: Wasmuth & Zohlen.

Führ, Eduard (2018): Schwarz – Weiß – Denken. In: *Wolkenkuckucksheim, Internationale Zeitschrift zur Theorie der Architektur*, 23(37), pp. 115–146.

Gauthiez, Bernard (2004): The History of Urban Morphology. In: *Urban Morphology*, 8(2), pp. 71–89.

Hake, Günter/Grünreich, Dietmar/Meng, Liqui (2002): *Kartographie. Visualisierung raum-zeitlicher Informationen*. Berlin: De Gruyter.

Herold, Stephanie (2018): Disziplinäre und ideengeschichtliche Hintergründe. In: Dolff-Bonekämper, Gabi/Million, Angela/Pahl-Weber, Elke (Eds.): *Das Hobrechtsche Berlin. Wachstum, Wandel und Wert der Berliner Stadterweiterung*. Berlin: DOM publishers, pp. 106–123.

Hettich, Urs (1969): *Dekomposition als Weg zur Lösung komplexer Probleme*. In: *Schweizerische Bauzeitung*, 87(23), pp. 455–457.

Humpert, Klaus (1997): *Einführung in den Städtebau*. Stuttgart/Berlin/Cologne: Kohlhammer.

Humpert, Klaus/Brenner, Klaus/Becker, Sibylle (2002): *Fundamental Principles of Urban Growth*. Wuppertal: Müller + Busmann.

Kegler, Harald (1990): Stadtplanung – Zur Genese einer wissenschaftlichen Disziplin. In: *Geschichte der Naturwissenschaften, Technik und Medizin*, 27, pp. 65–73.

Koolhaas, Rem/Mau, Bruce (1997): *S, M, L, XL. New York*. NY: Monacelli Press.

Krier, Rob (1975): *Stadtraum in Theorie und Praxis: an Beispielen der Innenstadt Stuttgarts*. 4th unchanged Edn. Stuttgart: Krämer.

— (1979): *Urban Space*. London: Academy Editions.

— (2006): *Town Spaces. Contemporary Interpretations in Traditional Urbanism*. Basel: Birkhäuser.

Kropf, Karl (2005): The Handling Characteristics of Urban Form. In: *Urban Design*, No. 93, pp. 17–18.

— (2011): Morphological Investigations: Cutting into the Substance of Urban Form. In: *Built Environment*, 37(4), pp. 393–408.

Lampugnani, Vittorio/Albrecht, Karin/Bihlmaier, Helene/Zurf luh, Lukas (Eds.): (2017): *Manuale zum Städtebau. Die Systematisierung des Wissens von Stadt 1870–1950*. Berlin: DOM publishers.

Lang, Jon (2005): *Urban Design: A Typology of Procedures and Products*. Oxford: Architectural Press.

Larkham, Peter (2005): Understanding Urban Form? In: *Urban Design*, No. 93, pp. 22–24.

Lee, Christopher (2010): *Working in Series: Towards an Operative Theory of Type*. London: AA Publications.

Mohamed, Syahidah Amni/Harun, Nor Zalina/Alias, Abdullah (2017): Typo-Morphology as an Approach for the Conservation of the Early Malay Towns. In: *Asian Journal of Environment, History and Heritage*, 1(2), pp. 143–154.

Moudon, Anne (1997): Urban Morphology as an Emerging Interdisciplinary Field. In: *Urban Morphology*, No. 1, pp. 3–10.

Raith, Eric (2000): *Stadtmorphologie. Annäherungen, Umsetzungen, Aussichten*. Vienna: Springer.

Reicher, Christa (2012): *Städtebauliches Entwerfen*. Wiesbaden: Springer.

Rose, Gillian (2007): *Visual Methodologies. An Introduction to the Interpretation of Visual Materials*. London: SAGE.

Rossi, Aldo (1973 [orig. 1966]): *Architektur der Stadt, Skizze zu einer grundlegenden Theorie des Urbanen*. Düsseldorf: Bertelsmann Bauwelt Fundamente.

— (1978): *Das Konzept des Typus*. In: Arch+, No. 37/1978, pp. 39–40.

Rowe, Colin/Koetter, Fred (1984 [orig. 1978]): *Collage City*. Basel: Birkhäuser.

Sharr, Adam (2007): *Thinkers for Architects. Heidegger for Architects*. London: Routledge.

Sitte, Camillo (1889): *Der Städte-Bau nach seinen künstlerischen Grundsätzen. Ein Beitrag zur Lösung moderner Fragen der Architektur und monumentalen Plastik unter besonderer Beziehung auf Wien*. Vienna: Springer.

Song, Hayub/Cinn, Eungee (2015): The Complementary Relationship between Architecture and Topography: Focus on the Performative Relationship between the Houses of

Kim Incheurl and Topography. In: *Journal of Asian Architecture and Building Engineering*, 14(2), pp. 271–278.

Streich, Bernd (2011): *Stadtplanung in der Wissensgesellschaft*. Wiesbaden: Springer VS.

Strauss, Anselm/Corbin, Juliet (1996): *Grounded Theory. Grundlagen qualitativer Sozialforschung*. Weinheim: Beltz, Psychologie-Verl.-Union.

Stojanovski, Todor/Axelsson, Östen (2018): T*ypo-Morphology and Environmental Perception of Urban Space*. Conference Paper ISUF 2018 XXV International conference Urban Form and Social Context. Online: https://core.ac.uk/download/pdf/224957286.pdf (accessed: 29 September 2020).

Stübben, Joseph (1890): *Der Städtebau. Darmstadt.*