The onset of digital archaeology and its subsequent remarkable development has had a crucial impact on the study of cultural heritage. Presently, researchers are able to manipulate and reinvent digital and historical data; the study of the city stands out in this context. Cities are microcosms, often reflecting the changing structure of societies over time. A vast array of digital tools (laser scanning, augmented reality, remote sensing, and beyond) can process, test, and display archaeological data, architectural remains, and built heritage on a scale previously unattainable. The digitization of historical research is manipulating and reinventing the ways in which we examine historical evidence. This intersection between history and computer science allows for an expansion and enhancement of historical, archaeological, and anthropological research. The resulting configurations lead to the creation of new data and new objects of study within these fields, which makes it crucial for those in these fields to understand the impact of generating digital information in this context.

Digital Cities explores the study of the city in the digital realm by reexamining the data processing and knowledge sharing between historians, architects, geographers, anthropologists, and computer scientists. *Digital Cities* considers the city from pre-historic settlements to the present in different geographical contexts. Each section of the book offers a new level of engagement with various digital tools, spanning topics such as the challenges digital instruments pose to the study of pre-urban and urban contexts, the didactic scope of virtual heritage, and the consolidation of the relationship between digital language and historical narrative. The resulting research traverses the idea of Digital Cities through a historical, social, and multimodal context, filling the gap in scholarship between the study of the city and the concept and significance of the Digital City.

MAURIZIO FORTE is William and Sue Gross Professor of Classical Studies Art, Art History, and Visual Studies at Duke University. He is the founder and director of the DIG@Lab at Duke as well as the author or editor of three books, including *Virtual Archaeology*.

HELENA MURTEIRA is an art historian with a PhD from the University of Edinburgh. She is a member of the Scientific Committee of the Centre for Art History and Artistic Research (CHAIA) at the University of Évora.

OXFORD
UNIVERSITY PRESS

www.oup.com

COVER DESIGN: JAMES R. PERALES
COVER IMAGE: CITYSCAPE FUTURISTIC ©ANTIV/SHUTTERSTOCK.COM

ISBN 978-0-19-750112-2
90000
9 780197 501122

Forte *and* Murteira

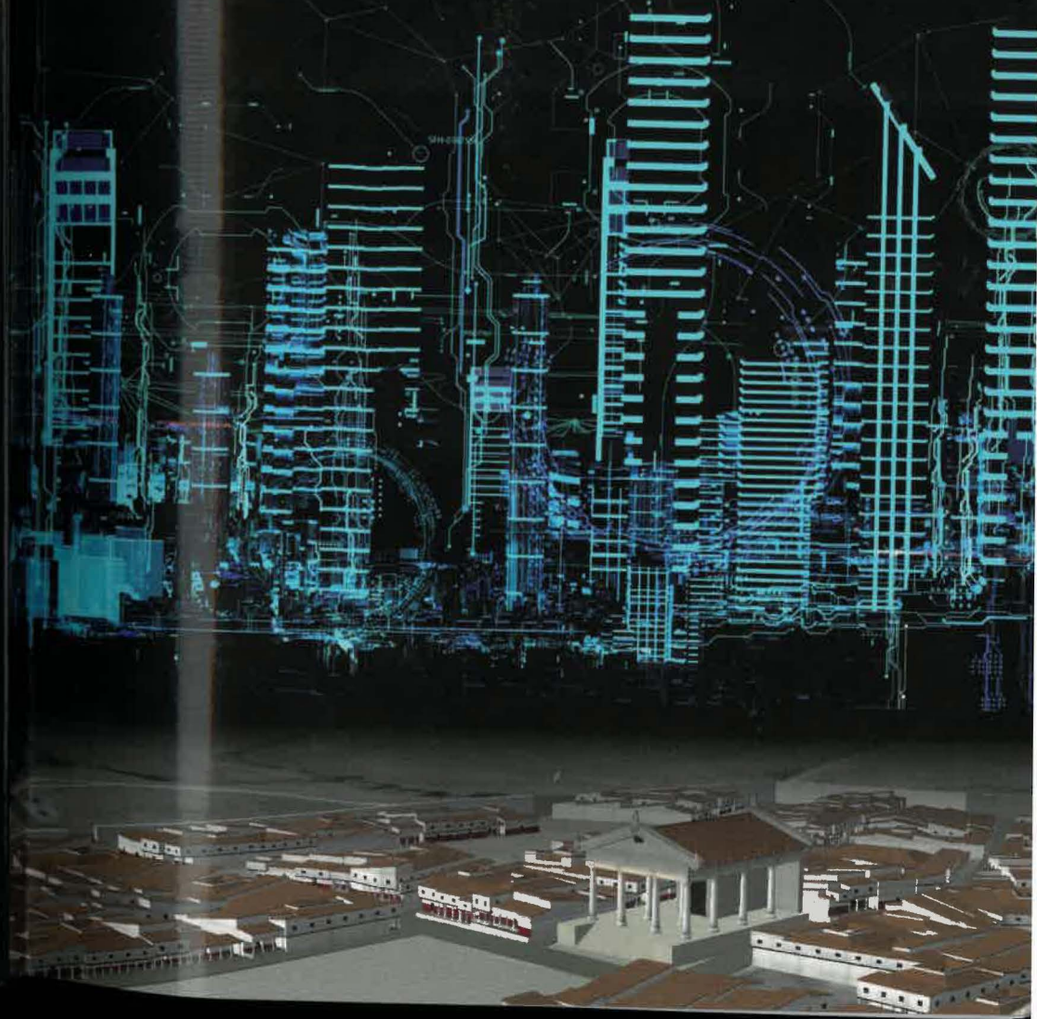
DIGITAL CITIES

OXFORD

DIGITAL CITIES

Between History *and* Archaeology

Edited by Maurizio Forte *and* Helena Murteira



Digital Cities

Between History and Archaeology

Edited by Maurizio Forte

and

Helena Murteira

OXFORD
UNIVERSITY PRESS

OXFORD
UNIVERSITY PRESS

Oxford University Press is a department of the University of Oxford. It furthers the University's objective of excellence in research, scholarship, and education by publishing worldwide. Oxford is a registered trade mark of Oxford University Press in the UK and certain other countries.

Published in the United States of America by Oxford University Press
198 Madison Avenue, New York, NY 10016, United States of America.

CIP data is on file at the Library of Congress
ISBN 978-0-19-750112-2 (pbk.)
ISBN 978-0-19-049890-0 (hbk.)

9 8 7 6 5 4 3 2 1

Paperback printed by Marquis, Canada
Hardback printed by Bridgeport National Bindery, Inc., United States of America

CONTENTS

ABOUT THE CONTRIBUTORS

Kristin Agcaoili, Center for Cyber- Archaeology and Sustainability, Qualcomm Institute, University of California, San Diego, USA

Zeynep Aktüre, Associate Professor, Department of Architecture, Izmir Institute of Technology (IZTECH), Izmir, Turkey

Richard Beacham, King's College, London, UK

Jean-Yves Blaise, Senior CNRS researcher, UMR 3495 MAP CNRS/MC, France

Geoffrey Booth, Associate Professor, Department of Landscape Architecture and Urban Planning, and Associate Director, CRS Center for Leadership and Management in the Design and Construction Industry, Texas A&M University, USA

Maria Leonor Botelho, Assistant Professor DCTP/ FLUP and Resarcher at CITCEM/ FLUP, Universidade do Porto, Portugal

Caroline Bruzelius, A. M. Cogan Professor Emerita, Department of Art, Art History and Visual Studies, Duke University, North Carolina, USA

Stephen Caffey, Instructional Associate Professor, Department of Architecture, Texas A&M University, USA

Gabriela Campagnol, Lecturer, Department of Architecture, Texas A&M University, USA

Gianluca Catanzariti, Geostudi Astier, Italy

Mark J. Clayton, Professor, Department of Architecture, Texas A&M University, USA

Nevio Danelon, postdoctoral associate, AAHVS, Duke University, North Carolina, USA

Iwona Dudek, Senior CNRS researcher, UMR 3495 MAP CNRS/MC, France

Maurizio Forte, professor of Classical Studies, director of the Dig@LAb, Duke University, North Carolina, USA

Maria Alexandra Gago da Câmara, Assistant Professor, Universidade Aberta (Open University), Lisbon, Portugal, and Researcher at Centre for Art History and Artistic Research (CHAIA), University of Évora, Portugal

Kevin Glowacki, Associate Professor, Department of Architecture, and Director, Center for Heritage Conservation, Texas A&M University, USA

Avner Goren, Milken Institute, Santa Monica, California, USA

David Johnston, Associate Professor of the Practice of Marine Conservation Ecology Coastal Environmental Management, Marine Science & Conservation, Duke University, North Carolina, USA

Julian Kang, Associate Professor, Department of Construction Science, Texas A&M University, USA

Anish Kannan, Center for Cyber- Archaeology and Sustainability, Qualcomm Institute, University of California, San Diego, USA

Sarah Kenderdine, Professor, Laboratory for Experimental Museology (eM+), École polytechnique fédérale de Lausanne (EPFL), Lausanne, Switzerland

Nancy Klein, Associate Professor, Department of Architecture, Texas A&M University, USA

Thomas E. Levy, Center for Cyber- Archaeology and Sustainability, Qualcomm Institute, University of California, San Diego, USA

Katherine McCusker, PhD student, AAHVS, Duke University, North Carolina, USA

Gianfranco Morelli, Geostudi Astier, Italy

Helena Murteira, Senior Researcher, Centre for Art History and Artistic Research (CHAIA), University of Évora, Portugal

Everett Newton, PhD student, Marine Science and Conservation, Duke University, North Carolina, USA

Eva Pietroni, CNR Institute of Science for Cultural Heritage, Rome, Italy

Angelika Psenner, Institute for Urban Design and Landscape Architecture, TU Wien, Vienna, Austria

Paulo Simões Rodrigues, Assistant Professor, Department of History, Director of the Centre for Art History and Artistic Research (CHAIA), University of Évora, Portugal

Jürgen P. Schulze, Center for Cyber- Archaeology and Sustainability, Qualcomm Institute, University of California, San Diego, USA

Bill Seaman, Co-director of the Emergence Lab and Graduate Program Director, Computational Media, Arts & Cultures; Professor, Department of Art, Art History & Visual Studies, Duke University, North Carolina, USA

Luís Miguel Sequeira, PhD student at University Trás- os- Montes and Alto Douro (UTAD), Portugal

Connor Smith, Center for Cyber- Archaeology and Sustainability, Qualcomm Institute, University of California, San Diego, USA

Glenn Yago, Milken Institute, Santa Monica, California, USA

CHAPTER 12

Spatial Representation of Vienna's Street-Level Environment

Urban Parterre Modeling

ANGELIKA PSENNER

Translated by Michael Strand

INTRODUCTION

Vienna's *Stadtparterre* (street-level environment) is in a precarious condition: on the one hand, ground floors are not being put to adequate use (problem of vacancies, underuse, use for storage and garages), on the other hand, the street space is basically monofunctional, being for the most part reserved for car parking and as a traffic surface. This fact appears all the more abstruse against the background of Vienna's rapid population growth[1] and the concomitant housing shortage. The need for additional housing cannot be met by drawing on the city's reserves of undeveloped land; therefore, new residential space will have to be provided in built-up neighborhoods in addition to the projected suburban development areas. To be able to do so, it is necessary to be aware of the nature, quality, and structure of use of the urban fabric and especially of the *Stadtparterre*, or urban ground floor.

The discussion of ground floor uses in inner urban areas is characterized by a certain hypocrisy. The general complaints about the more public-related uses of ground floors being increasingly discontinued are being mitigated by inactivity when it comes to launching initiatives to counteract the creeping privatization of this entire urban level. Everyday social exchange, whether

Angelika Psenner, *Spatial Representation of Vienna's Street-Level Environment* In: *Digital Cities*. Edited by: Maurizio Forte and Hele-na Murteira, Oxford University Press (2020).
DOI: 10.1093/oso/9780190498900.003.0013

intentional or incidental, while navigating the urban space on foot, essentially depends on a varied use of the ground-floor level, which in spatial terms is the plane that physically connects *all* urban levels. However, such multiple spatial engagement is prevented by current building regulations.

> It is indeed an inherent quality of the city that all routes intersect and connect, converge and ramify on the ground floor level. This of course also includes the spatial layers directly below and above the ground floor [which is why in this text we speak of a street-level *environment*], provided that they are interrelated as one topological unit. But who is able to identify, to read and map this network? (Luchsinger 2014, 4)

This is where the study described in this chapter takes its starting point—namely, from giving visibility to the spatial connections of the base zone and their functional engagement. A differentiated 3D representation visualizes the actual spatial relations of ground floor, street, and courtyard spaces, as well as the "Souterrain" and "Hochparterre" (mezzanine floors). This is much more than a mere delineation in the sense of a quantitative or qualitative description; the issue here is the sensual and holistic perception of the street-level environment. "The quasi-archaeological representation of the spatial situation of the base zone prompts a cognition and design process that is entirely different from previous attempts at a functional and social re-engagement of spaces. The focus here is on the re-interpretation of the ground-floor situation on the basis of patterns that only become visible in the 3D representation, just like excavated ruins provide indications of past cultures, revealing patterns of everyday life that are as unexpected as they are topical and exemplary for the future" (Luchsinger 2014, 4).

THE PROJECT'S BENCHMARKS

Creating residential space through rooftop conversions—which was done a lot over the past twenty years in Vienna—is often accompanied by a walling-up of ground floors (figure 12.1), as local building regulations require the provision of garages for private vehicles (cf. Psenner 2015a, 2015b, 2015c; 2014a, 2014b, 2014c; 2013; 2012a, 2012b).

The result is that actually no additional residential space is created; instead, the city merely moves one floor up, with detrimental effects such as disuse and depopulation on the public space at street level. If continued, this development will ultimately render an already precarious urban environment even more unsustainable.

Figure 12.1 Creating additional residential space through rooftop conversions is often accompanied by a walling-up of the ground floor, which renders an already precarious urban environment even more unsustainable.
Credit: Left: © A. Psenner; right: © S. Nöbauer.

The reasons why our cities have been made ever more car-friendly over time are well known.[2] However, historical photographs of our city streets speak to a different, highly diversified structure of uses. Before the street was turned into an exclusive traffic and parking area, it also served a number of other purposes, from meeting economic needs and providing necessities (trade, sales, transportation of goods), to cultural purposes, private self-representation, and the manifestations of public life. Motion and rest were considered as equally formative factors that defined the urban-design significance of the street (Walewa-Coen 1946, 97). As a matter of fact, street parking of cars in the nighttime was illegal in Vienna and was penalized with prison terms; things only changed in 1938, when the road-traffic regulations of Nazi Germany were adopted in Austria (Psenner 2013, 142ff; 2014a; 2015a; 2015c).

We also are familiar with images of megacities such as Tokyo, where residential streets—in spite of the tremendous mobility pressures of the Greater Tokyo Area with its population of 36 million—are primarily understood as spaces for living rather than traffic, and they have retained much of their public-space character (cf. Krusche and Vogt 2011, Krusche and Rost 2010, Krusche 2008). It is therefore necessary to put the issues concerning the street-level environment of Vienna in a broad systemic perspective and to identify ways in which architectural and urban research may contribute to understanding the existing problems. This also means relating to the street-level environment as a whole, rather than to certain parts of it.[3]

Stadtparterre: The Street-Level Environment

There is a strong, direct relationship between urban street space and the structures and uses of ground floors of buildings.[4] In addressing urban-development issues, it cannot be emphasized enough that it is necessary to consider the totality of the *Stadtparterre*, or street-level environment, as a consistent urban zone of public, semi-public, and private spaces (Psenner 2017; Davis, 2012). The "spatial representation of Vienna's street-level environment," or Urban Parterre Model (UPM),[5] therefore includes both built-up and non-built-up areas, covering the street, as well as the adjacent houses and courtyards. Thus street, ground floor, and courtyard are treated as separate entities, so that their interrelations can come to light, as we are aware that the potentials of ground-floor use and the structure of the correlating public street space are directly related.[6]

The Research Field

Buildings and tracts from the Gründerzeit period still make up a large portion of the Viennese cityscape. Despite busy construction activity, one in four apartments in the city is in a Gründerzeit building. This chapter therefore takes a closer look at street-level structures and environments from this period in an initial approach to the broader and more general subject of the *Stadtparterre*. Also, the project focuses on secondary streets because—unlike shopping streets or high-traffic roads—they have so far been mostly neglected by urbanist research and municipal administrations alike.

The Research Questions

As the conventional cadastral map (figure 12.2, left) only shows building perimeters, it offers no information about the city's internal structure. Street, ground-floor, and courtyard uses are not documented with the necessary clarity and completeness, and can therefore not be objectively analyzed in a structural context. The Comprehensive Ground Plan Map, or—as we call it—the Urban Parterre Model (UPM; figure 12.2, right) provides precisely the kind of information that is prerequisite for an authentic morphological analysis.[7]

In this context, the study presented here addresses the following questions:

- How was the Viennese ground level originally used? What urban functions were located there?
- What are the (historical) interrelations between public space and life inside buildings?

The causes of the current *Stadtparterre* crisis are thus analyzed from a historical and systemic perspective.

THE PROJECT'S METHODOLOGY

The 2D Comprehensive Ground Plan Survey

Originally, the two-dimensional Comprehensive Ground Plan Survey (CGPS) was derived from studies on the relationship between urban morphology and building typology, similar to the ones used by Saverio Muratori in Venice and by Gianfranco Caniggia in Florence and Como (cf. Peters 1999, 137).

Several such morphological studies were subsequently conducted by Swiss architects and historians. In the 1960s, architects in the canton of Tessin initiated an inventory that was continued at the Swiss Federal Institute of Technology (ETH) in Zurich in the 1970s; further progress in the field was made with a comprehensive survey of Zurich's urban center under the direction of architectural researcher Margareta Peters.[8]

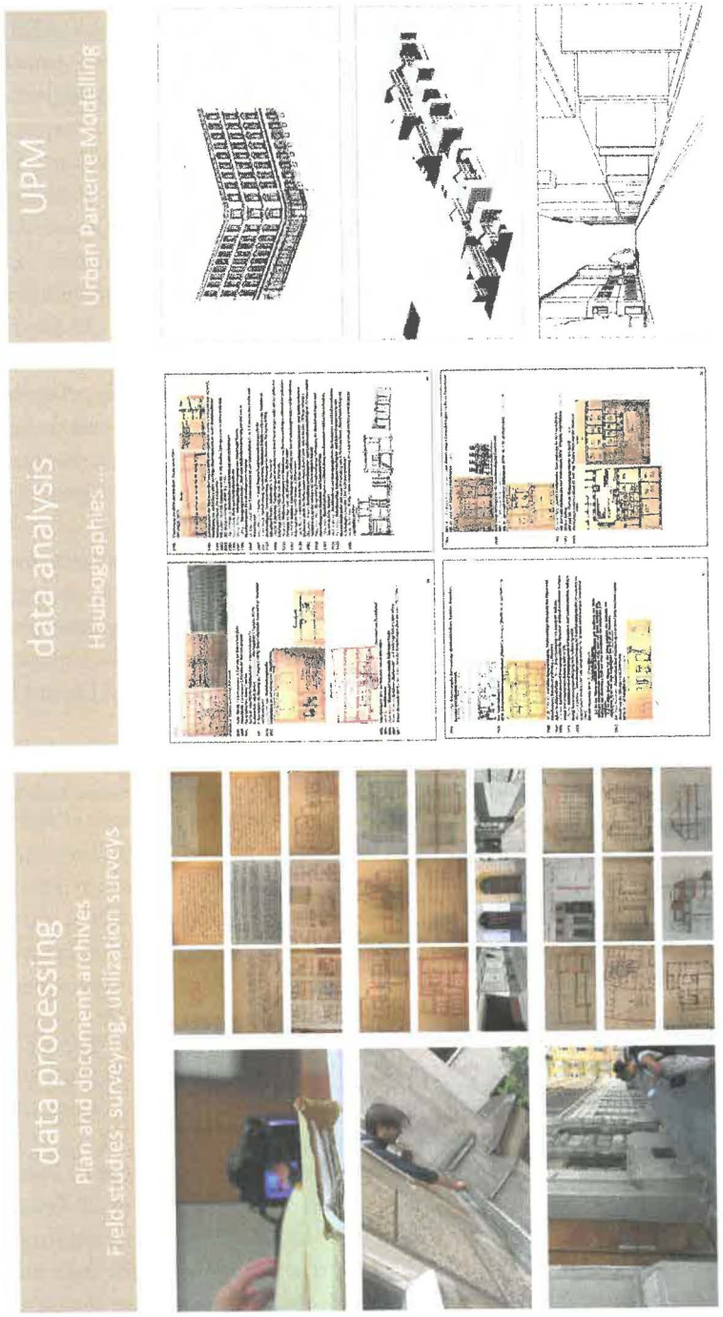


Figure 12.2 Visualization of the Urban Parterre Modelling UPM-procedure: data processing, data analysing and 3D-modelling of the data.
Credit: © A. Psenner.

Comprehensive ground plan surveys are available for the following Swiss towns and cities:

				RBTC[9]
Bellinzona	Luigi Snozzi, Tita Carloni, (Livio Vacchini)	1965–1969	basement (bm), ground floor, all upper floors (uf)	–
Zurich (Old Town[a] 1955)	Supervisor Prof. Aldo Rossi, ETH Zurich	1973	ground floor (gf)	–
Lucerne	Andy Raeber	1974–1984	ground floor	–
Bern (Old Town)	Supervisor Prof. Dolf Schnebli, ETH Zurich	1975	ground floor	–
Solothurn (state of 1900)	Supervisor Prof. Paul Hofer, ETH Zurich	1978	bm, gf, typical upper floor	–
Bern (Old Town 1200)	Supervisor Prof. Paul Hofer, ETH; Janine Martinez	1978–1981	bm[b]	–
Biel	Supervisor Prof. Paul Hofer ETH[c] (A. Corboz)	1979	bm, gf, typical upper floor	X
Tessin[d]	Supervisor Prof. Aldo Rossi, ETH[e]	1979	no specification	–
Zurzach	Prof. Hans Rudolf Sennhauser	since 1980	no specification	X
Le Landeron[f]	Doz. Marie Claude Betrix, Technikum Biel	1986–1992	ground floor	X
Baden	Baden Municipal Construction Dept.	1989–1990	ground floor[g]	–
Wil SG (Old Town)	Margareta Peters	1994	bm, gf, typical upper floor	–
Zurich (Old Town)	Supervisor Prof. V. Lampugnani, ETH; M. Peters	1995–1999	bm, gf, first floor	X
Zurich (industry quarter)	Supervisor Prof. V. Lampugnani, ETH; M. Peters	1997–1999	ground floor	X
Zurich (Stadelhofen district)	Supervisor Prof. V. Lampugnani, ETH; M. Peters	1999	ground floor	X

Notes: [a] Covering the area inside the Baroque town walls; [b] "Kellerplan" (cellar plan) of the medieval city center; [c] Project leaders: Margareta Peters, Jürg Reber and Christian Sumi; [d] Comprehensive survey of the Tessin Canton; [e] In collaboration with Max Bosshard, Eraldo Consolatio, Bruno Reichlin, Fabio Reichart, and Christian Sumi; [f] The CGPS Le Landron, the typological studies of the buildings and the students' design proposal finally led to the passing of new building regulations for the Old Town; [g] The plan is also entitled "Brandmauernsystem" (map of the fire walls).

After years of absolute negation of this approach - only in isolated cases did researchers resort to this methodology (Fortier, 1989) - the CGPS has recently attracted renewed attention again (Lampugnani et al. 2018, Ebbing 2018).

Conventional cadastral maps (called *Mehrzweckkarten* in Vienna) provide no sufficient information about ground floor plans and the structure of urban interiors (see figure 12.2, left), whereas a CGPS sets buildings in relation to public space and their topographic environment, *visualizing the interrelation between the interior life of individual buildings and the public street space surrounding them.* Comprehensive Ground Plan Surveys therefore are useful to examine the relationships between buildings, streets, and courtyards.[10]

The 3D Urban Parterre Model, UPM

A baseline set of data is provided by the existing digital cadastral map, which details land use for the entire municipal area of Vienna. It is a fundamental tool, a matrix that is filled in with ground-level plans of individual buildings, covering both historical floor plans and documented building uses, as well as most recent conversion records,[11] so as to reflect the morphological evolution of the *Stadtparterre*. All plans are then verified on site and, if necessary, adapted and amended, in particular with regard to actual building uses.

Given the importance of ceiling and building heights,[12] one of the study's primary objectives is to provide a three-dimensional model of the urban street-level environment. To do so, the method was further developed into the three-dimensional Urban Parterre Model (UPM). This three-dimensional representation of the data—with modeling done with Autodesk Revit[13]—helps in the analysis of links between buildings' interior spaces: Where is, or was, the basement or courtyard directly connected to ground-floor use? And how do these interior connections affect the entire parterre function? The introduction of 3D is the major difference from the Comprehensive Ground Plan Surveys done in the 1960s in many Italian and Swiss cities.[14]

In the Urban Parterre Model, the ground floor is rendered in every detail, while for the standard upper floor and basement, a set of simple structural data, such as weight-bearing elements (main supporting walls), access points (stairways and corridors), and the façade (opening axes), provides sufficient information for a rough-and-ready outline. Where the adjoining levels (basement and first upper floor) are directly connected to the ground floor by stairs or doorways, they are treated as extensions of the ground floor and therefore represented in greater detail. Normally, however, the areas above and below the ground floor are broadly outlined. Included in this are the street profile and daylighting conditions on the ground floor and street level. The façade is interpreted as a permeable interface between building and public space, with information on the formal façade design available as an option.

The UPM is considered a particularly sound representation, which includes basic information on ground floor use (by means of color codes). Thus, it produces precisely the information needed for analysing and defining the building's relationship to public space and the internal coherence in the *Stadtparterre*.

In this sense, the UPM represents a special type of 3D urban model, with precise detail data and offering a ground-level perspective. Usual 3D urban models mostly provide a bird's-eye view and do not contain the information needed for a ground-level investigation.

THE PILOT STUDY: ANALYSIS

So far, the Vienna street-level environment has been explored in terms of an exemplary street in an inner district, an archetypal Gründerzeit street totally rebuilt in the late nineteenth century. Preliminary research took an in-depth historical approach: (1) a theoretical study of the evolution of the unique architectural type of the Viennese Gründerzeit-Stadthaus, which covered topics like the original historical use of that type of architecture (which was by no means exclusively residential, as one might presume from today's perspective); and (2) consideration of the impact of relevant legislation (building regulations, commercial code, public health care, road traffic regulations, tax incentives, urban planning, etc.).[15]

In order to better understand the role that the street played within the larger urban fabric, the biography of the street was extensively researched, including detailed information on layout (geography, spatial and urban planning), architectural development (historical and current building plans on the selected lots), and development over time of the uses of adjacent ground floors and basements (trading documents, business licenses and tax regulations).

The Urban Parterre Model uses color codes—for example, green for semi-public spaces and spaces with high user frequency, such as shops, coffeehouses, studios; orange for work spaces, such as offices, workshops, factories; yellow for housing; dark gray for garages and storage spaces; light gray for vacancies—to identify the type and intensity of use (figure 12.3).

The study actually confirms the hypothesis that, from a historical point of view, ground floor space is semi-public space, with the façade functioning as a permeable interface allowing constant interchange between public and semi-public areas. Photographs of the time also substantiate this assumption: ground-floor façades were permeable, and private ground-floor uses extended into public street space; conversely, the street-level interior rooms were open to the public.[16]

The façades were analyzed in terms of their permeability with regard to the actual engagement of the street-level environment; the question was: What

Figure 12.3 Above: Uses of the *Stadtparterre* around 1910. Below: Today's uses of the *Stadtparterre* (UPM).
Credit: © A. Psenner.

goes on behind them and how does it affects the public space of the street, both during the day and in the night, so as to determine the effects of ambient lighting from house entrances and ground-floor residential and shop windows and night-time use frequency (figure 12.4).

Research also involved an insight study of actual workplaces on the ground floor, which involved a resident and visitor frequency analysis.[17] Also analyzed in this context was the internet presence of businesses situated on the ground floor, in order to evaluate the quality of the interlacing of Euclidean urban and ephemeral web space.

RESULTS AND FINDINGS

Including all additional relevant ground-floor data, the spatial representation of Vienna's street-level environment facilitated a conclusive analysis of the (use)

Figure 12.4 Pilot test showing daytime permeability of façades (a) and lighting/permeability during the night (b).
Credit: © A. Psenner.

structure and potential of the ground-floor zone and related it to the uses and functions of the street space. Thus, interrelations could be identified and problematic situations considered and resolved in a broader context (figure 12.5).

The Sidewalk

The holistic approach embodied in the term *Stadtparterre* shows the primary function of the sidewalk in its true light: easily and directly accessible, the sidewalk is the most important area of interaction in the public realm, a space where people can meet and move among, or simply observe each other relatively freely. Not least, it is the site of integrative interaction between minorities and majorities in a diversified society.[18] Clearly, it should be possible to engage this multifunctional urban space in all sorts of ways, provided it is adequately dimensioned.[19] At present, however, the average 1.7 to 2.2 meters between building fronts and parked cars are reserved for moving (pedestrian) traffic; section 78 of the Austrian Road Traffic Regulations even expressly prohibits "hindering pedestrian traffic by stopping for no reason," while failing to provide any information as to what might constitute an admissible reason to do so (Psenner 2004, 133; 2011a, 2011b; 2012b; 2013; 2014a, 137). Also, using the sidewalk "for other purposes than those of street traffic" is still conditional on administrative approval.[20]

This problem of lack of space also has to be seen as a consequence of a deliberate shifting of the rights of use: while more and more street space was assigned to cars, pedestrians found themselves reduced to increasingly narrow walking lanes. In the years after World War II, sidewalks were built with a minimum width of 1.25 meters (according to ÖFS building standards, 1956), whereas, in the Gründerzeit period, the *trottoirs*—*trotter* meaning to "roam about" in French—on both sides of the street had been assigned no less than one third (!) of the total street width (Kortz et al. 1905, 174; Drexel 2000, 207 and 209). On the initiative of the city administration, these narrow postwar sidewalks have been increasingly widened in recent years, with additional bulges added at street crossings so that the pavements now offer a little more space to walk and stand, but this still is a far cry from the comfortable 4 meter sidewalks common in New York City. To make things worse, the clear width (unobstructed passageway) achieved at great cost has in many places been drastically reduced again by signposts.

Structures of Historical Ground-Floor Use

One important aspect of Gründerzeit ground floors is their generous ceiling heights. The large amount of space thus offered is a special asset, not least

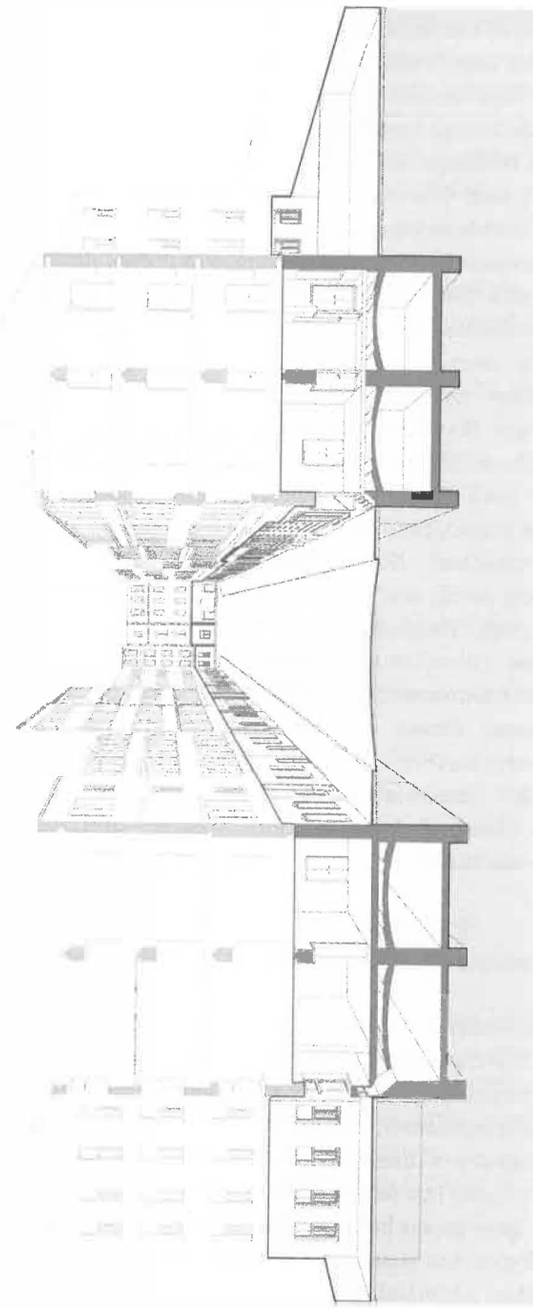


Figure 12.5 UPM: a 3D model of the urban parterre (Stadtparterre) and its coherent microstructure.
Credit: © A. Psenner and K. Kodydek.

because it opens up possibilities for a variety of uses, lending itself not to a specific market segment but, rather, to a broad range of prospective occupants (Psenner 2011c, 2012a, 2012b).[21]

At that earlier time, Vienna's economic, social, and urban fabric was characterized by a large number of small businesses, many of them workshops or small manufacturing operations, preferably located on the ground floors of Gründerzeit buildings. Of the businesses registered in the Establishment Census of 1869, only a few had more than ten workers; enterprises that employed a larger workforce were more or less all located in the suburbs—a specific structural characteristic which also continued to prevail throughout and after the economic crisis that came in the wake of the stock market crash of 1873.

In these conditions, Vienna had an incredible range of registered businesses, among them, for example, the *Pfaidlergewerbe* (shirt maker), *Paramentenerzeuger* (vestments manufacturer), *Banderzeuger* (ribbon maker), *Bettwarenerzeuger* (bed linen maker), *Naturblumenbinder* (florist), *konzessionierter Spirituosenschänker* (licensed liquor dealer), *Brunnenmeister und Brunnengräber* (well digger and builder), *Büchsenmacher und Schwertfeger* (gun and blade smith), *Bürsten- und Pinselmacher* (brush maker), *Deichgräber* (ditch digger/trencher), *Nadler Webkammmacher und Drahtwarenerzeuger* (needle, weaving comb, and wire products maker), *Federnschmücker* (plume feather decorator), *Flaschenbierfüller* (beer bottler), *Fragner und Greisler* (grocer), *Hafner* (stove fitter), *Kamm- und Fächermacher* (fan and comb maker), *Gemischtwarenverschleißer* (general store operator), *Kanal- und Senkgrubenraeumer* (sewer and cesspit cleaner), *Kostgeber* (landlord or landlady), *Lohnfuhrwerker* (haulage contractor), *Sauerkraut- und Saure Rübenverschleißer* (sauerkraut and pickles merchant), *Seiden- Schön- und Schwarzfärber* (dyer), *Tuchscherer* (cloth shearer), and *Wirkwarenerzeuger* (knitware manufacturer).

Historical Development of Ground-Floor Use in the Street Study

Despite its proximity to a parallel higher-level shopping street, the street examined has the characteristics of a supply road, so that the ground floors of the Gründerzeit buildings mainly accommodated workshops, small manufacturing, and trade businesses, while in the side streets residential use predominated in the majority of cases. This structure of ground-floor uses has partially subsisted to this day, but recently was disrupted by massive breaches of use patterns (e.g., large garage built into the ground floor of house nos. 5–7).

A morphological-use structure analysis of the stretch of street examined here showed that, historically, the typical Viennese ground floor was a semi-public space. As the apartments in most buildings were really small,[22] and also were mostly used by several occupants in shifts, residential functions

were often moved to the outside, out of the private units. Also, only very few apartments had fully equipped kitchens, or pantries and other food storage facilities, so that shopping for perishable goods was an everyday chore. These circumstances also account for the relatively large number of eateries, coffee houses, and liquor stores (seven on a stretch of only 190 meters), as well as grocers and other small retailers.

Over the past century, the following businesses, or business premises, were accommodated on the street-side ground floor of buildings along the 190 meter street stretch examined:

- 7 restaurants/coffee houses/wine spirit shops, of which:
  - 1 restaurant; after 1909: smoked meat production; after 1921: breakfast room; after 1960: patisserie
  - 1 restaurant; after 1904: coffee roaster; after 1933: restaurant; after 1970: cafe; after 1981: shop
  - 1 coffee roaster; after 1967: Cafe; after 1978 shop
  - 1 restaurant; after 1970: cafe
  - 1 wine spirit shop; after 1993: paint shop
  - 1 restaurant
  - 1 coffee house
- 5 not specifically defined salesrooms (called *Gassenlokale* and occasionally *Gewölbe*)
- 4 general stores (*Gemischtwarenverschleißer*)
- 3 bakeries/pastry shops
- 2 underwear and linen makers; after 2000: offices
- 2 shirt makers
- 1 pharmacy
- 1 dairy
- 1 barbershop
- 1 printing house (of the Sonn- und Montagszeitung)
- 1 furniture maker /carpenter
- 1 synagogue (after 1990: furniture store)
- 1 pharmaceutical company (*Pharmakon*); after 1964 advertising agency
- 1 necktie sewing school (*Privatlehranstalt für Krawattennaehen*)
- 1 producer of cork goods; after 1912: carpentry; after 1971: printing house
- 1 frame and molding maker; after 1928: glass-cutting workshop
- 1 shop for celluloid articles; after 1970: installer
- 1 stationer's shop (*Papierverschleißer*); after 1911: locksmith; after 1970: installer and plumber
- 1 dry cleaners; after 1967: grocery store
- 1 plumber's showroom
- 1 butcher shop; after 1999: video store
- 1 carpenter; after 1942: butcher shop and smoked meat production

Structural Characteristics of Use of the Historical Viennese Ground Floor

As mentioned earlier, the historical Viennese ground floor was a semi-public space, with no clear-cut boundary between inside and out: rather, doors and windows were left open most of the time so that there were many points giving access to the ground-floor premises. Photographs from the period attest to this: the ground-floor façades were permeable; semi-public, or even private uses of the ground floor extended to the street and, conversely, the premises were easily accessible to the "flow of the public."

Many of the ground-floor premises in the studied street (the study underlying this text had to be anonymized for data-protection reasons) were connected with basement floors or cellars underneath, which meant an extension of the ground floor zone. The (commercial) use of the street-facing premises in most cases also included the interior courtyard.[23]

The historical *Stadtparterre* was a ramified, varied, much-used, and hence engaging space. Permeable ground-floor façades provided a flexible interface between public and semi-public spaces that were intensely interacting with one another.

CONCLUSION

Currently, the Vienna municipality has no oversight or control over the ongoing urban modification described at the beginning of this text, as there are no data being collected on the actual ground-floor situation, nor are there numbers available about store vacancies or recently built-in private garages. Unlike for a number of Italian and Swiss cities and towns, no comprehensive ground plan survey has ever been drawn up for Vienna. This is the first major innovation that the study brings.

From an international research perspective, another innovative asset of the project is the three-dimensionality of the comprehensive model. Successful regulatory measures in urban planning, administration, and economic policies depend on sound and detailed knowledge of the actual architectural structure, as well as the current actual—and potential—use of the street-level environment. The UPM provides this information in an easily accessible and locally contextualized form. Thus, the development potential of the street-level environment can be clearly identified to inform urban planning.

The goal of this study was to map and outline the potential of the street-level environment, among other things, through an in-depth analysis of its past development. The current state of affairs is not satisfactory: moving and stationary traffic make the street an unattractive space to be in, without much amenity value and usability for the pedestrian public. Ground-floor vacancies are on the rise, and consequently even more space is being converted into indoor parking. Thus, the city moves upward—and when attics are converted into penthouses, the existing parking space regulation leads to the installation of further private ground floor garages and hence to further loss of potentially semi-public urban space. This precarious tendency is also reflected in new construction types: here, the ground floor usually accommodates secondary uses, garages or self storages (Psenner 2019), with residential use starting only on the first upper floor. The ground floor façades are closed and impermeable and therefore the building does not communicate with the surrounding urban space.

The complex micro-analytical possibilities of the UPM will allow the documentation of vacancies and other issues relating to street use in various neighborhoods and the analysis of contributing economic, traffic, and social factors. Systematic 3D modeling of the built-up environment coupled with an inventory of historical, current, and potential ground-floor uses will provide a basis for putting Vienna's street-level environment into a long-term development plan that can serve as a practical guide for future interventions in various neighborhoods and for the re-design of individual street complexes.[24]

This street-level environment study is a groundbreaking approach that will provide data that can be highly usable for urban landscape research and planning, including in particular computer-based simulations. Both the UPM and the historical analysis of the urban street-level environment, transforming as it has over time between the built-up and the non-built-up in Vienna's Gründerzeit neighborhoods, will be a sound basis for further in-depth analysis (Psenner 2017). The benefits that may be expected from this approach include:

- Ability to visualize the historical interrelation between street space and ground-floor use over time and to identify existing discrepancies between private use of the street space and the public interest.
- Transparent and objective visualization of interrelated functions so as to provide a sound argument action on public administration and/or business.
- Reliable planning and implementation guidelines for concrete improvements in the urban street-level environment.

In any case, the application possibilities of the model go far beyond the situation delineated in this chapter, as the UPM will be usable not only in an urban context but also in suburban or rural settings—for example, to study and address in regional planning terms certain architecture-related aspects and conditions of the problem of vacancies in rural areas (small towns, rural communes, and villages). Once fully developed, the analytical UPM approach may also be applied to any other critical ground-floor situation in urban peripheries or "shrinking city" situations.

First and foremost, though, the point here is to acknowledge the significance of ground floors for the functioning of a city—a fact that has somewhat fallen from view in the twenty-first century, ever since the emergence of 3D city modeling. The reason for this may be that conventional 3D city models cannot really represent the intricate, small-scale, multilayered, and ramified ground-floor structures as well as the UPM, and thus prevent us from perceiving them in a broader functional perspective.

REFERENCES

Campagnol, Gabriela / Caffey, Stephen / Clayton, Mark J. / Kang, Julian / Booth, Geoffrey / Klein, Nancy and Glowacki, Kevin. 2014. "Unreal Projects: Using Immersive Visualization to Learn about Distant and Historical Locales" In *12th International Conference on Urban History: Cities in Europe, Cities in the World. European Association for Urban History (EAUH), (Proceedings)*. Lisbon.

Caniggia, Gianfranco. 1963. *Lettura di una citta': Como*. Rome: Centro Studi di Storia Urbanistica.

Caniggia, Gianfranco. 1986. *Die Morphologsiche Betrachtungsweise von Stadt und Territorium*. Eidgenössische Technische Hochschule Zürich. Architekturabteilu ng: Geschichte des Städtebaus.

Davis, Howard. 2012. *Living Over the Store: Architecture and Urban Life*. London and New York: Routledge.

Drexel, Anita. 2000. *Pflaster auf städtischen Fußböden: Bauhandwerkliche und freiraumplanerische Qualitäten von Gehwegen in Wien und anderen Städten*. Vienna: Österreichischer Kunst- u. Kulturverlag.

Ebbing, Georg, ed. 2018. Christoph Mäckler. Lehre 1998-2018. *Von der Rematerialisierung der Architektur zur Rekultivierung des städtischen Raumes*. Berlin: DOM publishers

Fortier, Bruno. 1989. *La Métropole Imaginaire: Un atlas de Paris*. Brussels: Peirre Mardaga.

Kortz, Paul, and Österreichischer Ingenieur- und Architekten-Verein. 1905. *Wien am Anfang des XX. Jahrhunderts: Ein Führer in technischer und künstlerischer Richtung*. Vol I: *Charakteristik und Entwicklung der Stadt: Ingenieurbauten*. Vienna: Gerlach & Wiedling.

Krusche, Jürgen, ed. 2008. *Der Raum der Stadt: Raumtheorien zwischen Architektur, Soziologie, Kunst und Philosophie in Japan und im Westen*. Marburg: Jonas-Verlag.

Krusche, Jürgen, and Frank Roost, with Department Architektur ETH Zurich. 2010. *Tokyo. Die Straße als gelebter Raum*. Baden: Lars Müller.

Krusche, Jürgen, and Günther Vogt. 2011. *Strassenräume Berlin, Shanghai, Tokyo, Zürich: Eine foto-ethnografische Untersuchung*. Baden: Lars Müller.

Lampugnani, Vittorio M., Stühlinger, Harald R. and Tubbesing, Markus. 2018. *Atlas zum Städtebau. Band 1 und 2*. Munich: Hirmer.

Lewis, Robert. 2004. *Manufacturing Suburbs: Building Work and Home on the Metropolitan Fringe*. Philadelphia, PA: Temple University Press.

Luchsinger, Christoph. 2014. Preface. In *Das Wiener Gründerzeit-Parterre* by Angelika Psenner. Vienna: TU Vienna, Department of Urban Design.

Malfroy, Sylvain, and Gianfranco Caniggia. 1986. *Die morphologische Betrachtungsweise von Stadt und Territorium*. Zurich: ETH, Architekturabt., Geschichte des Städtebaus.

Muratori, Saverio. 1960. *Studi per un operante storia urbana di Venezia*. Rome: Istituto Poligrafico e Zecca dello Stato, Liberaria dello Stato.

Österreichische Forschungsgesellschaft für das Straßenwesen im österr (ÖFS). 1956. *Normblätter: Richtlinien für den Ausbau von Strassen; Bearbeitet von der Arbeitsgruppe "Planung und Verkehr."* Vienna: ÖFS.

Peters, Margereta. 1990. "Stadtgrundriss als Arbeitsinstrument: dem Mittelalter auf der Spur." *Hochparterre: Zeitschrift für Architektur und Design* 4: 30–31. http://retro.seals.ch/cntmng?pid=hoc-001:1990:3::1295.

Peters, Margereta. 1999. "Elektronische Erfassung eines Industriequartiers: zusammenhängende Grundrissaufnahme in Zürich; ein Experiment." *Schweizer Ingenieur und Architekt* 117:779–784. http://retro.seals.ch/cntmng?pid=sbz-003:1999:117::587

Plunz, Richard. 1990. *A History of Housing in New York City*. New York: Columbia University Press.

Psenner, Angelika. 2004. *Wahrnehmung im urbanen öffentlichen Raum*. Vienna: Turia und Kant.

Psenner, Angelika. 2005. "Parterre. Wechselwirkung zwischen Erdgeschoss und Straßenraum in Wien." *Derive* 18: 8–11.

Psenner, Angelika. 2011a. "Integrative Diversität zu ebener Erd'? Das Entwicklungspotenzial der stadträumlichen Struktur des Wiener Gründerzeit-Parterre." *SWS Rundschau* 2: 195–218.

Psenner, Angelika. 2011b. "Vienna's Historic Ground Floor and Its Socio-Urban Potential—Integrative Diversity Parterre?" In *REAL CORP 2011. Change for Stability. Lifecycles of Cities and Regions*, edited by Manfred Schrenk, Vasily V. Popovich, and Peter Zeile, 1119–1126. Schwechat: Competence Center of Urban and Regional Planning. www.corp.at/archive/CORP2011_11.pdf.

Psenner, Angelika. 2011c. "The Price of Generous Ceiling Heights: The Influence of Historic Building Value on Vienna's Gründerzeit Architecture." In *Theory: For the Sake of the Theory*, edited by Efe Duyan, 395–409. Istanbul: Dakam.

Psenner, Angelika. 2012a. "Mixed Building Use Promotes Mixed Urbanity: Insights from Historical Use-Neutral Architecture." In *REAL CORP 2012: Re-Mixing the City: Toward Sustainability and Resilience?*, edited by Manfred Schrenk et al., 463–473. Schwechat: Competence Center of Urban and Regional Planning. www.corp.at/archive/CORP2012_18.pdf.

Psenner, Angelika. 2012b. "Wie wollen wir das Wiener Gründerzeit-Parterre nützen?" In *Perspektive Erdgeschoss, Werkstattbericht 121*, edited by R. Scheuvens and T. Schütz, 18–23. Vienna: Magistratsabteilung 18, Stadtentwicklung und Stadtplanung.

Psenner, Angelika. 2013. "Wem gehört die Straße? Genealogie der Nutzerrechte in Wiens Straßen." *SWS Rundschau* 2: 131–159.

Psenner, Angelika. 2014a. "Don't Even Think of Parking Here. Wiener Straßenraum: Verhandlung von Nutzungsrechten und Nutzungsansprüchen." In *Place-Making in urbanen Diskursen: Interdisziplinäre Beiträge zur Stadtforschung*, edited by Ingo. H. Warnke and Beatrix Busse. Diskursmuster—Discourse Patterns 7, 121-147. Boston and Berlin: de Gruyter.

Psenner, Angelika. 2014b. "A Smart Researching and Planning Tool for the Neuralgic Urban Zone: 3D-ZPA." In *REAL CORP 2014: Plan It Smart? Clever Solutions for Smart Cities*, edited by Manfred Schrenk et al., 35–44. Schwechat: Competence Center of Urban and Regional Planning. https://repository.corp.at/297/1/CORP2014_28.pdf .

Psenner, Angelika. 2014c. *Das Wiener Gründerzeit-Parterre: Eine analytische Bestandsaufnahme. Pilotstudie (Final Report of the Study)*. Vienna: TU Vienna, Department of Urban Design.

Psenner, Angelika. 2015a. "Historischer Überblick über die Entwicklung der Straße & des öffentlichen Raums." In *Mission Mikrourbanismus*, edited by Erich Raith, 102–109. Vienna: TU Vienna, Department of Urban Design.
Psenner, Angelika. 2015b. "Fakten zum Wiener Gründerzeit-Parterre und seinen Nutzungschancen." In *Mission Mikrourbanismus*, edited by Erich Raith, 110–118. Vienna: TU Vienna, Department of Urban Design.
Psenner, Angelika. 2015c. "Street Life! It's the Only Life I Know. Street Life, And There's a Thousand Parts to Play." In *REAL CORP 2015: Plan Together—Right Now—Overall. From Vision to Reality for Vibrant Cities and Regions*, edited by Manfred Schrenk et al., 579–590. Schwechat: Competence Center of Urban and Regional Planning. https://repository.corp.at/22/1/CORP2015_30.pdf.
Psenner, Angelika. 2017. "Funktionen des ‚Ebenerds'—StadtParterre reloaded." In *Umbau*, edited by Österreichische Gesellschaft für Architektur ÖGFA, 70–83. Basel: Birkhäuser.
Psenner, Angelika. 2019. „Wenn der Laden zum Lager wird: Kritische Anmerkungen zum Boom von Selfstorages im urbanen Erdgeschoß." In *Wo die Dinge wohnen. Das Phänomen Selfstorage*, edited by Martina Nußbaumer and Klaus Pichler and Wien Museum, 68–73. Zürich: Park Books.
Walewa-Coen, Slawa Blagowesta. 1946. "Die architektonische Bedeutung der Straße mit besonderer Berücksichtigung der Laubenstraßen." Doctoral disseration, Vienna University of Technology.

CHAPTER 13

Unreal Projects

Using Immersive Visualization to Learn About Distant and Historical Locales

GABRIELA CAMPAGNOL, STEPHEN CAFFEY, MARK J. CLAYTON, KEVIN GLOWACKI, NANCY KLEIN, JULIAN KANG, AND GEOFFREY BOOTH

INTRODUCTION

The technology of immersive visualization (IV), sometimes also known as virtual reality (VR), has progressed such that it can be employed to deliver experiences of places and environments that are otherwise too difficult or even impossible to reach in the real world in real time.* Since the Rome Reborn initiative led by the UCLA Virtual Reality Lab in the 1990s and 2000s, digital heritage platforms and virtual reality environments have served as laboratories within which scholars from across the disciplines can speculatively re-engage with some of history's most expansive gestures of architectural expression (Frischer et al. 2000, 2003; Frischer 2003, 2008; Frischer and Stinson 2007). Building upon this tradition, the Unreal Projects endeavor brings together faculty and students from architecture, construction science, and landscape architecture and urban planning at Texas A&M University to conduct research

* The authors wish to acknowledge the support of the Texas A&M University's Core Curriculum Technology Enhancement Grant Program, the Center for Heritage Conservation, and the following individuals for their contributions in the completion of this chapter: Kendall Clarke, David Creamer, Jong Bum Kim, Fatemeh Pariafsai, Duygu Yenerim, and Shermeen Yousif.

Gabriela Campagnol, Stephen Caffey, Mark J. Clayton, Kevin Glowacki, Nancy Klein, Julian Kang, and Geoffrey Booth, *Unreal Projects* In: *Digital Cities*. Edited by: Maurizio Forte and Helena Murteira, Oxford University Press (2020).
DOI: 10.1093/oso/9780190498900.003.0014