Urban temporary housing environments—from a systematic comparison towards an integrated typology

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Received: 18 February 2020 / Accepted: 9 December 2020 / Published online: 10 February 2021
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Abstract

Housing plays a central role in everyday life and the fulfillment of human needs. Temporary housing demand can occur due to migration, extreme environmental events or personal decisions, and is expected to increase in the upcoming years. This study aims to create a general understanding of temporary housing. We conducted an integrated comparison of 66 international temporary housing examples via tabulation (table work), in an interdisciplinary manner considering details regarding built structure, open spaces, area, infrastructure, organizational and socio-economic aspects. It is the first time that a systematic comparison via tabulation (based on the approach of Braun-Blanquet) is used to classify temporary housing environments. The process is described in detail. The application of the systematic comparison creates a detailed typology that allows extensions and further differentiations. The types that emerge from the tabulation have specific concepts regarding the structural-spatial organization, technical infrastructure, and organizational matters, among others. The typology was further examined in the context of previous groupings in published literature. This novel approach of analyzing and structuring temporary housing offers a comprehensive perspective that can work as a universal understanding and language for precise communication among different disciplines regarding temporary housing.

Keywords Temporary housing · Temporary accommodation · Braun-Blanquet approach · Systematic comparison · Tabulation

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1 Introduction

Temporary housing includes all forms of accommodation of individuals with non-permanent intentions (Johnson 2002), covering structures built to be temporarily on-site, as well as permanent buildings that are used for temporary stays. A rise in the demand for temporary housing is expected (Perrucci et al. 2016) due to various drivers, including the increasing severity of impacts of ‘natural’ disasters, the effects of climate change, and political conflicts (Black et al. 2013; Foresight 2011; UNHCR 2020). For some individuals, temporary housing represents a makeshift solution until permanent accommodation is reestablished or found (possible drivers may be external such as the above mentioned or personal decisions forced by biographical disruptions or uncertain future perspectives due to e.g. separation or illness). Others may freely choose this form of living (experimenting with alternative forms of living, relocation for higher education, etc.). The contrasting pair of temporary and permanent only expresses intentions. Experience has shown that neither the first nor the latter always apply as planned. For this study’s purpose, we define a maximum (intended) stay/duration of 10 years as “temporary”. Purely touristic or hospital stays are excluded since the study’s object is housing which refers to settling and having everyday lives in the understanding of Katz (2017) and scholars of the subsistence theory (Mies and Bennholdt-Thomsen 1999). We chose the term ‘housing’ over ‘accommodation’ as the active verb to house stresses that it is constituted by various actions to fulfill human needs (Kennedy et al. 2008; Turner 1972). The study focuses on the urban environment, all analyzed examples are situated in or are suited for an urban context.¹

The research interest in temporary housing is rising. As highlighted by Albadra et al. (2018), the number of scientific publications on temporary housing has increased continuously over the last thirty years (see Johnson 2002; Félix et al. 2015; Perrucci et al. 2016; Al Asali et al. 2019). NGOs and public administrations have also engaged with the topic, releasing reports and guidelines suggesting procedures in post-disaster and migration events (Corsellis and Vitale 2008; IFRC and OCHA 2015; Sphere Project 2018; UNHCR s.a; UNHCR Shelter and Settlement Section 2016). Several authors from different backgrounds (post-disaster, migration, architecture) have tackled the challenge of classifying the different forms of temporary housing (Quarantelli 1982, 1995; Corsellis and Vitale 2008; Johnson 2010; Kikano et al. 2015; Albadra et al. 2018; Kronenburg 1995). Within and between different backgrounds ambiguous definitions and use of terms regarding temporary housing have been observed (Quarantelli 1995; Wagemann 2017).

This study is connected to a research project² that assesses and creates innovative and sustainable urban temporary housing concepts in an interdisciplinary way.³ Hence, the study aims to create a clear understanding of the complex phenomenon of temporary housing, focusing on the integral parts that it comprises. Various scholars have addressed the challenges of interdisciplinary research (e.g. Borrego and Newswander 2008; Carr et al.

¹ The complex and interdisciplinary question of ‘what is urban?’ is not debated here; for this study urban refers to urban ground or characteristics. The majority of the examples are located in cities, additionally, camps with city characteristics such as population size or density, are also considered in accordance with Alshoubaki (2018).

² The project “Urban pop-up housing environments and their potential as local innovation systems” is funded by the Vienna Science and Technology Fund (WWTF).

³ The data collection was conducted by six scientists of the following backgrounds: landscape planning, urban planning, solid waste management, sanitary engineering, architecture, closed-loop processes, human ecology, technology assessment, mathematics and energy engineering.

2018); for the aim of this study, lots of communication was necessary to create a common understanding of terms and concepts (Strasser et al. 2014).

To generate knowledge about temporary housing and its constituting parts, we applied a systematic comparison via tabulation (table work). With this method, we compared recent international temporary housing examples with each other to learn about their characteristics, similarities, and differences and eventually their principles and concepts. This method has never been applied to the field. We hypothesize that a systematic comparison via tabulation is a suitable method to compare temporary housing environments with each other. It is an integrated approach that allows the manifold disciplines to map the different elements of the housing environments and deduct a typology of temporary housing environments. The result is a typology that arranges the examples into comprehensible groups. Their designation provides explicit terms for the different forms of temporary housing, enabling clear communication within and beyond diverse research fields. Another benefit is that the typology is extendible providing an excellent basis for further research.

To understand the approach, we describe the process step-by-step in the method Sect. (2.2), after giving insights on the study's theoretical background (2.1). The results section is arranged according to the method's procedure: owed to the paper's brevity three out of the 66 examples and their associated groups are described (3.1 and 3.2). We then present the typology that emerged from the tabulation (3.4). This typology is then contrasted with four approaches of published literature (3.4) (2.2). In the discussion, the suitability of the method and results are discussed (4.1). Lastly, we review the method's challenges and prospects, concluding with an outlook on future research (4.2).

2 Theoretical and methodological approach

2.1 Theoretical approach

Out of manifold possible approaches we chose Gestalt theory to be the guiding metatheory of this research because it is integrative, interdisciplinary, and evidence-based (Schneider and Scharmann 2020). Gestalt theory proposes an integrated view on the topic by dealing with its constituting parts, stating that the whole is other than the sum of its parts (Neuweg 2019; Arvidson 2014), therefore, the whole (temporary housing) can only be understood by studying its inherent parts (building, area, users, etc.). This approach is suitable for complex subjects such as housing. According to Gestalt theory, systems cannot be forced into any arbitrary form. The measures of order have their origin in the system itself (Kriz 2008). The interpretation of the table resulting from the systematic comparison is guided by the characteristics of its structure.

A normative value within the study is to enable a good life for the residents, providing them opportunities to satisfy their needs (Max-Neef, 1991) and organize their everyday life in a self-determined manner (Mies and Bennholdt-Thomsen 1999). This premise is kept in mind throughout the whole study. This is part of the planning principle „*Innenhaus–Außenhaus*“ (Hülbusch 1981), which addresses the enclosed (*Innenhaus*) and open spaces (*Außenhaus*) in context with people's freedom of action (Mayrhofer 2019). The

assessment of private and communal enclosed and open spaces has therefore received special attention.

2.2 Method

Systematic comparison is a descriptive, comparative and synthesizing method that was originally developed in phytosociology to describe and compare plant communities with each other (Braun-Blanquet 1928; Tüxen 1970; Moore 1972; Dierschke 1994; Ewald 2003). Compositional patterns and gradients of research subjects are detected and analyzed in tables. Scientists from other areas applied the method to assess various research subjects, such as landscapes (Claisse and Géhu 1978; Theiling 1997; Pichler 2006). In landscape planning, it has been applied successfully since the 1990s for the differentiation of built and open spaces (Damyanovic 2007). Common applications are the comparison of built and open space structures on private plots, public open spaces and streetscapes, among others.

In its original application, the (plant) species that occur at the assessed spot are recorded in a table. For applications in other areas, the characteristics depend on the research question posed (Theiling 1997): in landscape planning, all structural, material and socio-economic characteristics relevant to the research objective are recorded. The same applies to this case. The research project posed the question of innovative and sustainable temporary housing forms, which is why these characteristics got assessed (and are included in the table). We have not only selected innovative and sustainable examples, but the intention was to examine implemented examples for their sustainability and innovation potential. Additionally, relevant details on the built structure, area, user groups, duration on site, etc. were recorded.

Figure 1 shows the process of the applied systematic comparison. After determining the aim, we collected a wide range of distinct contemporary temporary housing examples in the urban context (see (a) in Fig. 1). We recorded all examples for which enough information was available. Scientific journals and books, reports from humanitarian agencies and administrations, recommendations, and personal recollection (b) served as sources. A database was set up to systematically gather the examples' information regarding the structural and spatial environment, technical infrastructure, socio-economic organization, life-cycle considerations, and innovation potential. The examples helped to inform the compilation of attributes for the database (c). The minimum requirements for entering the database were the presence of a picture, the precise location, and basic information on the structural-spatial environment, technical infrastructure, and details on the users (d). For each example, a profile was created documenting broad information giving insights on its constituting parts (the use of materials, dwelling type, private and building-related open spaces, former land use, water supply, electricity connection, heating system, duration on site, user groups, as well as innovative aspects, among others) (e). Like other scientists comparing bigger numbers of housing environments (e.g. Seike et al. 2018), we had difficulties accessing data regarding all mentioned aspects. Only a few examples were well-described within a single source, therefore, YouTube videos, reports, news articles, documentaries, Facebook pages, Google Earth, communication with developers, and on-site visits provided additional insights. A total of 103 current examples from various countries (Europe, America, Asia, Africa) were collected from mid 2018 to mid 2019.

As preparatory work, we carried out a phenomenological comparison (Crease 1995f) (f) to perform a first grouping of temporary housing environments. For this, we took an image

Fig. 1 Working process

showing the entire dwelling of each example and compared them with each other, arranging similar examples according to their visual impression/appearance. Characteristics that were not shown on the picture (e.g. foundation, distribution of rooms, etc.) could not be considered in this approach. Like this, an initial sequence was created from individual units towards multi-unit buildings and from less durable (tents) towards more durable structures (permanent housing).

While comprehensive descriptions of the examples are not necessary for the phenomenological comparison, they are a prerequisite for the systematic comparison. This led to the exclusion of several examples in the database due to missing accessible information regarding specific components of the housing environments (g). Out of the 103 examples in the database, we assessed 66 via tabulation. In tabulation, the examples are described by the appearing characteristics, which we refer to as criteria. They are extracted from the

database and describe the examples regarding the mentioned aspects. All characteristics of the assessed examples that were noticed during the survey were included in the database and subsequently the table. This corresponds with Gestalt theory's requirement: Arnheim expounded on the importance of taking everything perceived literally (Arnheim 1962). In our case, that means that all aspects perceived during the investigations entered the database and subsequently the table. The tabular comparison arrangement started by putting the first example in a column and the relevant criteria in the rows below, marking the intersecting field with an "x". The criteria are for instance "building has a durable foundation", "unit is lockable" or "user group students". The criteria are formulated positively so that only appearing characteristics (no lacks like "has no PV panel") are described. That leads to a first column full of "x". Incorporating further examples, we assessed all existing criteria, ticking if occurring or left blank if the criteria are non-occurring in a given example (i). If examples contained characteristics that were not mentioned in the table yet, we added the new criteria and re-examined the already incorporated examples for these new criteria.⁴ The compilation of all analyzed examples amounted to 369 criteria that ensured that they were described in a multi-faceted and interdisciplinary way. The table is of a rather unwieldy dimension. Figure 2 shows a schematic diagram of the tabulation. The complete list of criteria can be extracted from Table S2 in the appendix.

Once the table was set up (*raw table*), several arrangement steps were applied: in the first step we organized the examples according to the order of the phenomenological comparison (*h*). This order is merely a presorting that works as guidance for this step and is moot for the further procedure. Then, we sorted the criteria by the number of fulfilled criteria placing the most frequently occurring criteria at the top of the table and subsequently all others in descending order (*constancy table*) (i) (Ewald 2003). We compared the columns and rows with each other and sorted them according to their similarities and differences (j). This was an iterative process, comparing the presence and absence of "x" until an order was established in which examples and criteria of similar patterns are placed next to each other.

The established order created a pattern (by accumulations of 'x' and unmarked spaces). A proper presentation of the sorted table is difficult due to its size. Figure 3 visualizes the emerged structure. A legible edition can be found in the appendix (Table S2). The resulting structure could then be detected (k): we identified and designated groups of similar structures. The groups hold criteria that are distinctive for one or various groups (*character and differential species* in phytosociology (Weber et al. 2000)). Each group is represented in the table by one or various examples that have similarities with each other and differ from the others regarding the occurrence and absence of criteria. The groups, so-called *syntaxa*, are organized on various levels in a typology following the systematic of phytosociology (m). From bottom to top, the levels are called *types*, *alliances*, *orders*, *classes*, and *formations*, each of them consisting of one or various of the previous (Schaefer 2012) (Table 1 in 3.3). Figure 4 shows a hybrid diagram that emphasizes the connection between tabulation and typology: the first five lines are the typology's *syntaxa* (more details can be found in 3.4.). Additionally, at the bottom, the names of the alliances are displayed. The table shows the selected criteria of the examples that prove to be the distinctive criteria of all *syntaxa*.

⁴ This step is necessary for the method and functions as a double-check, since the attention is led towards different features in the different examples. In one example the previous land-use may not have been prominent but the method requires that it is documented.

Fig. 2 Schematic diagram of the tabulation process

Literature offers defined terms and concepts such as the definition of a single-unit house in contrast to multi-unit buildings (Coolen and Meesters 2012; Harenburg and Wannags 1991). When creating the typology, existing empirical knowledge and defined terms could be taken as hypotheses and be examined (Fig. 1). The syntaxas' names represent the occurring phenomena of the respective group. Just as in phytosociology, the names are concise and carry an idea of the character of the syntaxa (Dengler 2016). The names cannot contain all characteristic aspects and be 'wholly adequate' (Weber et al. 2000, p. 740); however they must be explicitly making clear which form is meant. The syntaxa created in this study is described and explained in the results section. The arrangement of the examples and criteria according to the appearances and absences of "x" matches the organizational structure of Gestalt theory's principles of grouping (Wertheimer 1923) (step *k*). The structure created by the presence, co-occurrence, and absence of criteria had to be comprehended (*n*) and raised to a level of abstraction where concepts could be distinguished (*o*). The concepts then have to be understood in the context of the different forms of temporary housing.

The method of tabulation allows further table arrangements to be made to assess specific aspects. Section tables (*Teiltabellen*), for example, display selected syntaxa with their encompassing criteria arranged to thematic groups (Holzner et al. 1980). They show a clear depiction of the different disciplines (*p*), in Fig. 1) and are a helpful tool to understand the diverse concepts that are inherent to the syntaxa. Table S1 is a section table that shows selected criteria of *detached individual tents* and *detached durable multi-unit buildings*. The criteria do neither hold the order that resulted from the tabulation process nor all criteria. Relevant criteria are arranged according to disciplines to show the properties of *detached tents* and *detached durable multi-unit buildings* regarding the built environment,

The figure displays a large table with 66 rows, each representing an example. The first column lists the examples, and the subsequent columns contain binary data (0s and 1s). Two vertical grey bars highlight specific columns, and two horizontal grey bars highlight specific rows, indicating examples described in section 3.1.

Fig. 3 Visualization of the arranged tabulation table shows the occurring structure of the 66 analyzed examples; the grey fields indicate the examples that are described in 3.1 and shown in the section table (Table S1)

Fig. 4 Hybrid diagram showing the connection between tabulation and typology

spatial organization and environment, infrastructure, and circularity, socio-economic and organizational aspects. The apparent concepts of the two syntaxa are illustrated and discussed in the following chapter.

In addition to the presented method, literature screening was carried out. In the first step, we screened scientific databases (Scopus, Science Direct, Google Scholar). Whenever publications indicated further relevant publications, they were also assessed (snowballing). Several publications contain groupings of temporary housing environments, of which some are further analyzed and contrasted with our typology (see 3.4 and 4.1).

3 Results

In this chapter, the results of this study are presented. Since not all 66 analyzed examples can be presented, we describe three in detail in Sect. 3.1 to offer an impression of the examples and show how the descriptions got translated into criteria of the table. In 3.2 we describe the general principles of the example's types. In 3.3 we present and describe the whole typology and in the last Sect.3.4, we place it in context with groupings of published literature.

3.1 Step 1: From the examples...

In the following, three examples are presented briefly to show the process from the example description and analysis in the table to the creation and further interpretation of the groups (*types* in this case). These three examples have been selected to show both similar examples (same type) as well as very differing examples (different formations). Criteria that can be traced in the tables (Table S1 and S2) are italicized.

3.1.1 Example staff accommodation in Balukhali II

This example describes the staff's accommodation adjacent to a field hospital in Balukhali, Bangladesh in early 2018, approximately six months after massive movements of people fleeing the Rohingya genocide started. The large number of people settling the area of Cox's Bazar necessitated provision of additional health posts and humanitarian assistance, thus the field hospital was established. The base camp for expat health workers in this field hospital consists of individual unit tents (criteria in the section table (Table S1): *frame construction with lightweight walls, supported by poles, accommodation without foundation*) (Figs. 5 and 6). The settlement is equipped with a field kitchen, on-site sanitation, and off-grid water supply (*field kitchen in another dwelling, on-site sanitation (pit latrine), water supply by water trucking and drinking water supply via bottles*). Energy provision is provided by generators (emergency power generator). The camp is organized on different layers: the kitchen, sanitation, and laundry facilities are to be used by the residents together, energy provision, and waste collection have facilities on the neighborhood level (groups of tents), the appropriation of the open space surrounding the units happens individually.

Fig. 5 Tents in staffs' accommodation area at Balukhali II, Bangladesh **a**, field kitchen **b** and laundry facility **c**

Fig. 6 Sketch of field hospital with accommodation area at Balukhali II (Icons by Freepik)

3.1.2 Example UNHCR family tent in Zaatari refugee camp

This example describes a specific accommodation in Zaatari refugee camp, Jordan, in the first years of the camp. The camp opened to host people fleeing the ongoing violence in Syria (*user group migrants, user group fled from violence*). In the camp, there were detached units without foundation made out of *polyester-cotton, a lightweight flexible material, supported by poles* (Fig. 7). They were *individual units on one plot without physical borders like fences*, the units have *private open space through appropriation* (for

Fig. 7 Zaatari refugee camp in Jordan in 2013 (Photo by British Foreign and Commonwealth Office, licensed under CC BY-ND 4.0 (<https://www.flickr.com/photos/foreignoffice/9664134648>))

Fig. 8 Schematic sketch of Zaatari refugee camp (Icons by Smashicons)

cultivation, drying laundry, play, etc.). The technical and social infrastructure was organized by the camp (Fig. 8) and developed rapidly, just like the settlement. The situation today is rather different. In 2013 there were around 8,000 tents with either shared or private sanitation facilities. Clean water was trucked to the camp and wastewater was then removed by trucks again. The camp was connected to the electricity grid, units could be supplied with energy as well.

3.1.3 Example Home 21 in Vienna

This example includes two durable 4 (in some parts 5)-storied buildings in Vienna, Austria. Primary materials are concrete and steel (*temporary housing environment (THE) made out of heavyweight, rigid materials*). The buildings include around 250 apartments for people

Fig. 9 Building of Home 21 in Vienna, Austria (Photo by Daniel Hawelka)

entitled to social housing and people with an increased need for support (first housing for homeless persons, single-mothers, etc.) (*user group: locals, user group: people entitled to social housing, user group: homeless persons*, among others). The ground floor includes wheelchair-accessible flats and commercial units (*mixed use in THE*). The apartments are fully equipped and connected to centralized technical infrastructure (*connection to power grid, unit connected to centralized water supply, THE has sewage connection*). The residents have private balconies (*unit contains private open space (balcony)*) (Fig. 9) and *collectively used open space on the ground floor* (Fig. 10). The buildings have been developed within a city's subsidy program to alleviate housing shortage, encouraging the construction of temporary low-cost housing in areas that are eventually intended for other uses (*subsidized living units/state-funded, mixed building land (zoning plan)*). They are intended to be used for housing for 10 years and afterward for commercial uses. Since the example, like others, was evaluated via desktop research, limitations and errors can occur. As it could not be discerned on maps and plans, the exact location of the building's entrances is unknown.

3.2 Step 2: ...to principles and concepts of the syntax

The examples have specific characteristics that have to be abstracted and elevated to a level of principles to be compared with each other. Table S1 shows selected criteria of several analyzed examples, including the three presented examples in Balukhali, Zaatar, and Vienna (grey highlighted). The table shows that they have criteria in common with other examples, thus the first two were grouped by the systematic comparison to the alliance *detached individual tents (A1)* and further on to the type *detached individual tents in camps (T2)* and the latter into *detached durable multi-unit buildings (A11) within urban fabric (T15)*. Table S1 shows that there are criteria that are typical for the alliances, for *detached individual tents* for example such as '*unit accessed by footpath*' and that there are clear differences between the two types T1 and T2, such as '*unit embedded in publicly accessible urban fabric*'. But there are also gradients within the syntax: criteria that occur in one and the other demonstrating the transitions from one to the other. The differences regarding

Fig. 10 Schematic sketch of Home 21 (Icons by Freepik and Flaticon)

the various areas are diverse conditions of the spatial organization, set-up, and provision of infrastructure, property rights, use of open space, access to surroundings, etc. and ultimately mean different living conditions for the users.

3.2.1 Detached individual tents (A1)

The analysis of the systematic comparison (Table S2) and section table (Table S1) helped to attain general knowledge on *detached individual tents (A1)* and *detached individual tents in camps (T2)* based on the assessment of all examined tent examples. Tents consist of *one room only and are single-storied*. Materials and structure allow *space-saving storage and transport, fast and easy assembly and dismantling*, but present limited weather-resistance and durability, limiting the reuse potential. The examples of this alliance are generally provided with energy, sometimes the tents even have an electricity connection. In camps, cooking/dining and sanitation facilities are supplied by the camp and often located in separate dwellings. Among the examples, different levels of organization can be distinguished: on unit level residents possess direct, private access and appropriated open space surrounding the unit (see: spatial organization and environment in Table S1). Cooking, sanitation, and laundry facilities may be organized on unit, neighborhood (group of units), or camp level. In camps, the provision of tents, facilities, infrastructure, and services is generally centralized. Tents are mostly placed on unbuilt green land that is not formally parcelled out, and the residents do not own the land. When comparing this alliance with others in the table, the absences are apparent: the units are not lockable, which indicates for a lack privacy and security. Since the residents are not owners of the plot, and not always of the tent, they have (limited) entitlements. Figure 11 shows the physical concept of *detached individual tents in camps (T2)*.

Fig. 11 Schematic sketch of detached individual tents in camps (T2)

Fig. 12 Schematic sketch of detached durable multi-unit buildings (A11)

3.2.2 Detached durable multi-unit buildings (A11)

The buildings of this alliance are placed on *durable foundations*, an indication for being *residential buildings planned to be permanently on-site*. They are made out of heavy-weight, rigid materials or shipping containers and all have thermal insulation. The buildings have various apartments per floor (Fig. 12) and are multi-storied. The housing environments may consist of more than one building and often comprise over 100 units in total. The buildings are connected to centralized infrastructure (*unit has sewage connection, unit connected to centralized water supply, connection to central power grid, municipal waste collection*). The units work as independent households (*unit has private toilet, unit has private bathroom, private kitchen*) but share some facilities (shared laundry room). The units are lockable, an important condition for privacy and security. Since the *residents are renting* they have (limited) entitlements.

3.3 Typology

The systematic comparison via tabulation created a table in which the examples were compared with each other according to differences and similarities in 369 criteria (Fig. 3). This

Fig. 13 Further examples of temporary housing environments assigned to **a** detached cabins without foundation (A3) (Photo by Lifeshelter) **b** floating multi-unit buildings (A5) (Photo by Nick Karvounis on Unsplash), **c** detached demountable multi-unit buildings (A9) and **d** detached reused social facility buildings (A13)

structure led to a typology of urban temporary housing environments on five levels creating 2 formations, four classes, fourteen orders, twenty-two alliances, and twenty-six types (Table 1).

The first level of structuring is into two formations (Table 1): *demountable housing environments of planned temporary presence* (F1) and *temporary housing environments in durable buildings* (F2) that distinguish between the presence and kind of foundation. With the term ‘foundation’, we refer to buildings’ elements that transmit structural and externally applied loads to the building (wind, vibrations, seismic shocks, and tremors), directly to the ground (Jumikis 1984). Only elements that are anchored to the ground are considered foundations.⁵ The assessed examples have either no, a demountable (removable without major impact to the ground) or durable (made out of concrete, removal by heavy machinery, the ground is impacted for longer) foundation. The absence or presence and kind of a foundation is an indication of the temporary nature/permanence of a housing environment and has an impact on its subsequent use or re-use.

Demountable housing environments of planned temporary presence (F1) encompass dwellings that are built for a limited presence on a particular site. We call them demountable because these structures are modular and/or easily dismantled. The examples of this group are further arranged in 2 classes: *accommodations without foundations intended for residential use* (C1) and *buildings on demountable foundations intended for residential use* (C2).

Accommodations without foundations intended for residential use (C1) were further structured into: *tents* (O1)–textile dwellings supported by poles, *cabins* (O2)–hard shell units (like *a* in Fig. 13), and *mobile accommodations*⁶ (O3)–dwellings that are moveable

⁵ Heavy flooring such as in EXO emergency shelters are therefore not considered foundations.

⁶ In contrast to Kronenburg (2008), we define mobile accommodations as housing units that can only be moved without external assistance.

Table 1 Typology of urban temporary housing environments (the allocation of the three examples discussed in 3.1. is highlighted in grey)

Typology of urban temporary housing environments																																																								
Formation (F)	demountable housing environments of planned temporary presence (F1)				temporary housing environments in durable buildings (F2)																																																			
	buildings with demountable foundation intended for residential use (C2)				buildings on durable foundations intended for residential use (C3)				non-residential buildings on durable foundations (C4)																																															
Class (C)	individual unit buildings on demountable foundations (A6)				multi-unit buildings on demountable foundations (A9)				lightweight hails on demountable foundations (O6)				multi-unit buildings on durable foundations (O7)				reused social facility buildings (O8)				reused hotel buildings (O9)				reused administrative buildings (O10)				reused office buildings (O11)				reused retail buildings (O12)				reused industrial buildings (O13)				reused educational buildings (O14)															
	detached individual unit buildings (A6)				detached demountable multi-unit buildings (A9)				detached lightweight hails (A10)				detached durable multi-unit buildings (A11)				detached durable multi-unit buildings (A12)				detached reused social facility buildings (A13)				detached reused hotel buildings (A15)				detached reused hotel buildings (A16)				detached repurposed administrative buildings (A17)				detached repurposed office buildings (A18)				detached repurposed retail buildings (A19)				detached repurposed halls (A20)				detached repurposed sports halls (A21)				attached repurposed sports halls (A22)			
Order (O)	detached individual unit buildings (A6)				detached demountable multi-unit buildings (A9)				detached lightweight hails (A10)				detached durable multi-unit buildings (A11)				detached durable multi-unit buildings (A12)				detached reused social facility buildings (A13)				detached reused hotel buildings (A15)				detached reused hotel buildings (A16)				detached repurposed administrative buildings (A17)				detached repurposed office buildings (A18)				detached repurposed retail buildings (A19)				detached repurposed halls (A20)				detached repurposed sports halls (A21)				attached repurposed sports halls (A22)			
	detached individual unit buildings (A6)				detached demountable multi-unit buildings (A9)				detached lightweight hails (A10)				detached durable multi-unit buildings (A11)				detached durable multi-unit buildings (A12)				detached reused social facility buildings (A13)				detached reused hotel buildings (A15)				detached reused hotel buildings (A16)				detached repurposed administrative buildings (A17)				detached repurposed office buildings (A18)				detached repurposed retail buildings (A19)				detached repurposed halls (A20)				detached repurposed sports halls (A21)				attached repurposed sports halls (A22)			
Alliance (A)	detached individual unit buildings (A6)				detached demountable multi-unit buildings (A9)				detached lightweight hails (A10)				detached durable multi-unit buildings (A11)				detached durable multi-unit buildings (A12)				detached reused social facility buildings (A13)				detached reused hotel buildings (A15)				detached reused hotel buildings (A16)				detached repurposed administrative buildings (A17)				detached repurposed office buildings (A18)				detached repurposed retail buildings (A19)				detached repurposed halls (A20)				detached repurposed sports halls (A21)				attached repurposed sports halls (A22)			
	detached individual unit buildings (A6)				detached demountable multi-unit buildings (A9)				detached lightweight hails (A10)				detached durable multi-unit buildings (A11)				detached durable multi-unit buildings (A12)				detached reused social facility buildings (A13)				detached reused hotel buildings (A15)				detached reused hotel buildings (A16)				detached repurposed administrative buildings (A17)				detached repurposed office buildings (A18)				detached repurposed retail buildings (A19)				detached repurposed halls (A20)				detached repurposed sports halls (A21)				attached repurposed sports halls (A22)			
Type (T)	detached individual unit buildings (A6)				detached demountable multi-unit buildings (A9)				detached lightweight hails (A10)				detached durable multi-unit buildings (A11)				detached durable multi-unit buildings (A12)				detached reused social facility buildings (A13)				detached reused hotel buildings (A15)				detached reused hotel buildings (A16)				detached repurposed administrative buildings (A17)				detached repurposed office buildings (A18)				detached repurposed retail buildings (A19)				detached repurposed halls (A20)				detached repurposed sports halls (A21)				attached repurposed sports halls (A22)			
	detached individual unit buildings (A6)				detached demountable multi-unit buildings (A9)				detached lightweight hails (A10)				detached durable multi-unit buildings (A11)				detached durable multi-unit buildings (A12)				detached reused social facility buildings (A13)				detached reused hotel buildings (A15)				detached reused hotel buildings (A16)				detached repurposed administrative buildings (A17)				detached repurposed office buildings (A18)				detached repurposed retail buildings (A19)				detached repurposed halls (A20)				detached repurposed sports halls (A21)				attached repurposed sports halls (A22)			

* These types are formulated as hypotheses since they contain less than four examples.

*These types are formulated as hypotheses since they contain less than 4 examples

without lifting, which means that they include their mode of transportation already, (on wheels or floating on water such as *b* in Fig. 13).

Buildings on demountable foundations intended for residential use (C2) were structured by the number and settings of their residential units. *Individual unit buildings on demountable foundations* (O4) have one unit per entrance, *multi-unit buildings on demountable foundations* (O5) (such as *c* in Fig. 13) contain various units per entrance, and halls on demountable foundations (O6) a large room with one (or several) entrance(s) containing a large number of sleeping niches or bunks instead of units.⁷

The other formation, *temporary housing environments in durable buildings* (F2) include all buildings on durable foundations (coinciding often with heavyweight materials).⁸ Accommodations of this formation are intended to stay on-site for a long time ('permanently'). They may have been built for temporary residential use or another purpose and are (temporarily or permanently) used for temporary accommodation.

Two classes are differentiated: *Buildings on durable foundations intended for residential use* (C3) include buildings that were constructed with the intent to accommodate people, whereas *non-residential buildings on durable foundations* (C4) include buildings that were constructed for other purposes. Buildings on durable foundations intended for residential use (C3) have in common that they are built for accommodation purposes, so their facilities enable habitation without major structural modifications. They are structured into *multi-unit buildings on durable foundations* (O7), *reused social facility buildings* (O8) (like *d* in Fig. 13), and *reused hotel buildings* (O9). In the latter two cases, the buildings are utilized for other uses than what was initially intended (social facility and touristic stays).

Since the utilization of *non-residential buildings on durable foundations* (C4) as accommodation for people represents a repurposing, also referred to as adaptive reuse, it entails that they have to be (structurally) adapted or complemented. We assessed *repurposed administrative buildings* (O10), *repurposed office buildings* (O11), *repurposed retail buildings* (O12), *repurposed industrial buildings* (O13), and *repurposed educational buildings* (O14).

The orders were further organized into alliances according to the urban layout (detached, semi-detached and attached accommodations describe if the dwellings share walls with neighboring dwellings or not) and types according to the settlement properties (in a camp⁹ or within the urban fabric of a city).

3.4 Typology in the context of published literature

In published literature, various groupings of temporary housing environments can be found. The approaches are determined by the particular research questions or applications. NGOs and public administrations, for instance, often consider different forms of assistance (such as the distribution of material, financial support, etc.) in addition to accommodation options (Sphere Project 2018; UNHCR s.a.), and scientists create typologies according to

⁷ We define unit as at least one spatially separated area (room).

⁸ Durable building refers to buildings that persist in a setting on a particular spot for a longer period. The term does not refer to the longevity of the materials. Demountable housing environments of planned temporary presence may consist of durable materials/modules.

⁹ Broadening UNHCR 's (2014) definition of camps, we use this term for purpose-built settlements for certain groups (refugees, IDPs, homeless persons, etc.) that are managed by third parties (e.g. governments, humanitarian agencies).

their specific field of study. Our research question was informed by an interdisciplinary project pursuing a general approach. Table 2 shows the structure and concepts of four grouping approaches (Quarantelli (1982), Kronenburg (2014), Johnson (2010), and UNHCR (2018)) and an overview of our typology. The four approaches were selected since they focus on temporary housing solutions, mainly excluding other types of aid (financial support, food supply, etc.).

Quarantelli's (1982) approach structures housing environments that are used in post-disaster housing according to the planned duration and time of application. Kronenburg (2014) applied a grouping of "mobile and temporary building systems" according to their number of components, as well as the time and effort needed to assemble the buildings on-site. Similar to other authors (e.g. Onay 2018), Johnson (2010) differentiates post-disaster housing into two main groups: types that need new construction¹⁰ and types that do not. Additionally, she diversifies according to organizational, built, structural-spatial, and social-economic aspects. Compared to Johnson's approach, in our typology the structural-spatial conditions of housing environments feature prominently in contrast to the social-economic aspects. UNHCR's (2018) typology of shelter types for refugees is solely based on structural characteristics of the housing environments.¹¹ It appears that after the first grouping into three divisions (similar to ours), known building types are applied to designate the diverse structures.

A common feature of the approaches by Johnson, UNHCR and ours is that they differ at various (two or five) levels, on each level additional information is provided and different concepts can be detected. Since instructions on their derivation have not been published, questions regarding the applied methods for comparison remain open. Furthermore, we screened publications of various authors that compared temporary housing examples (Seike et al. 2018; Toma 2018) or case studies (Kelman et al. 2011) with each other, but did not find descriptions of how classifications were derived. It is a unique feature of our typology that we present the typology including its derivation.

4 Discussion

4.1 Typology as the basis for a better understanding

Wagemann (2017, p. 235) discusses the difficulty "to find definitions that apply in different contexts because each disaster, each country, and the way houses take shape is different". To understand the phenomenon of temporary housing, clear concepts and consistent terminology are needed (Quarantelli 1995; Wagemann 2017; Pezzica et al. 2018). These should be independent of the trigger and generally applicable.

In Table 2 we introduced four published approaches to structure temporary housing environments and compared them with our typology. While the four analyzed approaches are suitable for the objective of their respective application, their suitability for a general application is varying and depends on the structuring features. Quarantelli's approach (see at the bottom of Table 2) is difficult to apply to housing environments that emerge for other

¹⁰ Tents, shipping containers, etc. do not necessarily need new construction since they can be reused. We should consider this grouping as "types that do require new setting up/placement".

¹¹ The document includes further typologies according to which shelters can be sorted: collectivity, communality, management, adequacy, sealing; that seem to be applied independently (UNHCR 2018).

reasons than emergencies and have unpredictable life spans due to its ambiguity. Typologies structured by material-structural characteristics are easier to apply to other contexts, though some might need adaptations. To apply Kronenburg's approach in general contexts, it would first have to be expanded for buildings other than mobile. Although there are similarities in the essence of Johnson's, UNHCR's and our typology, the typology we developed involved an interdisciplinary analysis, providing detailed wording and descriptions which allow a precise classification that is not restricted to the dwellings but also touches upon their environments. Our types include sound information on structural and spatial conditions. From the type designation *detached durable multi-unit building within the urban fabric*, it can be discerned that the dwelling is intended to be on-site for a longer period, since it is a durable building. The number of units indicates the density. It is surrounded by open space and has no connection to other buildings (detached) which makes its application more independent from the surroundings. Its location in the urban fabric indicates its possibility of connection to the surrounding social and technical infrastructure, as well as being bound by the city's regulations.

We take tents as an example to compare the different approaches' designation/allocation. They can be found in Johnson's and UNHCR's approach with the respective additional information (grouping) that they are non-permanent structures (UNHCR) or rather newly constructed (Johnson). Kronenburg does not assign it directly, the definition of relocatable buildings (transported in parts, fast assembly on-site, etc.) or demountable building (transported in many parts (...), compact for transportation) may both be suitable. In Quarantelli's approach, they may be allocated to any of the first three groups, depending on the duration of use (in the publication they are mentioned as temporary housing example). In our typology, there is the possibility to refer to them as tents but also to name them more precisely (A1-2, T1-3). The allocation to the formation and class states that the dwellings are intended to be temporarily on-site and have no foundation. Compared to the other approaches, our typology is unambiguous and more informative as it goes into greater depth.

Our proposed typology for the context of temporary housing environments offers the following advantages: a general applicability due to its structure, a clear wording and terminology, and the possibility to replicate and expand (see 4.2), in case further differentiation is desired. We suggest taking the typology's syntaxa (designations) to refer to the different forms of temporary housing. Applying a well-defined terminology based on tangible characteristics (spatial-built) offers a precise language for communication within and among the diverse fields and backgrounds. Only based on a common understanding overarching the different fields, a discourse between the disciplines can be created, facilitating an exchange of experiences, findings, approaches, and innovations.

4.2 Tabulation and typology as a basis for further research

One of the study's purposes is to understand temporary housing by assessing a variety of different housing forms. The systematic comparison leads to a '*qualitative type-creation according to characteristics*' (Hülbusch 1981), based on the precise assessment of the criteria and their interrelations. It is the first time that this method is applied to the field of temporary housing. In section tables, the syntaxa's characteristic criteria become evident (by appearance or absence of criteria). This allows clear insights into the syntaxas' differing concepts regarding the built environment, spatial organization and environment, technical infrastructure, and socio-economic and organizational aspects. The conditions of the

Table 2 Selected approaches to structuring temporary housing environments from published literature compared to our typology

Authors	Kronenburg (2014)	Jonsson (2010)	UNHCR (2018)	Stocker et al. (2020)
Title of publication	Sheltering and Housing after major community disasters: Case studies and general observations	Planning for temporary housing	Shelter typologies	Urban temporary housing environments – from a systematic comparison towards an integrated typology
Background	Architecture in motion. The history and development of portable building	Post-disaster housing	Refugees	Temporary housing
Categorization according to author	Architecture	Typology of temporary housing	Typology of shelter types	Typology of temporary housing ¹
Structure	<p>Portable buildings</p> <p>Types of mobile and temporary building systems</p> <p>Transported whole and intact, may be self-powered or include method of transport</p> <p>Relocatable buildings</p> <p>assembled on-site, quick provision of space without restriction of size imposed by transportation</p> <p>Demountable buildings</p> <p>transported in parts, fast assembly in size and layout, compact for storage and easy to erect and dismantle at site operations</p> <p>Temporary sheltering</p> <p>residings of household during emergency period; types: tents, schools, army</p> <p>Temporary housing</p> <p>residings of household; types: mobile homes, mobile homes, tents, mobile homes, rented apartments, hotels and motels, rent assistance</p>	<p>Pre-disaster housing</p> <p>Typology of temporary housing</p> <p>Types that do require new construction (mass housing camps or dispersal):</p> <ul style="list-style-type: none"> * self-built shelters * shipping containers or mobile homes * temporary housing units 	<p>Refugees</p> <p>Non-permanent structure</p> <ul style="list-style-type: none"> * tent * prefab unit * other 	<p>Temporary housing</p> <p>Demountable housing environments of planned temporary presence (F1)</p> <ul style="list-style-type: none"> * accommodations without foundation intended for residential use (C1) * tents (O1) * individual tents (A1) * multi-unit tents sharing side walls (A2) * cabins (C2) * detached cabins without foundations (A3) * mobile accommodations (O3) * detached individual units on wheels (A4) * floating multi-unit buildings (A5) <p>Buildings with demountable foundation intended for residential use (C2)</p> <ul style="list-style-type: none"> * individual unit buildings on demountable foundations (O4) * detached individual unit buildings (A6) * detached multi-unit buildings on demountable foundations (A7) * individual unit buildings sharing side walls (A8) * multi-unit buildings on demountable foundations (O5) * detached demountable multi-unit buildings (A9) * lightweight hails on demountable foundations (O6) * detached lightweight hails (A10) <p>Temporary housing environments in durable buildings (F2)</p> <ul style="list-style-type: none"> * buildings on durable foundations intended for residential use (C3) * multi-unit buildings on durable foundations (O7) * detached durable multi-unit buildings (A11) * durable multi-unit buildings in closed coverage type (A12) * detached durable multi-unit buildings in closed coverage type (A13) * detached reused social facility buildings (A14) * reused social facility buildings in closed coverage type (A15) * reused hotel buildings (O9) * detached reused hotel buildings (A15) * reused hotel buildings in closed coverage type (A16) <p>Non-residential buildings on durable foundations (C4)</p> <ul style="list-style-type: none"> * repurposed administrative buildings (O10) * repurposed administrative buildings in closed coverage type (A17) * repurposed office buildings (O11) * detached repurposed office buildings (A18) * repurposed retail buildings (O12) * detached repurposed retail buildings (A19) * repurposed industrial buildings (O13) * detached repurposed industrial buildings (A20) * repurposed sports halls (O14) * detached repurposed sports halls (A21) * repurposed sports halls in closed coverage type (A22)
Concepts / criteria for justification	<p>structures according to number of components and time and effort of assembly on-site</p> <p>describes phases of housing after disasters, structure according to planned duration and time of application</p>	<p>describes possibilities of sheltering; structure according to building types and socio-economic (organizational) aspects</p>	<p>structures according to built organization</p>	<p>structures according to interdisciplinary analysis; designation according to built organization</p>

¹For reasons of space limitations a reduced version of the typology is shown here (without types)

²For reasons of space limitations a reduced version of the typology is shown here (without types)

physical and organizational environment are preconditions for the resident's freedom of action (Mies and Bennholdt-Thomsen 1999). Due to the thematic focus of this paper, these aspects have not yet taken center stage but should be examined in further research.

Further compromises, challenges, and drawbacks of the study are addressed in the following:

It is the theory's (Gestalt theory) and method's (systematic comparison) requirement to depict the subject as a whole. Assumptions were made in cases where no public data was available, like surmising that Viennese households are serviced by the municipal waste collection, although the example's description does not explicitly state the fact. Ideally, all information can be verified. Since on-site visits were not possible for all examples, we mostly depended on external sources that do not represent the object itself but are the perceptions and reproductions of others. Biases (such as judgemental perceptions) may be included, which must be taken into consideration.

The examples found in scientific publications, newspapers, and on websites may over- or underrepresented certain forms of accommodation. Specific triggers may lead to special housing forms, such as staying at a relative's place (e.g. after natural disasters) or self-built accommodations (e.g. in cases of homelessness), for instance. These kinds are underrepresented in literature and publicly accessible sources (Quarantelli 1980). Therefore, we stress that the typology represents an overview of the analyzed housing environments but cannot be considered to be all-encompassing.

The limited number of examples that could be collected in the required quality presents a challenge for the processing and interpretation of the table. To formulate exact subdivisions, more examples would be needed. For this reason, some syntaxa of the typology are to be understood as hypotheses, which are to be examined based on further examples and investigations (groups containing less than four examples are marked with an * in Table 1). Since the theory and method of the approach allow additions and differentiations, the typology can be expanded at any point.

The analysis indicates that the housing environments' diverse aspects affect one another (e.g. aspects of built environment affect infrastructure connection and circularity aspects, just like the organizational aspects affect the built environment and other areas). Besides the resulting groups of the typology, other gradients in the analysis table can be observed: multi-unit buildings on demountable foundations and multi-unit buildings on durable foundations, for example, belonging to different formations have various criteria in common. The assessment of these aspects provides in-depth information on the forms of temporary housing that is yet to be further detected and discussed.

This study could be deepened in two directions. On one side, the examples could be investigated in more detail (through on-site visits and interviews), on the other side, more examples could be assessed. Both would improve the results and may alter them. To expand this research by adding examples, the Table S2 can be taken as a basis. It is recommended to gather all information in a textual description (including pictures, maps, and plans if available). The gathering of the example's description should be driven by its properties. Additionally, the table's criteria should be taken as a support to know what to investigate in what detail. The example is given an individual ID number and transferred to the table. As explained in the method section, all present criteria are queried and marked with a x if applying. If new criteria are created, all previous examples have to be assessed regarding the new criteria. The addition of new criteria might change the order of examples and criteria in the table. The addition of various examples may lead to changing patterns. The reading of these patterns may guide to further differentiation (like various types of tents) and/or changes in the typology (allocation of examples to other (new) syntaxa because of new appearing patterns). One aspect that would

especially benefit from further research regards the social aspects of the temporary housing environments.

5 Concluding remarks

This study had two main aims: to create a clear understanding of temporary housing environments and to demonstrate the application of the systematic comparison to temporary housing. Recent international examples of temporary housing were analyzed and compared with each other via tabulation. This approach is novel to the field. We showed that the systematic comparison meets Gestalt theory's requirements of a complete depiction of the whole subject by assessing different aspects of the research subject. The systematic comparison led to a typology that classifies the housing environments according to their qualities on different levels.

Contrasting our typology with others, we showed that structural-spatial characteristics are suitable to structure the variety of temporary accommodations. The precisely defined terms facilitate a clear understanding of planned and existing structures. The suggested terminology provides a common language to scholars and involved persons of different backgrounds, promoting communication, understanding and learning among different disciplines. This creates the possibility to exchange knowledge and findings, fostering new findings and synergies of various disciplines. The various disciplines might learn from the experiences and structures of other fields, opening spaces for innovations.

The extensive research that has been carried out is a suitable basis for further investigations. The typology is not a rigid structure: the systematic comparison via tabulation allows the integration of further examples and criteria. Continuing the process started here, extensions (new types) as well as more specific differentiation of the classification (sub-types/variations) can be achieved. The method also opens up the possibility for in-depth investigations on examples and/or types, about which there is still a lot to learn.

Supplementary information The online version of this article (<https://doi.org/10.1007/s10901-020-09812-x>) contains supplementary information, which is available to authorized users. **Acknowledgements** We thank our entire project team for the inspiring discussions, with special thanks to Gaetano Bertino and Thomas Märzinger, who collaborated in the collection of examples and creation of the database. We sincerely thank the three anonymous reviewers whose suggestions helped to improve and clarify the manuscript.

Funding The research of this project has been funded by the Vienna Science and Technology Fund (WWTF) through project ESR17-010 and by the Institute of Landscape Planning, University of Natural Resources and Life Sciences Vienna, Austria. Open access funding provided by the University of Natural Resources and Life Sciences Vienna (BOKU).

Data availability The datasets generated during and analyzed during the current study are available from the corresponding author on request. A list of references used to create the database is attached to the submission and may be published as an electronic supplementary material.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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