Polyvalence, a concept for the sustainable dwelling

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TOPIC: TIME-BASED DWELLING

Abstract:

Polyvalence, a concept for the sustainable dwelling.

The word 'polyvalent' has been known for years in the context of the multi-purpose hall or salle polyvalante, the kind of building that is to be found in every French village or small town, that can be used for weddings and parties, for musical and theatrical performances and as a cinema. A hall of this kind can be used for all kinds of functions without any adjustment being required to the building itself. The word was introduced to the architectural debate by Hertzberger [1991], some of whose ideas on polyvalence can be seen in the Diagoon houses (fig 1) he designed for Delft (1967 – 1971). Here too polyvalence means that the building can be used in different ways without adjustment to the way it is built. There is however a difference: the different uses of a salle polyvalante take place consecutively, but a dwelling must be able to provide space for all the different activities which it is capable of accommodating to take place at the same time. Polyvalence in the context of housing relates primarily to the interchange ability of activities between different rooms.

The consequence of this difference is that polyvalence imposes different requirements on the spatial organisation for housing than it does for commercial and industrial buildings. Whereas in a hall polyvalence can be achieved by the use of the proper dimensions and ratios and by the provision of special service areas such as dressing rooms or a foyer, for housing the degree of polyvalence depends primarily on the relationships between the various rooms, i.e. on the spatial composition. The spatial system of a house can be expressed by a topological diagram, a graph According to Hanson [1998]. A spatial system in which different rooms can only be accessed through another room, for example the living room, is less capable of being adapted to suit different living patterns (fig 2 B). The contrast here is with dwellings in which the spatial system allows every room to be reached from a central point or by a number of different routes (Fig 2 C and D). In my article I intend to workout this theme. Based on analysis of differed polyvalent housing projects I will try to find out the basic principles of polyvalent dwelling.

Key words:

Dwelling, Polyvalent, Spatial composition, Graph, Design analysis, sustainable

Determinism or changeability?

At the beginning of the twentieth century architects seized upon the problem of providing homes for the working classes. The urbanisation that had taken place in the nineteenth century had produced rapidly growing metropolises with cheap housing. The housing developments built purely for profit were notorious for their poor hygiene and cramped conditions. This was the first time that progressive architects assumed responsibility for building homes for the masses. Neither the various types of nineteenth-century workers' dwellings nor the houses of the bourgeoisie provided the basis for a proper solution to this problem. The new homes for the working classes had to be developed from scratch—and on a scientific basis.

1. Van Tijen, study of minimum dimensions required in the home. Source: Vreeze, 1993, p. 297

Time and motion study was the right tool for this: in the Netherlands, Willem van Tijen analysed the activities that take place in the home (Fig. 1). He recorded home life in terms of dimensions and motion diagrams (Tijen, 1966, p. 44). In Germany Grete Schütte-Lihotzky similarly developed the Frankfurter Kitchen, based on ergonomic studies. After World War II this research led to publications such as *Functional Principles of Dwellings (Bouwcentrum, 1958)* and *Regulations and Tips (MVRO, 1965)* in the Netherlands. The latter document, with which every subsidised Dutch home had to comply during that period, provided the general specifications for the homes that were built under the post-war reconstruction programme.

The ergonomic studies, and above all, the way they were translated into building regulations for subsidised housing, provide a snapshot image of the typical post-war family. When many of the homes were being built in the post-war reconstruction era these requirements were set for a long time in reinforced concrete. The dimensions complied with the minimum sizes laid down in the building regulations. The space was squashed in-between a large pipe duct and a reinforced concrete load-bearing wall, and was thus unchangeable.

As explained in Frame and Generic Space (Leupen, 2006, p. 18), we are faced with a contradiction in terms: the more precisely we are able to decide what requirements a dwelling should meet at the start of its life, the greater the likelihood of a discrepancy arising between the dwelling and its future use. The more precisely architects were able to define the measurable aspects of living and convert them into a design, the more the design neglected the unquantifiable and non-measurable aspects and the less able it was to provide an answer to unpredictable changes in use.

Polyvalence

One of the concepts that can deal with changeability and unpredictability is polyvalence[1]. The word 'polyvalent' has been known for years in the context of the multi-purpose hall or salle polyvalente, the building found in every French village or provincial town which is used for weddings and parties and for musical, theatrical and film performances. The word was introduced into the architectural debate by Hertzberger, some of whose ideas on polyvalence are reflected in the Diagoon houses he designed for Delft (1967-71). He juxtaposed polyvalence against flexibility:

> Flexibility therefore represents the set of all unsuitable solutions to a problem. On these grounds a system which is kept flexible for the sake of the changing objects that are to be accommodated within that system would indeed yield the most neutral solution to specific problems, but never the best, the most appropriate solution.
>
> The only constructive approach to a situation that is subject to change is a form that starts out from this changefulness as a permanent - that is, essentially a static - given factor: a form which is polyvalent. In other words, a form that can be put to different uses without having to undergo changes itself, so that a minimal flexibility can still produce a optimal solution. (Hertzberger 1991, pp. 146-7).

Here too polyvalence means that the building can be used in different ways without structural interventions. There is a difference, however: the activities in a *salle polyvalente* take place consecutively, but a dwelling must be able to provide

space for all the different activities which it is capable of accommodating to take place at the same time. Polyvalence in the context of housing relates primarily to the interchangeability of activities between different rooms.

Until the 1920s people built homes that allowed for a relatively high degree of interchangeability in the use of space. Indeed, it might even be said that homes were always polyvalent to some extent. Rooms derived their meaning from their status rather than from any precise definition of their function. If we look at the bourgeois 19th-century houses we see large and small rooms that are equally prestigious by virtue of their decoration. It is impossible to tell from the plan which activities were supposed to take place in each room. In practice, the use was defined by the occupant's preferences. The location of the rooms in relation to service areas such as the kitchen and bathroom does, of course, betray their purpose: the dining room is adjacent to the kitchen and connected to it by a serving hatch, and there is an interconnecting door between the master bedroom and the bathroom.

Six basic activities

If we are to gain a better understanding of polyvalence, we need to know the activities that a home generally needs to accommodate, since these are the activities that need to be able to change places in order for the home to be polyvalent. In principle, thousands of activities, differing from place to place and from culture to culture take place in the home. If the act of dwelling is universal, then it should be possible to reduce it to a set of basic activities – irrespective of culture or financial status. The differences between cultures, stages of development or financial status can be seen in the relationships between these basic activities and how they are performed. As regards the latter, the nature of the required objects (furniture, appliances, crockery etc.) plays an important role: one person may cook on a wood fire and another on a six-ring electric cooker, but they will still both be cooking.

I used such a set of activities, based on diagram by Nishihara, to analyse the different patterns of dwelling. In the diagram (Fig. 2) Nishihara compares traditional Japanese domestic culture with Western domestic culture in terms of six activities (Nishihara, 1968). In present-day domestic

culture rooms are set aside for specific activities, whereas the traditional Japanese house has a number of multi-purpose rooms which derive their meaning from the objects used there. If the paraphernalia for the tea ceremony is brought out, the room becomes the tea ceremony room; if the sleeping mats are rolled out and the tea ceremony paraphernalia is put away, the same room becomes a bedroom.
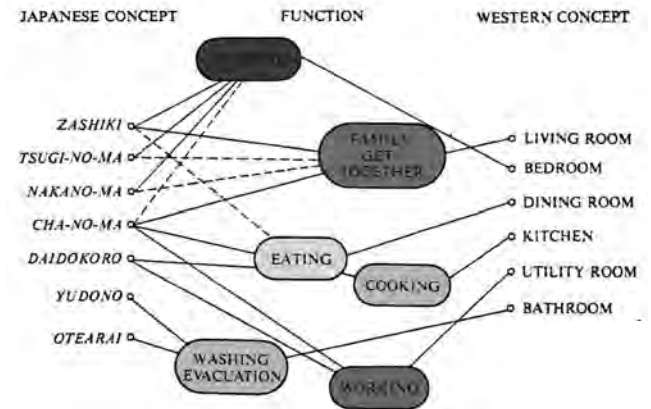
2. Comparison between the traditional Japanese house and the Western house (Nishihara, 1968)

The case study discussed below aims to provide an understanding of the polyvalence of dwellings and to test the hypothesis that the polyvalence of a dwelling depends on its spatial organisation. We approached the first point by determining how far the six basic activities could be located in different ways. We achieved this by applying various situations to the dwelling. These can be expressed in a graph, based on the six basic activities identified by the analysis: **S**leeping, **G**et Together, **E**ating, **C**ooking, **B**athing and **W**orking.[2]

To test the hypothesis that the polyvalence of a dwelling depends on the pattern of relationships between the living/sleeping areas we translated the spatial organisation of the dwellings into a graph to permit a comparison[3]. As dwelling is a dialectic process between the dwelling and the dweller we compiled two types of graph, one for the spatial system of the dwelling and one for the way in which the dweller can use the dwelling[4]. A number of activity graphs can be drawn for one and the same spatial system, depending on

how polyvalent that system is. Say there are six basic activities and six rooms where they can be performed, and assuming that all the rooms are the same size, then all the models of spatial organisation (star, circle or chain) are equivalent in relation to the number of possible arrangements of activities. Theoretically this is 6 factorial = 720. If we lay down rules about the arrangement of activities, however, (e.g. the activity Get Together is accessible only via the activity Sleeping) or the location of specific activities (the room for Cooking and the room for Bathing are fixed), we find that the six basic models differ in terms of the possible arrangements, or the degree of polyvalence. We find that, when specific conditions are imposed, the number of possible arrangements is greater for the star model (i.e. it scores better on polyvalence) than for the chain model. This number can be calculated arithmetically, but the essential factor is the imposed conditions, which are culturally determined (we are not used to entering the living room via a bedroom) and which vary from one domestic situation to another.

The projects below have been selected for their unusual spatial organisation. All of them are to some extent polyvalent, so they can be inhabited in various ways. In most cases the polyvalence only applies to some of the rooms, and the venue where people get together – the living room – is determined by its place in the organisation and its size.

For four thousand years now dwellings have provided a space measuring approximately 4m x 4m where people can get together. Only studio apartments and temporary accommodation such as hotels do not have a space of this kind for each unit. This space is often found at different levels, e.g. the foyer of a hotel, or the communal kitchen-diner in a student hostel. In practice it means that a house must, at the very least, have a room where this space fits, in other words a room measuring at least 4m x 4m. If more than one room fits the bill, the space for getting together is interchangeable.

MVRDV, Ypenburg 'VINEX' development
Dwellings with a star-shaped spatial organisation have a high degree of polyvalence. In principle, the classic single-family terraced house conforms to this pattern if the access system – hall, stairs, landing – is kept separate from the living/sleeping areas. Since the 1970s there has been a tendency in the Netherlands to integrate the living space with the access system by means of an open-plan staircase (see Fig. 3, graph C). This is often done under the pretext of 'spaciousness', but the main reason is to skimp on the square metres. This approach is more the rule than the exception in current 'VINEX' developments.

At first sight the dwellings designed by MVRDV for the Ypenburg VINEX development are no different: on entering you find yourself in a space with open-plan connections to the kitchen and living room. This relationship can easily be changed, however: by placing a door between the kitchen and the room at the rear. This space then assumes a different position in the spatial organisation, enabling it to be used e.g. as an individual living room/bedroom. In this way the house could be lived in by a number of individuals sharing a living room-kitchen, or the space through which one enters with the connected kitchen. As the kitchen is located between two rooms, the activity Eating can take place at either the front or the rear.

Diener & Diener
The dwellings for the IJ-burg development near Amsterdam designed by the firm of Diener & Diener in Basle also have a spatial organisation which you enter through one of the large rooms – which therefore falls under the Get Together category. Model C also applies to this dwelling. You enter through one of the rooms, and the other four larger and smaller rooms are interchangeable. These other rooms permit various uses: they can accommodate private activities such as sleep and relaxation or individual work. In this set-up one of the large rooms could be used as a second room for getting together (a second living room). A different distribution of activities is conceivable: the large and small rooms could be used in pairs by an individual for working, sleeping and relaxing. The large rooms would then provide space for receiving individual guests. In this way the dwelling could accommodate two individuals sharing a kitchen-diner. As the fitted kitchen is in the first room, this is where meals would be eaten.
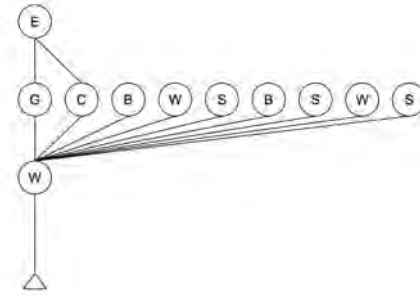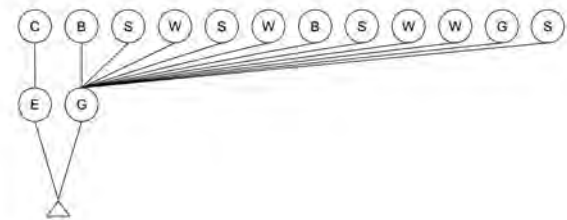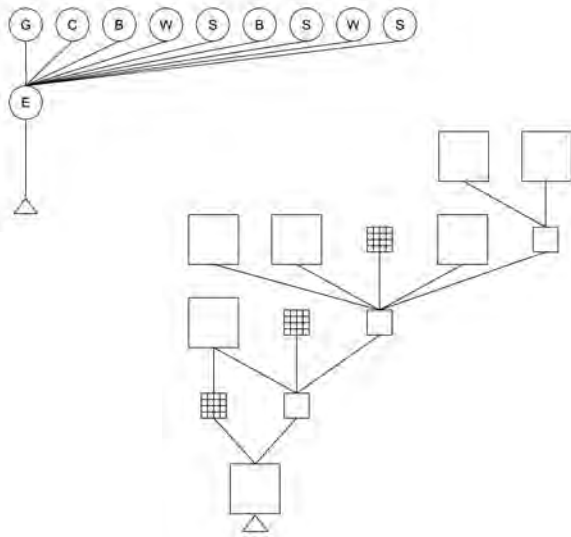
Daniel Pantillon
The Swiss student Daniel Pantillon was inspired by the IJ-

3. MVRDV, Ypenburg single-family dwellings
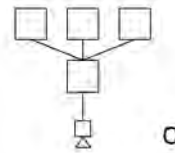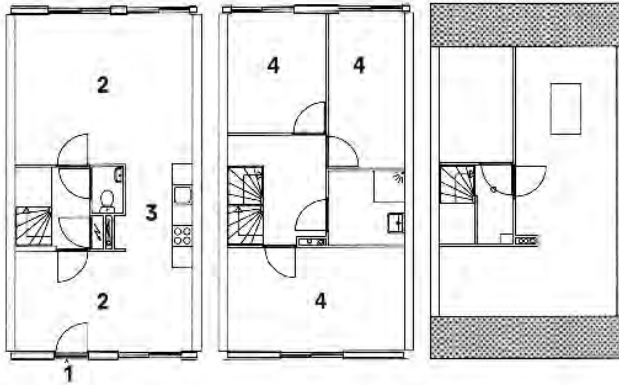
burg project. In his design for his graduation project[5] he introduced a long central room, which by its nature and location is suitable for a variety of communal domestic activities. To some extent this lends the room a degree of polyvalence, albeit within the spectrum of activities that are performed communally in a household. Pantillon has increased the polyvalence of the other rooms by fitting them with double doors, thus making it possible for e.g. the central living activity – getting together – to take place in one of the side rooms, which has an open-plan connection to
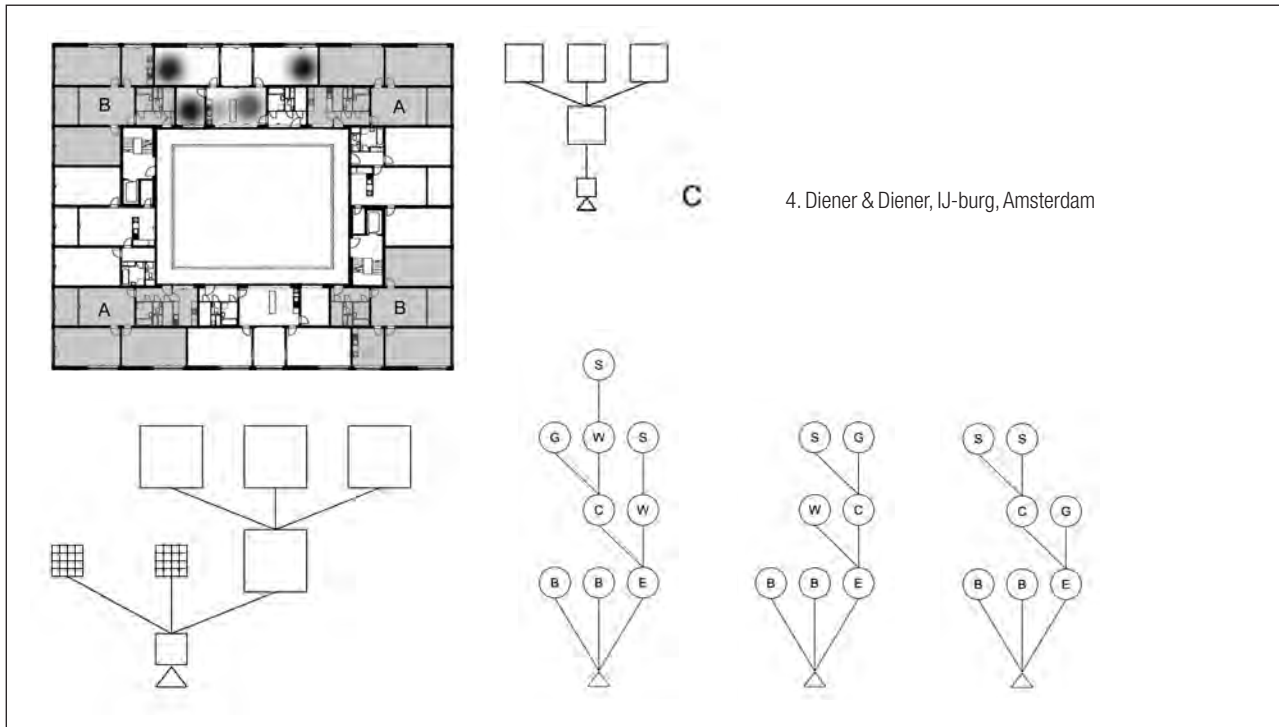
4. Diener & Diener, IJ-burg, Amsterdam

the central long room. This dwelling thus provides scope for a household that engages in a lot of communal or public activities such as receptions, house concerts or working from home. Its polyvalence is also increased by the fact that there are at least two places near the kitchen for Eating.

Duinker & Van der Torre

The project designed by the firm of Duinker & Van der Torre for the Dapperbuurt district is a classic example of polyvalent housing. Here too, doors play an important role in manipulating the spatial organisation in this case two-way doors and sliding doors. Large doors and sliding walls can increase polyvalence. Although the sliding doors change the spatial organisation to some extent the dwelling is still polyvalent, as it can be used in different ways without moving a single nail (Leupen, 2006, p. 191). Duinker & Van der Torre's dwellings have a circular structure (model D), which in principle enables a room to be accessed from two directions. This increases polyvalence, provided the circle

is not too large – otherwise it turns into a chain structure (each room is only accessible from the next one). To reduce this effect Duinker & Van der Torre have created a shortcut between two of the rooms in the circle: the centrally situated vestibule, which forms the shortcut, also provides access to the bathing and toilet facilities. The polyvalence of this dwelling is seriously limited by the fact that only one room is large enough to accommodate the activity Get Together. If the three rooms were all large enough for this purpose the dwelling would be far more polyvalent.

Riegler & Riewe, Graz

There is a housing development in Graz whose spatial organisation is full of shortcuts: the rooms in this project are connected with one another in various directions. This project, designed by the architects Riegler & Riewe, can essentially be read as a grid model (model E), an organisation that is very similar to that of Palladio's Villa Rotonda. Thanks to their grid structure these dwellings have almost infinite organisational possibilities. Each room can be accessed from

5. Daniel Pantillon, graduation project New concepts for the dwelling, ground plan of a dwelling in the urban villa
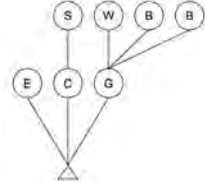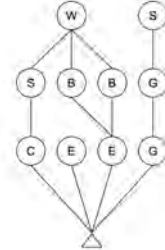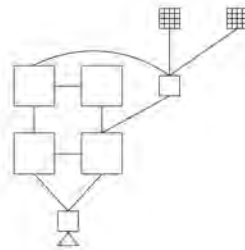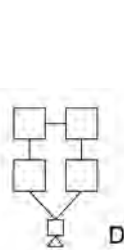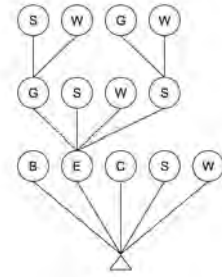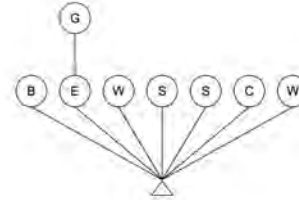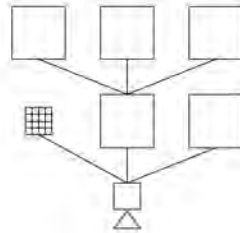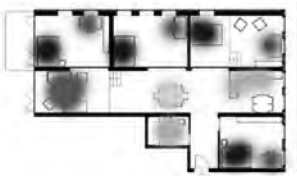

6. Duinker & Van der Torre, Dapperbuurt district, Amsterdam. Graph of the spatial organisation and two graphs of possible activities.

two or even three directions. The effect is enhanced by the fact that the dwelling has a central backbone with space for circulation. The organisational possibilities are even greater if the various location options for the kitchen are taken into account. The question, however, is whether this still amounts to polyvalence, and the answer depends on whether a kitchen is regarded as a piece of furniture or part of the building. If we regard it as a piece of furniture, then moving it is just a matter of reorganisation, but moving a kitchen is usually a major operation, a 'conversion'.

Conclusions

In theory every dwelling has the capacity to be used in various ways: a room defined as a bedroom, for instance, can be used equally well as a study or hobby room. Things get more interesting, however, if a dwelling can accommodate different living patterns. A home that can be occupied, without modification, by either a family with two children or three or four singles can be described as highly polyvalent.

The projects in the study feature different sorts of polyvalent dwellings. Three of them have essentially the same
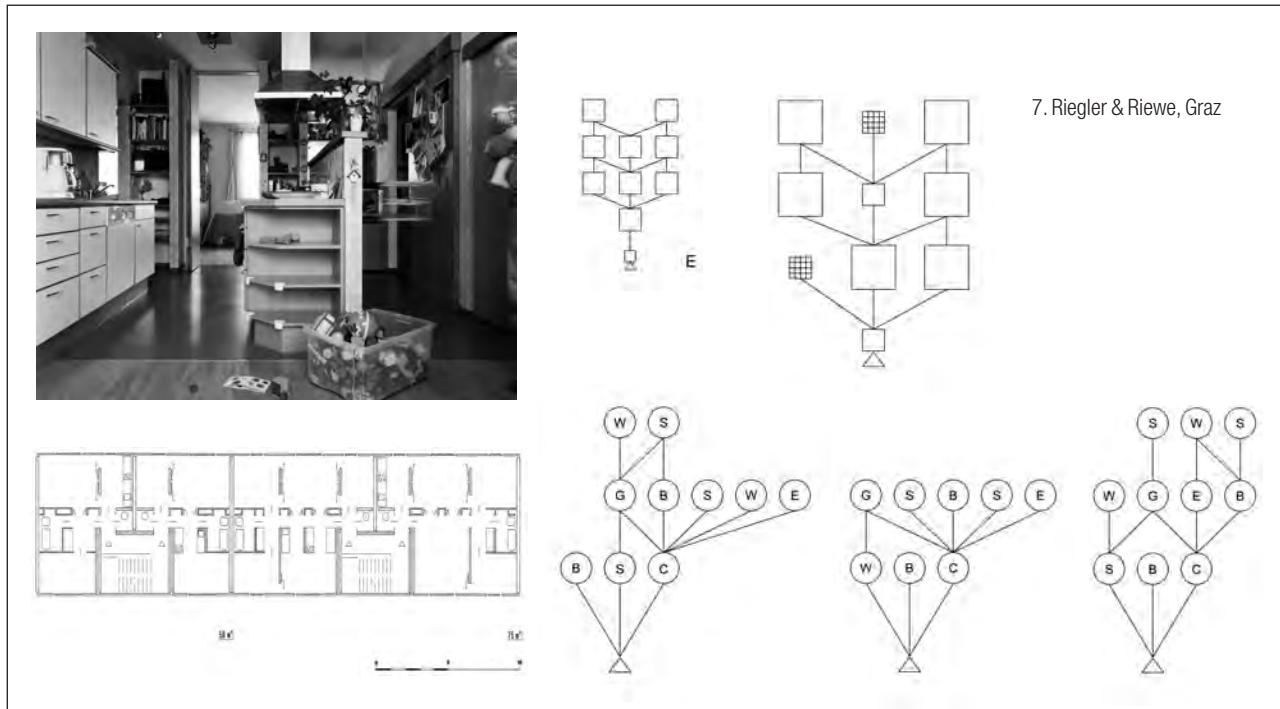
7. Riegler & Riewe, Graz

graph. The Diener & Diener's project in Amsterdam, the MVRDV project in Ypenburg and the Daniel Pantillon project can all be reduced to the star model with a central room (Fig 8). However, these three projects have different characteristics, because the graphs show differences in detail and in the room measurements. For instance, the long space in the middle of Patillon's floor plan is a special space with special use possibilities.

The other two projects in the study have a more complex structure. In the Duinker & Van der Torre project and the Riegler & Riewe project in Graz the rooms can be accessed in more than one way. This implies a circle model and a grid model respectively. The grid model provides many possibilities for dwelling since almost every room can accommodate different activities because of its independent relationship with other rooms.

We can identify five basic models for the spatial organisation: A Chain, B Star, C Star with central room, D Circle, E Grid (entrance = square + arrow). These are shown here in graph form (Fig. 8). In terms of privacy the chain model is the least polyvalent: you always have to pass one room

when going to another. It is not surprising that none of the polyvalent projects in the study fits this model.
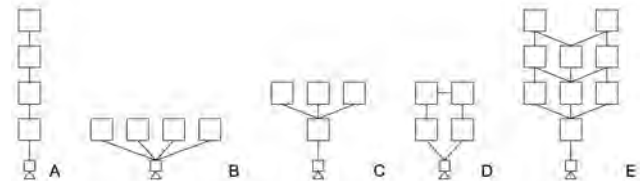
8. Graph of dwellings. A Chain Model, B Star Model, C Star Model with central room, D Circle Model, E Grid Model (entrance = square + arrow).

Clearly, there are degrees of polyvalence. The extent to which a dwelling is polyvalent could be said to depend on the number of possible arrangements or combinations of activities it permits. This number is related to four factors. First of all, the size of the rooms plays an important roll; living/sleeping areas larger than 16m² have the potential to accommodate any basic activity. The number of large rooms is also important. The more rooms that are larger than 16m², the more freedom there is to distribute the basic functions among them. Polyvalence is restricted when there is only

one large room. In a domestic situation with two adults and one small child, for example, the design of Diener & Diener and Duinker & Van der Torre are equally polyvalent. As explained above, in the different graphs describing the underlying spatial structure of the dwelling, the case study shows that e.g. a star or circle structure has more potential than a chain structure. Rooms that provide access to other rooms with no alternative route are less suitable for basic activities such as sleeping. Finally, the relationship to rooms with fixed activities such as the bathroom and kitchen also plays a role in polyvalence.

Systematic research into how a large number of dwellings regarded as more or less polyvalent actually function in practice could increase our understanding of this fascinating phenomenon. Putting knowledge of polyvalent dwellings into practice could result in a new generation of homes with interesting spatial organisations and substantial expectations (sustainability) as regards changing and unpredictable uses.

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Notes

1   In principle time and uncertainty can be addressed in three ways:
    1. Make buildings polyvalent.
    2. Make buildings that are part-permanent and part-changeable e.g. carcass buildings.
    3. Make semi-permanent buildings, e.g. 'industrial, flexible and deconstructable' buildings (Leupen 2005)
2   I differ from Nishihara in using Get Together rather than Family Get Together, as living in a home does not by definition involve a family. Instead of Washing/Evacuation I use Bathing.
3   The drawing method has been developed from the one used in Decoding Homes and Houses (Hanson 1989)
4   Analyses by Esther Stevelink and Sophie Pfeiffer
5   Daniel Pantillon graduated from the New Concepts for the Dwelling Studio at the Faculty of Architecture, Delft University of Technology.

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