Representation and type

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The paper discusses the relationship between typology and representation in the development of a database of building stock (Dutch secondary education school buildings). The purpose of the database is to support analysis of the stock with respect to flexibility and adaptability to changes in social and educational conditions.

Keywords: Typology; representation; case-base.

Didactic changes

In the last decade a number of changes have taken place in Dutch secondary education, including the introduction of the vocational vmbo level. Two of the main reasons were decreasing the gap between secondary and tertiary education, and adjusting learning to the demands of the times. These changes also apply to the subjects taught at secondary schools of all kinds. The emphasis now lies more on acquiring general or specific skills and information technology. Pupils use the computer to find relevant information, they learn the role of ICT in society and how ICT is used in specific professions. The way the pupils learn has also changed. By creating a workplace structure, for example, they learn theory in businesslike surroundings. These radical changes in the manner of teaching and learning have to take place in the traditional, classical structure of the existing school buildings. The actual building stock is still based on the conventional classroom, while the emerging didactic approaches require different activities like working in small groups of five to eight pupils or working individually.

By developing a database of school buildings for secondary education in The Netherlands we aim to support analysis of the existing stock with respect to quantitative and qualitative characteristics that determine flexibility and adaptability to changes in social and educational conditions. Formal building types play an important role in this analysis, as they allow abstraction and encapsulation (Steijns and Koutamanis, 2005). One of the main hypotheses behind the database is that flexibility and adaptability can be expressed adequately at the level of the type. Individual characteristics of an instance are generally local constraints on the magnitude of change rather than on the possibility of the change itself.

Type and representation

The present paper focuses on a school which in many respects is a typical example of the current conditions and intentions. The school offers two kinds of secondary education; a vmbo (lowest level) and a havo/vwo (higher levels). Teaching staff is accordingly divided into two separate teams. Each team is allowed to develop an own educational approach and policy within general, rather abstract constraints, most of which represent mutual agreements on a lowest common denominator. The vmbo team wants to implement a new didactic approach that focuses
more on the individual pupils. The havo/vwo team wants to adopt a slower evolutionary approach on the basis of the traditional, classical education they are familiar with. This means that the school should accommodate two different organizational structures in the same organization and building.

The existing school building in Rotterdam is designed for traditional education, i.e. based on the classroom. The geometric representation of the ground floor (Figure 1) shows a labyrinth of smaller and larger spaces connected by either small corridors or large spaces. The first floor is divided in three wings, each with their own structure (Figure 2). The second and third floors have clearly identifiable corridors along which the spaces are situated (Figure 3 and Figure 4).

The three types that now dominate the existing building stock in The Netherlands are the corridor type, the hall type and the pavilion type (Boersma et al., 1996).

Corridor type: The main characteristic of the corridor type is its sequential spatial structure. Spaces...
are positioned on either one or on both sides of the circulation space. Exceptions due to size or structure (entrances, gyms, etc.) are usually attached to the building as formally distinct parts (e.g. wings).

Hall type: The different wings of this type are mostly variations of the corridor type (Steijns and Koutamanis, 2004). These wings are all connected by a central hall which usually houses different functions. The hall school is recognizable by the internal circulation ring which connects the wings.

Pavilion type: The different pavilions in the pavilion type school building are easy to recognize and can all have their own structure. These individual pavilions are variations of the hall type (with a circulation ring) or the corridor type (Steijns and Koutamanis, 2004).

The typology of school buildings has been linked to the structure of the representation underlying the database. This representation is of the relational type originally proposed by Steadman (dual graph representation): it describes both the primary properties of architectural elements (spaces and building elements) and their spatial or structural relationships (Steadman, 1983; Steadman, 1976). Explaining each type by means of this representation focuses on the topological level, where we were able to attenuate secondary geometric characteristics of both the building as a whole and individual spaces specifically.

In the case of our example, the topological representation of the second floor is quite clear (Figure 5) and shows how the main corridor connects sequen-
tially ordered spaces. At the junction of two staircases the corridor widens and becomes perturbed as a result of functional considerations such as fire safety and acoustic isolation.

In the topological representation of the ground floor the same main corridor is also recognizable (the shaded part in Figure 6), even though it was not evident in the geometric representation. The corridor widens locally so as to accommodate activities for large groups of pupils, e.g. around communal spaces. These larger spaces often grant access to other parts of the building and function both as use space and circulation space. The topological representation of the ground floor suggests that the building is of the hall type because it has an internal circulation ring. This circulation ring, however, consists of both circulation and use spaces. Closer inspection reveals that the building follows primarily the corridor type. Ambiguities in the geometric representation are largely due to the connection to the gym wing and the uncertain relationship with and character of the communal spaces.

**Qualitative and quantitative aspects**

One of the main functions of the geometric representation is to allow precise and accurate measurement of distances, spaces and volumes. These measurements are seldom significant by themselves, as they relate not only to the type but also to the size of the instance. Ratios of e.g. space versus circulation space, on the other hand, are useful as indicators that measure the consistency of types and verify assumptions concerning their structure and performance. The ground floor of our example consists for 32% of circulation space (Figure 7). Compared to the first floor (Figure 8) where only 20% is dedicated to circulation, the ground floor clearly contains a substantial part of the total circulation space of the entire building. However, if we treat the common spaces for lunch as use and not as circulation space the number changes dramatically to 12% (Figure 9). This is consistent with our expectations from an instance of the corridor type, as well as with our observations of use patterns on the ground floor, where the school does not give a spacious impression.

If we consider the larger spaces on the ground floor to be use spaces, the area for circulation on the ground floor almost equals that of the first or that of the second floor (Table 1). The area for use spaces on the other hand equals that of the first and second floor together. The ratio use/circulation differs therefore as well significantly.
New requirements and building adaptability

The new educational framework currently under preparation by the two teams (havo/vwo and vmbo) in our example means that a large number of new activities have to take place in the building. By clustering these activities we can make explicit the new organization of the school. Each team has its own set of activities and its own organizational structure. The havo/vwo team can be seen as a top-down organization where activities and actors are allocated on the basis of a preset organizational structure. The class, the classroom and the hourly schedule are the leading principles. The vmbo team on the other hand can be seen as a bottom-up organization, as learning activities are structured based on individual needs and demands. Pupils are clustered in groups with a maximum of 80 pupils. These groups have their own home base where pupils have variable workplaces according to what and how they choose to learn. Leading principles in this case are a flexible schedule, individual needs and varying group sizes.

Following a normalization of group sizes and group organization, we concluded that there are two ways of allocating havo/vwo and vmbo clusters in the building:

Vertically: each cluster can be situated in a separate wing of the building. Vertical connections between the clusters within a team can be created by means of double heights and communal spaces. The central part of the building (where perturbations occur in the topological representation) can be used for general activities.

Horizontally: the other possibility is to situate each cluster on a separate floor and general activities on in-between floors. Pupils either ascend or descend to these floors to meet and associate.

As in many Dutch secondary schools, the new organization does not require more space than what is currently available in the building. The main changes occur because of the different character of learning activities. This means different space scales and space clusters, as well as additional facilities. Some of the new requirements can be met by fusing together existing classrooms into flexible, multifunctional spaces but there is an obvious limit to that. For example, it is possible to make a home base for a group of up to 80 pupils on the basis of two classrooms but uniting three classrooms in a row may create a space with awkward proportions and poor acoustic and functional performance. Particular attention is needed for the circulation spaces around such larger amorphous spaces. On the third floor of the existing school (Figure 4) five classrooms have been merged into one multimedia centre allowing pupils to work individually behind a computer or in small groups. Figure 10 shows the topological representation of the situation how it used to be; the corridor connects the sequential spaces. Figure 11 shows that the main route has been interrupted by the new multimedia space and the corridor is now divided in two separate parts. This disturbs expectations from the type of the building and causes disruptively opportunistic behavior: pupils may be reluctant to use the multimedia space as a shortcut between circulation spaces.

Similarly, existing classrooms can be subdivided into spaces for individual workplaces and small groups but again there is a limit to what can
be achieved in this way. The topological structure of such subdivisions makes evident the resulting complexity in rather confined spaces, while the requirements on acoustics, ventilation and cooling can become quite heavy. In addition, there is always a danger of wasting space in larger rooms because these invariably contain unfavorable zones.

Extension of the existing building is probably the safest option for creating spaces for the new activities. Each type can be extended in specific ways that do not disrupt its internal structure and the corresponding organization of activities. However, this also depends on site constraints. Our example is a corridor school rather cramped in a smallish site. The obvious choice of sequential extensions along the corridor is impossible in this case. The same applies to the second choice, widening of the corridors so as to integrate small-scale activities in the circulation zone (e.g. individual workplaces), as most corridors are doubly loaded.

Conclusions

By analyzing concrete cases such as the example discussed in the present paper, we have come to doubt the consistency of the three schools types and therefore also their utility for the structure of our case-base. We expect that the corridor type should be refined into a number of more precise (sub)types but we have more doubts about the hall type. In addition to refinement into subtypes we need to develop precise criteria for the classification of instances, as what appears to be a hall type may be a corridor type with one or more halls attached to it. The topological representation has proved to be a valuable tool for the analysis of such problems.

The assumption that we can form adaptability expectations at the level of type seems to hold with respect to both internal spatial reorganization and building extensions. The combination of geometric and topological representation seems sufficient for identifying the potential of a building but must be complemented by a representation of the site so as to take into account the context as well.

References

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