0 INTRODUCTION

This paper deals with the topics of design theory, decision support systems and product modeling.

In order to be able to generate optimal decisions in the framework of architectural and building systems design it is necessary to use a proper base, like a design theory, which finally can lead towards a satisfying product modeling in a wide sense of this term.

1 Therefore we offer first the Basic Model of the Architectural Detail (BMD) which actually covers all the technical and functional responsible influences on building products.

2 Afterwards we deepen three of those main influences, which became the elements for the General Building Model. Further we will state some Hypotheses in order to achieve Sustainable Building.

3 In order to learn more about the laws, explored in the field of Building we will use the analogy with language.

4 A next chapter deals with the step-by-step procedure for developing joints as it has been worked out in the doctor's thesis “A Typology of Joints”. All together will show that the knot or joint in its quality as a dividing and uniting phenomenon has a general value also for other levels in building, where its quality can be applied.

5 Finally the theoretical statement will be illustrated by a project, in which both the approach towards a Sustainable Development and the application of the laws or rules and guidelines for detailing, are realised.

Because knots or joints in building became our specialty, we will try to convince you of the overall importance of joints. This goes hand in hand with a way of thinking about building, and consequently the potential of achieving sustainable development in building and other areas of manufacturing artifacts.
1. BASIC MODEL OF THE ARCHITECTURAL DETAIL

The Basic Model of the Architectural Detail (BMD) delivers an instrument, which enables the participants in the building process, to become conscious/aware of the relevant factors playing a role in decision making.

The model simply can be presented in a matrix. This matrix consists of nine squares - three by three. In the vertical axis we find the non-material factors like:

1st shape, form, space (at the top)
2nd process, method, time (at the bottom)

In the horizontal axis we find the material factors like:

3rd (building) materials and energies (left)
4th components, elements, building parts (right)

Above, in the corners left and right we see:

5th functional, users and similar aspects (left above)
6th indoor climate, equipment and atmosphere (right above)

At the base in the corners we learn about:

7th bios, nature, environment, the source of all possible realisations of buildings (ecology)
8th human factors, including ergonomy and health on physical, psychological and mental level.

In the center the 9th part, the final point, the result of all components as well as the key - the nucleus - for all possible realisations, we find: the detail or connection, the joint or knot.

In other words there is the art to combine all needed parts - elements - components to reach essentially a harmonious whole - a building principle, method as well as system.

This very model hence, can help in all building design activities because of its holistic set up. It can support decision making by having an overview, especially after looking to all the (few) (main) aspects of the model and the reality. The applications in practice have already started.

Amongst others John Olie deepened this approach in his doctor’s thesis, guided by the author, A Typology of Joints, supporting Sustainable Development in Building, based on a case study of the typo-morphological principles of the window in the cavity-wall.

The presented work can further lead to an improvement in the whole building scene, stimulated by the theory or by some insight, carried by an intellectual approach as well as experiences in the practical situation. Moreover nationwide research (I.O.P.) on the ‘bouwknoopp’ - the building knot, the detail or nucleus was already a part of this possible support system, which deals with function (including material), form and process.

The described model you can find in Figure 1.
However in the matrix of the BMD we find three auspicious elements, which became the building stones of another model, developed within the research study A Typology of Joints. The choice was the central element itself, the solution of the knot or joint, the human needs or demands and the ecological opportunities and limits. Moreover, we can link the Morphology, Material and Method of the afterwards to describe General Building Model to the Space and Shape, Matter and Energy as well as Time and Productions of the BMD.
2. GENERAL BUILDING MODEL

In general we could distinguish three systems being active in the sector building:
Ecology to be understood as the environment around us, but of which we are at the same time part of.
Demand to be understood as ourselves, with our requirements in time and space.
Solution to be understood as the means, being an artifact, to reconcile the misfits between the environment and ourselves (Ecology and Demand).

This Solution is building some kind of artifact that adapts the environment (Ecology) to our needs (Demand). In the relationship between Demand and Ecology building can be seen as the intermediary between these two systems. For the problem between these systems, building presents a means for solving the problem. Here we are considering the control of Light, Air, Warmth, Moisture, Sound, Field, View, Minerals, Plants, Animals and People. This category of factors concerns the pragmatic relationships.

Now we hope that the experience of the existing environment together with the building solution meets our requirements, in other words that performance is according to our requirements.

In the relationship between Ecology and Solution the building can be seen as a system of parts coming into being according to the possibilities offered by the environment in relation to the preferabilities of people. Here we are considering the Execution, Durability and Maintenance of a building. This category of factors concerns the syntactic relationships.

The “means” of the building is also an “end” in the sense that the building itself can be considered as object of experience. In the relationship between Demand and Solution the question of “meaning” is posed: How well does the Material, Image and possibility of Control of the building solution inform us of the relationship between the environment and ourselves? Ecology is the resource for ourselves and building. Due to the certain degree of control we have in building, we can consider Demand and Solution together as an organism having a certain impact on Ecology. This category of factors concerns the semantic relationships.

To illustrate what we have stated we can use the following example:
When it rains we would like to stay dry, so what we need is something between the rain and ourselves, an intermediary so to speak. After first using e.g. large leaves … we eventually developed, based on a system of parts, what we call an umbrella. The umbrella itself, being an object of experience, relates means (system of parts) to purpose (intermediary) by the material, its image and how we can control it (to put up or fold up).

If we were to take a painting or a sculpture as an example we might state that being object of experience is the primary function of the artifact: the painting or sculpture itself refers to other phenomena, experiences … hereby causing a certain emotion, serving our psychological and spiritual needs. Building serves our physical, physiological, psychological and spiritual needs, being the Mother of Art …
Instead of building in general we could also read “joints” in this model. The model distinguishes ways of looking at joints, thereby defining categories of factors that determine joints. How these joints are eventually determined is another question, that calls for a procedure to direct development. In order to determine the development of the procedure itself, an analogy has been made with “language” in the linguistic sense:
3. THE LINGUISTIC ANALOGY

In language we distinguish the basics of an alphabet, morphemes, words and sentences.... Application is guided by rules called grammar, being general and objective. Application is also guided by “rules” belonging to a style, being specific and subjective. Language is intended to convey a message for the benefit of communication and thereby understanding. How we convey a message can differ considerably due to the possible difference in style. This is illustrated by the following example:

The following poem was written by F.S. Flint:
“Among the lily leaves the swan,
The pale, cold lily leaves, the swan,
With mirrored neck, a silver streak,
Tipped with a tarnished copper beak,
Toward the dark arch floats slowly on;
The water is deep and black beneath the arches.
The fish quiver in the pool
Under the lily shadow cool,
And ripples gilded by the whin,
Painted, too, with a gloom of green,
Mingled with lilac blue and mauve,
Dropped from an overhanging grove;
White roses of flame the swan beneath the arches.”

Ezra Pound revised the poem considerably:
“Under the lily shadow
and the gold
and the blue and the mauve
that the whin and the lilac
pour down on the water
the fish quiver

Over the green cold leaves
and the rippled silver
and the tarnished copper
of its neck and beak
toward the deep black water
beneath the arches
the swan floats slowly

Into the dark of the arch the swan floats
and into the black depth of my sorrow
it bears a white rose of flame.”
Pound was one of the leading figures in a movement called “Imagism”. In short the rules of Imagism were the following:

1. The subject should be dealt with directly (this being in contrast to “Symbolism”) whether subjectively or objectively.
2. In a poem no word should be applied, that does not support the intention of the message directly.
3. The lines themselves should determine the rhythm of the poem, not a fixed rhymescheme determined the lines.

Pound was of the opinion that the language of a poem should approach ordinary speech, although being of a higher intensity and of greater expression ….

Analogous to language, in the development of joints (in this case) we apply the morphological method consisting of:

* (alphabet) Basic “letters” of straight - slanted - curved: The square, the triangle and the circle are considered to be the basic shapes for all other shapes, including hybrid shapes. We may consider the one-dimensional lines “straight-slanted-curved” as the elementary “letters” of the morphological alphabet.

* (morphemes) Factor-principles: Specific to a factor we could develop a range of solutions of how parts in general join, varying shape, size and position characteristics, grading from less favourable to more favourable when considering performance. The reason for developing a range will become clear later on.

* (words) Factor-typologies: Specific to a joint-situation the best possible factor-principle must be applied. In order to do this a special step-by-step procedure has been developed, that will be explained in part C.

* (sentence) General-typologies: Specific to a joint-situation all the relevant factor-typologies must be integrated into one general-typology. In order to do this a special step-by-step procedure has been developed, that will be explained in part C.

* (grammar) Grid-rules (formal): All characteristics of shape, size and position of parts follow the defined grid and its rules. The modularity achieved by the grid and its rules is conditional for the process of integration as will become clear in part C.

* (style) Ecology-hypotheses (expression of content): The way we integrate or compose the various parts (words and sentences) in order to achieve a satisfying whole depends on which rules we follow in the process. The rules developed here work as a mechanism, steering and directing the development of joints. The following Ecology Hypotheses have been applied in the typical procedure for the development of joints in the next chapter.

Ecology-Hypothesis A1: (category A: the joint as intermediary) When the performance of the joint (meeting-fixing-sealing) is such that the requirements of Demand are met with a minimal need for additional energy/matter, then building in general complies more with sustainable development.
Ecology-Hypothesis B1: (category B: the joint as object of experience)
When the experience of the joint is such that we acquire a better understanding of the principles of morphology in relation to the “forces” of Ecology, then building in general complies more with sustainable development.

Ecology-Hypothesis C1: (factor Execution of category C: joint as system of parts)
When the morphology of only the main building components ensure the required performances of “meeting”, “fixing” and “sealing” in the joint, then building in general complies more with sustainable development.

Ecology-Hypothesis C2: (factor Durability of category C: joint as system of parts)
When the performances of “meeting”, “fixing” and “sealing” ensure an optimal durability of the parts in the joint, then building in general complies more with sustainable development.

Ecology-Hypothesis C3: (factor Maintenance of category C: joint as system of parts)
When the performances of “meeting”, “fixing” and “sealing” comply with assembly and disassembly sequences in relation to expected (Durability) or desired lifetimes of parts, then building in general complies more with sustainable development.
4. THE DEVELOPMENT OF JOINTS

The step-by-step procedure for the development of joint principles is based on the “morphological method”, meaning that knowledge is expressed in terms of shape, (relative) size and position of parts and whole.

The “alphabet” of the basic shapes of straight, slanted and curved is general for all joints. The “morphemes” being the factor-principles are specific for a specific factor e.g. “moisture” or “durability”, but are not bound to a specific joint-situation.

The “words” being factor-typologies are specific for the factor and the specific joint-situation. The “sentences” being the general-typologies enhances the integration of all the distinguished factors in a specific joint-situation.

The “story” or “poem” can be seen as the total sum of all the general-typologies, that determine the whole building.

The typical step-by-step procedure shown in figure 3 is considered to be a “process” type, that leads to “product” types of joints. The conviction is that the procedure must be carried through over and over again, constantly refining, integrating new knowledge (preferably acquired by empirical research), that has been translated to general principles (factor-principles). This means there is a constant development of joint typologies in time, and therefore also implies that there are no long-term standard solutions for joints.

The typologies of joints are to be seen as being “digital” and therefore “virtual”. The actual joints are the translated typologies to “analogue” solutions. The translation mainly enhances the processing of the specific material characteristics of parts and whole.

An example of the application of this design procedure in a project will be shown in the next chapter.

Figure 3: The typical procedure for the development of joint-principles (‘A Typology of Joints’, John Olie, 1996)
5. PRACTICAL APPLICATION

Students in the sub departments Building Technology, Construction and Execution of the Faculty of Architecture, Building and Planning at the Eindhoven of Technology worked already partially in the described sense and developed adequately proposals for A House of Another Future (HAT).

This research orientated student’s work took and takes place parallel to the practical design work, started more than ten years ago by Peter Schmid and going on in co-operation with John Olie for the last two years.

It seems that the time is near, that the concepts and designs will be executed in a model on scale 1:1, as an example of the highest possible Sustainability in Building as The House of Another Future, based on the scenario’s of Health and Environment as well as systematically and consequently research orientated student’s work concepts from the detail up to the whole system.

The place where the project (HAT) should be realized, is the National Educative Environment Park in Zwolle in the Netherlands. Some illustrations may give an impression about this project - HAT, particularly based on the concept for detailing.

Figure 4: The House of Another Future: cross-section and deviation
Peter Schmid, John Olie

Figure 5: The House of Another Future: groundfloor and artist’s view
Peter Schmid, John Olie
6. REFERENCES


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