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Craftsmanship in Architecture

Abstract:

In my dissertation at the ETH Zurich and the Lucerne University of Applied Sciences and Arts, I examine the role that crafted production of buildings plays for architectural space. A crucial point is the question of specific forms of knowledge. On the one hand, both craftsmanship and architectural design rely heavily on tacit forms of knowledge (skills, experience) in addition to communicable knowledge. Secondly, the erection of built architecture can be seen as a system of distributed knowledge, where the transfer of knowledge from the architect towards the craftspeople is crucial for the successful implementation of an architectural concept into physical space. The methodology includes the investigation of case study buildings. One aspect of the survey could be named "Reverse Design". Here, the process of the making of a building is re-experienced to be able to consciously reflect upon design decisions and problem-solving strategies. One aim is to make aspects of the tacit knowledge (experience) of the construction process communicable.
Keywords: architecture, craftsmanship, production method, production process, work traces.

1. Background

The Dissertation "Handwerklichkeit"[1] examines the traces of the physical building process of architecture, with the focus is on the traces of craftsmanship. The examination of the traces is a vehicle to find out about correlations between the appearance of built architecture and its construction process.
Today, craftsmanship is not the unchallenged construction method any more. Almost a century after modernist protagonists postulated industrial production to revolutionise construction, this finally seems to become reality today. Although alternative construction methods – like mass production or prefabrication of elements – have been around for a considerable time, their comprehensive availability today also changes the picture of the built environment. When Le Corbusier's early buildings were still made by craftspeople, and finally rhetorically clad in perfect plaster surfaces to show the industrial expression of the new time, the opposite phenomenon can be observed today. Industrial expression has reached such a saturation, that suddenly reactions of artificial re-rustification can be noticed.

FIG.1. Staging (inexistent?) industrial construction:: Villa La Roche in Auteuil, as published by Sigfried Giedion in Der Cicerone, 1927. Picture from Wigley, Marc (1995). White Walls, Designer Dresses: The Fashioning of Modern Architecture. Cambridge, Mass: The MIT Press.

The Dissertation concentrates on the techniques of timber construction or carpentry respectively. The built case studies to be examined are located in Switzerland or close by and contain wooden structures with linear members. The scope covers pre-industrial rural buildings as well as state-of-the-art structures fabricated with the help of computer-aided manufacturing. Wood construction seems suitable for this examination. The carpentry trade in the German-speaking countries features a rich

[1] Dissertation by Uli Matthias Herres, supervised by Prof. Annette Spiro (ETH Zürich) and Prof. Dieter Geissbühler (HSLU – T&A).

craftsmanship tradition and traditional techniques, while in the last years however, it has changed massively due to the introduction of digitally controlled milling machines. Now it is the most digitalized building trade (Schindler, 2009).

FIG.2. Staging (inexistent?) craftsmanship: A mere picture of crafted expression coincides with an aspired picture of alpine aesthetics. Cladding of a modernist building in Engelberg in 2010, photograph by Hanspeter Bürgi.

The two examples pictured are not the subject of this work, but they depict a basic observation. After the wide availability of "industrial" perfection has reached a critical mass, a post-industrial society seems to have a changing view on craftsmanship that has yet to be reflected. This is the framework from within the dissertation looks at elementary correlations between craftsmanship and architecture.
The most important basis for this work is a working definition for crafted construction ("handwerkliche Fertigung"). It has been defined by reference of theoretic texts from different areas, which had to be tested upon their appropriateness for the field of architecture (see paragraph 2). It is now tried through the analysis of processes of crafted construction, though interviews with craftspeople and through the insights gained by the analysis of the case study buildings. In the course of the project, the definition of an architecture-specific notion of craftsmanship is to be specified, together with a description of its possible characteristics.
A very important component of crafted construction – and craftsmanship in general – is the combination of different forms of knowledge applied.

Through the examination of traces of the construction process the potential influence of the construction through craftsmanship on architecture is analysed. This phase of the project is currently in process. The focus in the examination of the case studies lies on the interrelations between built architecture and the process of construction, which makes it necessary to approach the examples from two sides: the building as-found as the physical product of a process, and the process itself.

FIG.3. The case study buildings: Vernacular farmhouse in CH-Birrwil from 1692, timber frame with infill of wooden panels and rich ornamentation. (photographs of the case study buildings by the author)

FIG.4. House in D-Herrischried from 1983, design developed out of carpentry techniques, architect W. Graubner. (photographs of the case study buildings by the author)

FIG.5. Ferienheim Büttenhard from 2008-10, built with hardwood harvested on-site, architects Bernath & Widmer, Zurich. (photographs of the case study buildings by the author)

FIG.6. Tamedia office building in Zurich from 2013, built with laminated timber beams with extensive use of CNC-machines, Shigeru Ban architects (photographs of the case study buildings by the author)

2. Specific characteristics of a crafted construction of architecture

Talking about craftsmanship is difficult, as the term is not defined clearly[2]. Rather,

[2] The dissertation is carried out in German. As it examines craftsmanship, a way of working which – by definition, as I will show later – includes a share of non-communicable aspects, it depends heavily on a precise choice of words. In a translation, the precision may be blurred at times, which has to be taken into account. For instance the word "Handwerk", already hard to deal with in German due to contradicting connotations and the parallel existence of different meanings, does not entirely have the same meaning as the English "craftsmanship".

different definitions from various disciplines – above all historiography and sociology – exist parallel. Furthermore, different positive as well as negative connotations are connected to it and make its use even more delicate. The clarification of terms is crucial. The development of a proper definition of *crafted production, i.e. of craftsmanship as a production method of architecture* is a core aim of the work.
To be able to further describe this special method of construction, it is necessary to confine it from its alternatives, including manual work, crafts as an art form (Kunsthandwerk), or mechanized production. There must also be a distinction to architectural practice itself. Furthermore it must be challenged in how far crafted construction of *architecture* is distinguished from the crafted production of other objects. This seems to be a gradual differentiation, as I will show later.
Existing definitions from the point of view of other disciplines must be tested on their usability to describe a production method of architecture. For instance, Richard Sennett's (2008) influential definition of craftsmanship is in many ways an important basis, but cannot be taken over for architecture without further narrowing down. As the title of his book "the craftsman" shows, his – sociologic – view focuses on the process and how it affects the subject of craftsmanship. Consistently, his definition, as one of a few, refuses to link craftsmanship to the production of physical objects; it applies to the musician as much as to the architect. To reflect craftsmanship as a construction method, it cannot be adopted without restrictions.
The most important definitions include the reflections of practitioners, who try to verbalize the aspects of crafted construction they learned intuitively; they try to make the implicit component of craftsmanship communicable. To mention are most of all David Pye (1968), Toshio Odate (1998) and Wolfram Graubner (1986).
The following theses describe - as working definitions - aspects of *crafted construction of architecture*.

a. Crafted construction is target-oriented making measured by its product

For this work the product as the object of the production process is in the focus rather than the subject, the craftsperson. The work traces examined form the link between construction process and built architecture. The definition for this project must therefore consider the object, to be able to narrow the term down to a usable degree. Mere sociologic or historic definitions of craftsmanship must be excluded for the sake of clarity. For this reason I speak of "crafted construction" instead of the more general "craftsmanship".
Most of the 7 theses interlock; in fact the attempt to divide them in singular theses can only be an auxiliary to help to explore and communicate the character of

crafted construction. Many of the theses are directly linked to the direct, personal, physical interaction with the individual task and material.

b. *Crafted construction includes the risk to spoil a product during the process.*

David Pye introduced the component of risk as the distinguishing feature if what he called the "workmanship of risk". This production method contains the risk to spoil a piece of work during its production process; this risk is only controlled by the craftsperson's "skill, dexterity and care". It is obvious that this characteristic of the production method can possibly leave traces on the product.

FIG.7. The picture shows a wooden boat in the making at the Michelsen boatyard in D-Friedrichshafen in 2010. The angle grinder seen in the picture is used to "carve" the complex compound curves of the transom frame on the left.

Following Pye's argumentation, the aspect of control of the craftsperson over this tool is much more important for the outcome of the work than is the source of power that drives the tool.

c. Crafted construciton is an iterative process with correspondent modes of thought

The wooden joint in this picture was made by the author by meticulously trying to produce two identic pieces, as the two components of this special joint are identical. After some reflection it became clear, that it would have been much easier to produce one piece and then use it as the pattern for the other; this would have reduced the time-consuming task of working without tolerances significantly. For the functioning of the joint it is absolutely irrelevant if the two pieces are actually alike; this only becomes important when a larger number of pieces is prefabricated. This not only tells about the iterative character of craftsmanship but also about the different modes of thought of craftspeople and engineers.
This way of working allows the direct interaction with a concrete, not homogenized material such as massive wood. [3]

FIG.8. The observation that crafted construction is an iterative process arises from the analysis of techniques and processes of craftsmanship. One step is often built up directly on the previous – moreover, on the physical product of the previous step.

d. Adequacy is a criterion for the quality of crafted construction

Of course, the achievement of perfection through craftsmanship can be linked to an immense effort. As a criterion for the quality of crafted construction I want to introduce instead the adequacy of the chosen means and effort in relation to the

[3] Which, in fact, brings all repair works in fact at least in close vicinity to craftsmanship

task at hand. This effort is partly personal; the craftsperson puts his or her lifetime and power into the project. But the adequacy exceeds personal criteria. Toshio Odate, in his description of the Japanese master craftsman, the shokunin: „...shokunin means not only having technical skill, but also implies an attitude and social consciousness.(...)The value of an object is dependent on a subtle combination of skill and speed. (...) In short, the pride of the shokunin is the simultaneous achievement of skill and speed. One without the other is not shokunin." (Odate S. VIII). Sennett as well states „the craftsman does things with minimal force" , and there can be "no absolutist standards of quality" (S.51).

FIG.9 e 10. Theoretically, crafted construction can achieve the same precision or quantitative perfection (in the sense of a conformity of a product with an ideal plan or shape) as any other production method. Thus, perfection alone cannot be a distinct criterion for crafted construction.

This criterion can also be useful to distinguish from crafts as an art form or premodern, crafts-based art forms, as well as from the mystification of crafts that can be noticed at times.

e. The Craftsperson assumes a responsibility for the outcome of the task

at hand.

The craftsman's ethos is a central point in Richard Sennett's definition of craftsmanship: "craftsmanship (...) names an enduring, basic human impulse, the desire to do a job well for its own sake." This ethos, as a responsibility assumed by the craftsperson for the project, is closely linked to the aspect of adequacy. Adequacy implies that the craftsperson must judge the task at hand as well as his or her work constantly during the work process. Also the aspect of risk as mentioned by Pye incorporates this responsibility. Not only the craftsperson's skill and dexterity controls the risk; "care" is needed as well. In other forms of production, the individual responsibility can be replaced by control mechanisms; this aspect can be used to distinguish craftsmanship in general from other, especially proto-industrial forms of labour.
Glen Adamson (2007) described the analysis of medieval limewood carvers by Michael Baxandall, for whom skills is an important part of decision-making and stylistic sensibility of the craftsmen, far exceeding purely technical aspects. (p.76).
The range of responsibility felt by the craftsperson is crucial to distinguish craftsmanship in architecture from craftsmanship in general. It makes a huge difference, if the craftsperson feels responsible for the mere component he is working on, or for the building or space as a whole entity. The fake masonry wall in Engelberg shown above may be a piece of craftsmanship in itself; but in the context of the whole building one can not possibly speak of a crafted construction.

f. Crafted construction depends on a combination of explicit and implicit forms of knowledge.

Both forms of knowledge are crucial and function in a complex relationship. The following short and not terminal description is based on the analysis of processes.

Explicit knowledge describes communicable and expressible knowledge. It can be written down and in turn understood by reading; it is rational. It includes different components, which are relevant for the construction process.
Material knowledge could describe knowledge about the specific characteristics of wood. On the one hand, as *process knowledge,* it contains an understanding of the material's behaviour during the processing and is crucial to avoid mistakes like chipping or cracking and to determine weaknesses in the material. Furthermore, it

is applied to save effort. For instance, material can be removed very efficiently by using a fore plane across the fibre direction, as the wood is weakest between the fibres. However this leads to massive tear out of fibres and results in an unclean surface, which is why the finishing steps with a smoothing plane have to respect the fibre direction again. It should be mentioned that this knowledge can be embedded into the implicit so that the judgement of the material can happen intuitively.

Material knowledge also applies for the behaviour of the wood as part of the finished construction. *Construction knowledge* comprises the understanding of the functioning of particular wood joints as the DNA of a construction, up to the understanding of a whole, complex construction system. Many constructions anticipate the movements of the wood during the lifetime of the objects they form. Framework constructions with floating panels for example do allow the wood to shrink and swell without cracking. Construction knowledge is therefore very close to material knowledge.

Tool knowledge also forms a part of the explicit process knowledge. It contains the choice of the kind of tool, the judging of the individual tool for a certain job, the knowledge about the theoretic operation of the tool, and its maintenance. Sharpening for instance is considered an important knowledge and skill[4] and contains explicit and implicit components.

Implicit knowledge on the other hand describes the forms of knowledge that cannot be entirely communicated. It contains skills and dexterity, whose roles are described by David Pye, Toshio Odate and Richard Sennett, among others. It can only be learned by imitation and repetition, by making; knowledge is built up by physical practice and is therefore equivalent to experience: like riding a bicycle, it cannot be verbalized.[5]

Intuition, the ability to judge and evaluate a situation or a material, can apply as a passive form of implicit knowledge. Primarily adequacy and care used to control the risk in a construction process demand a fast and often unconscious judgement of situations. Beatrice Wagner (2005) described this intuition as the recognition of patterns in the unconscious part of the human brain. Examples are the

[4] For instance, the French master cabinetmaker André Roubo, who edited a comprehensive reference book about his trade, includes articles on sharpening and even writes about the workbench being the craftsman's biggest tool: (Roubo, 1774).

[5] In Japan, persons can be declared a living national treasure ningen kokuho (official name *Jūyō mukei bunkazai hojisha*, keeper of immaterial cultural heritage), a practice which reflects upon the fact that implicit knowledge is bound to an individual.

judgement of materials, tools or shapes through the eye, but also the feel. The feedback of the material through or the resistance to the tool, and the feel of the hand are part of many techniques.[6] Another part of this trained intuition is the sense of the eye for a fair curve or a "pleasant" shape. (Wagner, 2005*).*

Finally, the iterative character of the process of crafted construction is reflected in a correspondent mode of thought. In the carpentry craft, absolute and relative measurements exist parallel. For instance, in timber roof trusses the height of the purlin beams can be determined by external factors, while the structure of the truss is given by the chosen structural system. Within this framework, the individual members are measured relatively to each other. These measurements are affected by the individual beams at hand, or by the process. Through this strategy, one parameter of the time-consuming fitting of joints can be eliminated.
The most time consuming joints are the ones, where not only the two pieces to be joined have to be considered, but where an absolute measurement has to be incorporated additionally. Techniques and structures are often optimized in a way that these tolerances can be met with.

As a cross reference, it should be mentioned that the explicit forms of knowledge can be stored in collective knowledge as traditions. Traditional wood joints for example make it – theoretically – possible to achieve a faultless construction even when the executor does not understand its principles, as long as he correctly reproduces the form. Of course the chance for error is higher. Implicit knowledge however must be learned individually. A special example of a strategy to pass on implicit knowledge is the traditional cyclic reconstruction of the Ise Shrine in Japan as described for instance by Cassandra Adams (1998). Here, the frame conditions for a transfer of implicit knowledge are provided and formalized in form of a ritual.

g. Crafted construction relies on specific tools and material

The learning of a technique is mostly inseparable from the use of tools. It includes the frequent use of a special tool with a special material, for instance sawing, chiselling or planing. Material characteristics as well as the *hand*ling of the

[6] It is evident that the hand's ability to distinguish for example an irregularity in a surface, far exceeds the eye's; hence the often observed scrutinising touch with the hand over a surface that is being finished.

tool form a part of the implicit knowledge. These tools and materials in turn co-determine the traces of work on the construction.[7]

3. Traces

This work uses the examination of traces of the construction process as a vehicle to gain insight into the correlation between the two. This phase of the project is currently in process.
Nevertheless some conclusions and theses can be drawn from the analysis of the processes. Can the specific character of crafted construction itself, especially its specific knowledge, leave direct or indirect traces on the building?
In this paragraph I want to introduce some preliminary hypotheses, which are now being tested with the case studies:

- Explicit knowledge, especially construction knowledge shows itself in the techniques applied as well as in the regularity of the emerging structures.
- Implicit knowledge on the other hand leads to direct physical traces. Tool traces and freehand forms showing the "handwriting" of the executor are direct manifestations of the controlling of risk during construction. Accepted irregularities or small mistakes are evidence of the adequacy of efforts.
- the achievement of certain shapes often take the line of the least resistance, which is also a direct consequence of adequacy. This also applies to ornamental forms: sometimes they are direct tool traces.

A superordinate kind of traces emerges from the mode of thought of crafted construction. They include the dealing with tolerances, and the existence of such strategies by itself. By this means, the nature of the work in the construction affects a building in a very early conceptual and fundamental way. This can either be achieved by the architect, who involves construction fundamentally into the design process, or by the fact that a design already exists in the form of collective knowledge, as a traditional type.
These traces can cause certain effects, which become readable on the building. They

[7] In relation of the direct physical output of architectural work, a plan or model, architecture itself can be a craft after this definition. In relation to its physical manifestation – the building – architectural practice is a mere meta-craft, because direct physical interaction together with its connected components is replaced through an oblique relation. The definition for this work must be clear enough to make the distinction between design and execution clear.

can even evoke connotative effects. Diversity as a density of visual details can be a direct consequence of traces. This in turn can lead to identity, to the object being distinguishable from others, which makes it possible to identify with the object. The (assumed) stored time and care of the executor can influence the appraisal of an object.

FIG.11. The star-shaped ornaments on a cabinet in the Mainfränkisches Museum in D-Würzburg are in fact direct tool traces of a gouge set at a 45° angle.

4. Methods: Questions to the case studies

As the single components of the definition of crafted expression cannot be regarded separately, the construction process must be examined together with its product. Only this holistic view allows the understanding of the interrelations between the two. Crafted construction is not self-referential but target-oriented. The focus on the work is not only on the traces or on the process, but on the interrelation of both: in how far does crafted construction affect built architecture, architectural space? In this regard the work is practice-based in the sense that *building* (as a verb and as a noun) is in the focus, but also because it is aimed to reflect upon the work of the architect.
Consistently, the examination of the case studies is started from two opposite starting points simultaneously: from the close look at the process (as already started in the development of the working definition of crafted construction), and from the close look at the building. The two are of course complemented by the consultations of texts by theorists or reflecting practitioners.

Analysis of case studies: focus on process

Here it is crucial to examine where in the process traces do occur, and how they are dealt with by the craftspeople. The close look at the process makes it possible to sensitise the own look and helps to find out where to look for traces in the case studies.

The approach bases on experimental, personal making. The processes, the mistakes, problems and detours, the forms of knowledge applied, and the building up of skills are documented and reflected as far as possible. The emergence of traces is examined as precisely as possible.

The working definition of crafted construction is permanently challenged in the course of the examinations.

Analysis of case studies: focus on the building as the product

The analysis of the case studies is based on the search for traces of the construction process. In a defined area the traces are documented and charted, and the construction is measured as-found, i.e. including the irregularities, imperfections and relative measurements. Not the geometric ideal line between two points is assumed, but the actual derivations from this line.

If required, feedback from the process analysis, by trying to re-enact the construction of structures found in the case study buildings is possible.

Not only the physical occurrence of traces is important, but also the quality of the traces and the possible reasons for their existence. An interesting question in the context of the aspect of adequacy is if the traces are accepted, intended, or mistakes.

Some traces are not representable geometrically, which especially applies to surface characteristics such as finishes. They have to be described to grasp their qualitative characteristics.

Only a comparison between the means used, the outcome and the intention of the craftspeople and the design itself gives evidence for the existence of crafted construction and for its impact on the built architecture.

The Architectural

The methodology tries to combine implicit and explicit forms of knowledge, trying to make the first communicable as far as possible but accepting their special character. Thus it reflects upon the specific character of the research object itself. Parts of this could be called reverse design, as some methods try to comprehend how an existing spatial structure was really executed, similar to reverse engineering or experimental archaeology. It tries to make phenomena that exist within the physical act of the

making of architecture *as communicable as possible* without neglecting the limits of this approach. In the course of the project it becomes more and more clear that I am not acting in an unprecedented space; the reflection of the theses that form the definition of crafted construction can draw from many fields. For instance, adequacy is close to Cicero's notion of decorum in classical rhetoric (Cicero, de oficiis). Although starting with a close, sometimes self-referential view of the construction process, some aspects found on the way may turn out to be timeless.

These methods only function in direct interaction with each other, as the examined physical and intellectual factors do. The close interaction of theoretic reflection and practical examination is crucial to gain insight into the research object at hand. In the work, the adjustment of one factor often affects and changes the others, so that each of them needs to be treated over and over to achieve a coherent overall picture. This seems quite architectural.

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