La colección *Textos de Arquitectura, Docencia e Innovación* vehicula reflexiones diversas sobre el aprendizaje y la enseñanza. Se trata de un marco de debate dirigido tanto a docentes y estudiantes, como a profesionales e interesados en la idiosincrasia de la formación de las futuras y futuros arquitectos. La colección pretende ensanchar así puntos de vista y ampliar el conocimiento de la Arquitectura a través de la descripción y el análisis de prácticas docentes actuales y pasadas. Consecuentemente, se reúnen experiencias pedagógicas que ofrecen un panorama actual de la enseñanza de la Arquitectura tanto a nivel nacional como internacional, tanto disciplinar como interdisciplinar.

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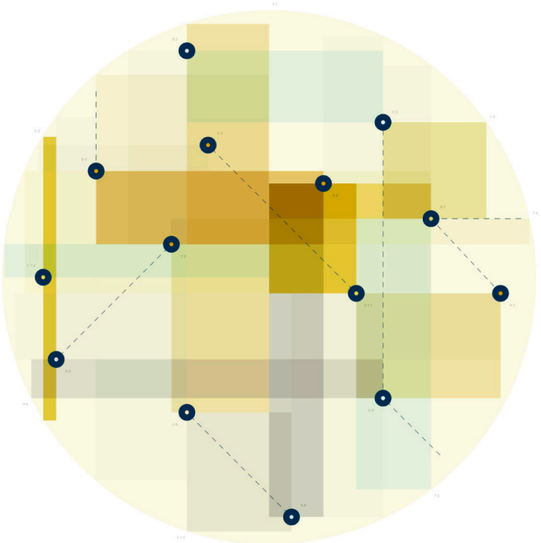

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"Hay que aprehender (como "llegar a conocer", como "hacer propio"). Pues si el aprendizaje es provisional o impostado no es verdadero. Aprender como una actividad favorecida por la inteligencia de grupo, pero en último término siempre es una actividad propia, privada. Una actividad que es un logro de la inteligencia, la sensibilidad, el esfuerzo y la curiosidad. De la razón crítica. Pero de la razón íntima; donde todo eso ha quedado combinado. Aprender lo esencial es algo íntimo porque lo aprehendido se incorpora a nosotros (o no es tal). Y si no es así, nuestra arquitectura devendrá en algo que solo será repetición superficial, imitación banal, epígono acrítico (patético) o vanguardia apresurada (ridículo)."

Javier García-Solera

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ÍNDICE GENERAL

EXPERIENCIAS DOCENTES

EXPERIENCIA 07

BLOQUE TEMÁTICO
METODOLOGÍAS ACTIVAS

MA.07

LEARNING BY BUILDING.
TWO TEACHING EXPERIENCES FROM THE DEPLAZES ETH-Z CHAIR

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RESUMEN

La cátedra de Andrea Deplazes, Catedrático de Arquitectura y Construcción de la ETH de Zúrich, defiende que proyecto y construcción deben ser enseñados conjuntamente. A lo largo de los últimos años ha apostado por orientar la educación que imparte en esta dirección en lo que se ha bautizado como "Learning by Building". El objetivo del presente artículo es exponer y analizar las ventajas y los beneficios de esta práctica docente a través de la exposición y análisis de dos experiencias didácticas concretas.

Palabras clave: docencia, proyecto, construcción, diseño, técnica, learning-by-doing.

ABSTRACT

The Chair of Andrea Deplazes, Professor of Architecture and Construction of the ETH Zurich, defends that design and construction should be taught at the same time. During the last few years he has chosen to guide his didactic strategy in this direction, in what has been called “Learning by building”. The purpose of this article is to present and analyze the advantages and benefits of this teaching practice, through the presentation and analysis of two didactic experiences.

Key words: teaching, project, construction, design, technique, learning-by-doing.

INTRODUCTION

It could be argued that teaching in any architecture studio always has a common feature: The student *learns to project by projecting* through the resolution of an exercise specially designed for that purpose. Usually, the teaching department proposes an architectural Project as an academic exercise to be developed by the student throughout various representation methods (drawings, models, renders, etc.). This teaching methodology belongs to what is known as *learning by doing*, in which the amount of verisimilitude that the exercise must approach depends on the judgment of the professor. From a pedagogical perspective, this can be very useful can also lead to partial learning outcomes that can be detached from the architect's professional reality. Thus, although this approach allows the student to learn to design by designing, it also excludes everything related to construction.

"Architecture exclusively exists when it has been physically built, when from the established program an architectonical project is developed and results in a spatial and material object"[1] (Deplazes, 2013). Thus, Architecture can and must be understood as the indivisible addition of design and construction. It seems then advisable to ask oneself: When and where do the students learn to build? What academic exercises provide them with knowledge about construction? The construction, the site, the budget or the relationship with the various agents throughout the development of a project are fundamental issues in Architecture, when and how does the student becomes familiar with those? Is it advisable to separate both learning experiences –design and construction– if the objective is the full training of the student as an architect?

The Chair of Andrea Deplazes, Architecture and construction Professor at ETH Zurich, defends that design and construction must be taught altogether and through the last years has been involved, among other projects, in the creation of a digital model workshop RAPlab[2] for the students from D-ARCH/ETHZ[3] to be used, in working together with other chairs –of construction, modeling, CAAD– or in the recently started experience in September 2017 of unifying in the first year of studies the Studio and construction courses under the same unit.

As part of this approach, Deplazes' Chair has developed over the last years several didactic experiences in which the student has directly participated in the design process and the construction of the project, which, from the beginning, has been propound to be materialized. In this type of activities the real aspects of construction and the external factors that affect Architecture are an intrinsic part of the exercise itself. This teaching method, based on the learning by doing concept, leads to what we will name here *as learning by building*.

The objective of this article is to expose and analyze the advantages and benefits of the learning by building through the exposition and analysis of two specific didactic experiences:[4] designing and building a bird-watching spot for the Kis-Balaton National Park in Hungary (2003) and a roof for the playground of the Kern state primary school in Zurich (Switzerland, 2006).

Fig. 1 Students 1:1 METAL WORKS welding the roof. Font: D-ARCH / ETHZ / Deplazes, A Archive (2006)

Fig. 2 1:1 WOOD WORKS workshop's construction process Font: D-ARCH / ETH-Z / Deplazes, A Archive (2003)

PROJECT 1. 1:1 WOODWORKS. BIRD MONITORING CENTER. KIS-BALATON, HUNGARY, 2003

In autumn 2002 Deplazes' Chair[5] and Moravánszky's Chair[6] from ETH Zurich come together to attend the Kis-balaton natural park request of constructing a new bird monitoring center, that comes to the school from the personal connection of AKos Moravánszky. The "Balaton ETH-Z team" is constituted, consisting of 20 students, 6 assistant professors of both Chairs and both lead professors. Bearing in mind the cultural and economic differences between Hungary and Switzerland, minimizing the project's cost is intended from the beginning,[7] and it is decided for that purpose that participation of external companies should be avoided.

The material chosen for this construction is the Acacia Wood, which in Hungary is usually used as firewood. The choice of the material is explained by the following argument: "logs can be stacked. For instance, in firewood warehouse a wall is built, which can be taller or more stable as its base is enlarged. Both walls and stacks belong to the "solid construction" range, even if wooden boards or planks are stacked as previously described. This process is particularly successful when the wooden logs, which are approximately a meter long, are cut by an axe dividing them into four quarters and creating triangular wedges. By twisting and staggering the logs, they can be stacked with almost hermetic joints. Acacia's strong timber used in the Balaton Project resulted particularly suitable, due to the fact that its juxtaposed fibrous cracks were woven ones with the others like a Velcro tape, which raised the friction resistance and, overall, the piling resistance under its increasing own weight"[8] (Deplazes, 2003).

Fig. 3 "Ster", construction principle of the wooden piles. Font: D-ARCH / ETH-Z / Deplazes, A Archive (2001)

Through an educational point of view, the Project interest is focused on the "Baustelle" concept, which could be translated as "on-site" or "the place where construction is taking place", understanding it as "the boundary of Architecture… the place of transformation… the building's location in the planet… and the project's litmus test"[9] (Deplazes, 2003). It is decided to construct it regarding the "Ster", the most common unit of measurement in the firewood commerce, which implies a volume of a cubic meter consisting of wooden pieces of undefined measurements, splintered or not, including the spacing between trunks.

The exercise was developed in three non-consecutive stages a weeklong each, using the framework of *seminar-weeks*[10] of compulsory attendance for students. In November 2002, during the first project's seminar-week, an idea contest among the students took place, for the construction of three huts that respected both the Kis-Balaton expert's directions, and the needs regarding the use of the material and the constructive technique proposed. A jury chose one of the projects for its further development and construction.[11]

In March 2003, the students spent a week in the ETH woodland park in Sellenbüren, where they became familiarized with the "Ster" construction technique and they could experiment, under the guidance of their assistant professors and the park rangers, with the possibilities of the system and its limitations on building openings, curves and domes.

During the period of time between this week and the one when the huts where built in May 2003, the assistant professors were in charge of organizing the construction, the material, the plans required to be presented to the authorities in order to get the construction license, the budget, the trip and the team's stay in Kis-Balaton.

Fig. 4 Construction diary of the 1:1 WOOD WORKS workshop. Font: Deplazes, A (2003)

Once in Hungary, the team just has 6 working days. They proceed to the construction of the huts, finding difficulties on-site that are presented as intellectual challenges, in order to allow the students to understand the intrinsic complexity of construction and the need of planning every aspect of the construction as detailed as possible to minimize spontaneous decision-making.[12]

The construction of the two false vaults and the large vault took place from the theoretical knowledge of the loads' behavior in vaulted structures. This process became an empirical trial-and-error exercise that, in many occasions, when mistakes where found on the logs placement, led to disassembling parts that had already been built.

Fig. 5 Interior of the construction once finished. Font: D-ARCH / ETH-Z, Deplazes, A Archive (2003)

Fig. 6 Load test and celebration. Font: D-ARCH / ETH-Z, Deplazes, A Archive (2003)

PROJECT 2. 1:1 METALWORKS. A NEW COVERED SPACE FOR KERN SCHOOL, ZURICH. SWITZERLAND, 2006

In October 2005 Deplazes' and Hovestadt's Chairs[13] of ETH Zurich get in touch with IMMO[14] to communicate their search of a real object whose construction could become an academic exercise. IMMO proposes the construction of a new roof for the playground area of Kern state school, a request made by the students themselves and that had been filed in June 2003 due to a lack of funding. Both institutions come to the following agreement: ETH would undertake the design and construction of the project free of charges while the IMMO would cover the cost of the materials used and the costs coming from those external enterprises that were needed to complete the project.

The exercise was developed, as the previous one, on three non-consecutive stages that had a week length each, under the seminar-weeks' framework. The beginning of the first seminar-week was developed in November 2005. The professors' team decided, for didactic reasons, that the project would be developed using metal sheets. Ludger Hovestadt, Chair professor of CAAD, explains it this way: "Metal sheets do not allow mistakes in planning. The holes wrongly cut cannot be filled and relocated as other materials allow. The changes made a posteriori considerably affect to the construction's quality. Moreover, with successive deformations the material can be stretched (which affects to the expected tolerances). Therefore, all the details must be planned ahead, with a tenth of millimeter precision, from the beginning"[15] (Deplazes, 2017). It is for this reason that the first days of the week the students were trained in different techniques of cutting, folding and welding metal sheets carrying out real practices, with the objective of later applying this knowledge to the manufacture and construction of the project. This first stage forced the professors of both Chairs involved to organize themselves as a single teaching unit that, in addition, had to coordinate with other departments of ETHZ.[16]

The last days of that first seminar-week were used to develop the roof proposals. The students were organized in six working teams and developed six projects, knowing that they should consider the constructive concept in their design. As if it were a real competition, the last day a jury[17] was formed and they selected the project "Wasserspiel" (water games) formed by fifteen even metal elements or umbrellas, whose different heights and positions aid rainwater to be conducted to the floor.

Fig. 7 Project’s visualization. Font: D-ARCH / ETH-Z, Deplazes, A Archive (2005)

Fig. 8 Construction diary of the 1:1 METAL WORKS workshop. Font: Deplazes, A (2007)

After this seminar-week the assistant professors of both chairs were in charge of improving and optimizing the design to ensure its constructive viability. Initially, the ETH was expected to produce the pieces in their own facilities, but that was not possible as the university could not assume the responsibility and guaranty required for the fabrication. For that reason, an external company was chosen.[18] Under the supervision of that company's professionals, the assistant professors tested several constructive aspects of the project (such as the need of foundations and its dimensions, the anchoring detailing…) and fabricated and assembled a first prototype using, for that purpose, the same techniques that the ETHZ students had previously learned. The students could not participate in that project stage because meeting the deadline agreed with the IMMO was required, which requested the building to be built during the summer vacations of 2006. Although the aesthetic and conceptual design of the chosen proposal was always respected, it was clear –as in the previous case– that the academic calendar does not always rightly adjust to the continuous work process that a project implies, which deprives the student of fully understanding such process in a unified and continuous way.

During the second seminar-week, in April 2006 the twenty seminar students participate in the manufacturing and assembling of the elements, guided by the ETH assistant professors and the workers from the enterprise in charge of the pieces' manufacturing. The manufacturing experience offers the students the possibility of understanding the materialization and assembling of the elements that are designed on paper. This allows them among other things, to understand the importance of bearing in mind tolerances, the precision required in drawing plans or the need of tacking into account the fabrication process itself.[19]

The elements were stored in the company's workshops until August 2006. Taking advantage of Kern school's summer break, an external company was in charge of the construction of the foundation where the metal elements would be anchored. Coordinated by the assistants of both Chairs, the seminar students completed the roof installation, which was finished in just three days.

The teaching of the project from the architectural concept as Design and Construction

The German term "Baukunst", used as a synonym for "Architektur", could be translated to English as the Art (die Kunst) of Building (der Bau). The inclusion of the "construction" term in the word used to refer to Architecture highlights the intrinsic character of the constructive part in the architectural realm. On the other hand, the presence of the "Art" term on the word "Baukunst" refers to the fact that not all construction can be considered Architecture: "Construction… cannot be considered just as a matter of technique and technology, but as the

result of an artistic objective, in which the better the technique and construction fundamentals are mastered, the more coherent and concise on its disposition the design will be"[20] (Deplazes, 2013). Architecture, as the word Baukunst indicates, is not mere construction, is the Art of Construction.

"Baukunst implies a necessary and complex interaction between design and construction"[21] (Deplazes, 2013). "Ultimately, Architecture exclusively exists when it has physically been constructed. When, from the program established, an architectural project is developed and a spatial and material object is formed"[22] (Deplazes, 2013). The work's intellectual conception cannot be detached from its material execution: "design" and "construction" form an indivisible whole in the architectural project.

Fig. 9 Celebration at Blechteam. Font: D-ARCH / ETH-Z, Deplazes, A Archive (2005)

Fig. 10 Structures' assembly. Font: D-ARCH / ETH-Z, Deplazes, A Archive (2005)

As shown above in the two Deplazes' Chair teaching experiences, the student's approximation to the architectural project can be approached through various tools:

Drawing. In the classroom, drawing should be used as a specially useful tool for the project's representation and verification. Under no circumstances should we forget that this requires a high range of abstraction of what is being represented, and in no case the representation can become a goal in itself, or in a self-referential document that looses any contact with the reality it has to represent –the project–: "The plan shows an intention: The intention of the finished state of a design that must be translated into a physical form. Moreover, it builds an "action guide" for the insiders and professionals, which illustrates the assembling process (or construction): a chronological sequence of activities, in priority order, that can materialize even the most complex constructions in a conscious way"[23] (Deplazes, 2007).

Modeling. Model's elaboration has been evolving so much in the last decades due to the technological advancements in the field of computer-aided design (CAD[24]) and to the emergence of machines such as the laser-cutters, CNC machines, 3D printers and vacuum formers, which are gadgets that are already existing in many architecture schools. Despite its undeniable utility in terms of three-dimensionally explaining the projected object, the simplicity needed in a model (scale reduction, material simplification, etc.), constraints the student to use it to understand the complexities of the constructive methods of the project.

The prototype. Modern technology promotes computer aided manufacture of 1:1 scale prototypes of façade solutions, structures, etc., both in the professional and the academic fields. Unlike drawing or modeling, the prototype abandons the representation field to embrace the realization field: building an element of the project enables the students to test the design's constructive reality, a fact that implies an enormous qualitative leap in the students' training and that it should, therefore, be integrated in a natural way in the academic exercises developed at Architecture schools.

Construction 1:1. As shown above in the description of the two Deplazes' Chair teaching experiences, the direct contact with construction on-site results in one of a kind experience in the architecture student's training process. So much so, that Deplazes' Chair advises all their students to pursue a semester or a yearlong internship at an architectural office during the firsts 2-3 years of academic formation, which enables them to have direct contact with the construction site. This direct contact with the reality of construction becomes essential to appropriately complete the theoretical, historical and aesthetic knowledge learned within the classroom.

Fig. 11 MANIFESTA 11 pabilion / Zurich. Font: D-ARCH / ETH-Z, Studio Emerson, T Archive (2016)

Fig. 12 Callejon Menores House, Toledo. Font: Salmerón, Margarita (2016)

Both of the aforementioned experiences were designed in a manner hat the student was forced to use all this projecting tools, with a special remark on the 1:1 construction. "The process that goes from the concept to the finished building must be experimented at full depth, from a specific location's conditions; its primary actors are in charge of the resolution of a specific problem, until developing one solution and carrying it out themselves"[25] (Deplazes, 2007).

This approach requires the necessary adjustments of the architecture school facilities: the spaces and furniture traditionally conceived to allow the realization of master classes, the large-dimensions hand drawing plans and the handcrafted elaboration of paper and cardboard models, etc., should give way to structures suitable for computer design needs, digital presentation and usage of CAM modeling machines. It would also be advisable to have schools with suitable spaces for building 1:1 prototypes. When the school could not offer manufacturing workshops, cooperation with external entities should be provided, as it was done in one of the academic experiences previously mentioned.

Thus, it seems advisable to remark that is not necessary to propose complex and over-budget 1:1 construction projects; on the contrary, it is advisable that the projects that are proposed as academic exercises are simple and of a controlled extension, in order to avoid an excessive complexity that would probably become difficult and counterproductive in terms of academic purposes.[26]

Learning by Building

The architectural project training has always been approached regarding the learning by doing assumptions, which conceives the student as an active subject and the main character of the learning process in an educational framework designed by the professor.[27] However, usually, in the project studios this action is exclusively oriented towards design, in other words, to the project's representation previous to its materialization. With this teaching approach, which we could name learning by designing, the understanding of the project process is necessarily bias and partial, so the student does not have the opportunity to understand what construction implies. In order to avoid this situation, Deplazes' Chair proposes that the students not just learn Architecture designing, but that through designing and building, understanding design and construction as an indivisible whole. Learning by design should be substituted, whenever possible, by what we have here named *learning by building*.

This teaching approach becomes beneficial to all involved parties: the students get in contact with the design and construction processes at its whole complexity and extension, therefore improving their learning; the university materializes its teaching task in specific architectural objects, a fact that increases its activity's visibility as an educational institution, gets in contact with new ideas

and approaches that can later be implemented in its economic activity; and the users of the new constructions see how through small architectural interventions problems and weaknesses of their daily life are resolved.

NOTES

[1] "Letztendlich existiert Architektur jedoch nur, wenn sie physisch geworden ist, wenn aus dem gesellschaflichen Programm ein architektonisches Projekt und daraus ein materiales und räumliches Objekt geworden ist".
[2] Raplab D-Arch ETHZ. https://www.raplab.arch.ethz.ch/
[3] D-ARCH are the initials of the Architecture School of Zurich Polytechnic University.
[4] Architektur+Konstruktion Chair of Andrea Deplazes has been developing, on its own or in collaboration with other Chairs, two different teaching experiences in which the students has actively got involved in the development and construction of an architectural project: the Gantenbein Winery in Fläsch (Switzerland, 2006) and an alpinist center in Monte Rosa (Switzerland, 2009).
[5] Andrea Deplazes directs Architektur+Konstruktion Chair of D-ARCH in ETH Zürich. www.deplazes.arch.ethz.ch
[6] Ákos Moravánszky is the Theory of Architecture Professor in the gta institute der ETH Zúrich. www.gta.arch.ethz.ch
[7] The costs are broken down in the following chapters: 130 Ster of acacia wood with a value of 3.400 € (which include three trucks with a trailer and two without trailer carrying wood cut in parts of the standard size). Two pallet jacks of 3.100 € cost. The costs of cutting the wood had a value of 6.500 €. And the placement of a sand layer and boulders as paving in the construction's interior had a value of 500 €. In total, discounting the participants' transportation and maintenance costs (who covered their transportation and they stayed in camping tends in the construction field), the project's cost raised until 13.500 €.
[8] "Holzscheite Lassen sich zu Schreiterbeigen oder Scheiterhaufen aufschichten. Im ersten Fall entsteht ein Brennholzlager in Form einer Mauer, die umso stabiler oder höher gebaut werden kann, je breiter ihre Basis ist…Mauer und Haufen gehören dem Prinzip nach in der Bereich des Massivbaus, selbst wenn sie, wie oben geschildet, aus Holzscheiten aufgeschichtet sind. Besonderes gut geling das, wenn Rundholzabschnitte von etwa einem Meter Länge scheitrecht, d.h. die Kopffläche aufrecht nach oben, mit dem Spaltkeil geviertelt werden. Jedes Holzscheit weis daher einen dreieckigen Querschnitt auf. Gedreht und versetzt zueinander Lassen sich die Scheithölzer statt und fugenschlüssig aufschichten, es steht Lage um Lage ein Trockenmauerverband. Das beim Balaton-Projekt verwendete, zähe Akazienholz erwies sich zudem als besonders gut haftend, weil sich seine aneinander liegenden, faserigen Spaltflächen wie Klettverschlüsse ineinander verhakten, was den Reibungswiederstand und im Gesamten die Festigkeit des Mauerwerks unter der wachsenden Eigenlast fühlbar erhöhte".
[9] "Die Baustelle ist ein Grenzgebiet der Architektur… Die Baustelle ist ein Ort der Verwandlung… Die Baustelle ist die Verankerung des Bauwerks in der Welt… Die Baustelle ist der Prüfstand der Ideen und Konzepte".
[10] Usually these seminar-weeks are used for travelling, but it is possible to offer other types of seminars, as it is the case of the one we are studying.
[11] The jury was formed by: Mate Harkay and Csaba Megyer from Kis-Balaton, Akos Moravansky and Andrea Deplazes (Chair Professors of ETHZ), Daniele Marques (swiss architect),

Jules Jausherr (students' representative), Florian Niggli (Suctures Professor of ETHZ) and Nik Biedermann (assistant professors' representative). The chosen project was the proposal presented by the students Linder Steiner and Gabriela Steiner.

[12] During the construction process the fact that the wood quantity expected and agreed was not on site on the deadline agreed had to be faced: Just a third part of it had been received when the construction started, to which they had to readjust the work to be made with the available material each day and change the design elements to suit those absences. The last day it was necessary to remove a part of the peripheral wall that had been built the second day, in order to use the wood to finish the last dome.

[13] Luger Hovestadt directs CAAD (Computer Aided Architectural Design) Chair of the D-ARCH of ETH Zürich. www.caad.arch.ethz.ch

[14] The IMMO is the Department of "high-rise construction" of the city of Zurich. He is in charge of managing the municipal constructions, which includes educational, administrative, health, social, cultural and sportive centers.

[15] "...denn Blech verzeiht keine Planungsfehler. Falsch geschnittene Löcher Lassen sich nicht wie bei anderen Materialen zuschmieren. Nachträgliches Ausbessern beeinträchtigt die Verarbeitungsqualität erheblich. Zudem wird bei Umformen das Material gedehnt! Es muss also von Anfang an alles bis in den Zehntelmillimeter vorgedacht werden…"

[16] The students' training in cutting, pressing and soldering was developed in collaboration with Thomas Jost, the responsible for the ETHZ Metal Department workshop of Mechanical Engineering, and If Ebnöther, the responsible for the D-ARCH / ETHZ model workshop.

[17] The jury was formed by: Mark Ziegler (IMMO ZH), Sandra Zacher (IMMO ZH), Roger Hartmann (IMMO ZH) and Patrick Gartmann (Civil engineer) as external members of ETHZ; Prof. Andrea Deplazes, Maud Chàtelet, Christoph Elsener and Barbara Wiskemann as members of Deplazes' Chair and Christoph Schindler and Oskar Zieta as members of the CAAD Chair; If Ebnöther as responsible for the D-ARCH model workshop and Florian Niggli as Statics Professor.

[18] Blechteam GmbH Riedackerstrasse 5, 8153 Rümlang. Switzerland.

[19] In this case, issues such as the size of the steel plate, the laser cutter's precision, the metal's enlargement during the folding process and the addition of 0,5 cm of gun lacquering of the pieces resulted essential.

[20] "Konstruktion wird hier nicht nur als eine Frage der Technik oder Technologie verstanden, sondern als Ergebnis einer künstlerischen Zielsetzung, die umso kohärenter und prägnenter ihre Gesrtalt findet, je besser die technische-konstruktiven Grundlagen beherrscht werden".

[21] "Bauprozess als notwendiges und komplexes Wechselspiel zwischen Konzeption und Konstruktion".

[22] "Letztendlich existiert Architektur jedoch nur, wenn sie physisch geworden ist, wenn aus dem gesellschaflichen Programm ein architektonisches Projekt und daraus ein materialles und räumliches Objekt geworden ist".

[23] "Der Plan zeigt eine Absicht: Die Absicht des fertigen Zustands einer Konstruktion, die ins Physische übertragen werden soll. Gleichzeitig ist er für den Eingeweihten oder den Fachmann eine Handlungsanleitung, denn er bildet den Prozess des Zusammenfügens ab: Einen chronologische Abfolge von Tätigkeiten, nach Prioritäten geordnet, di es erlaubt, auch noch so komplizierte und komplexe Konstrukte und Aggregate folgerichtig zusammenzustellen…"

[24] Computer Aided Design.

[25] "Der Prozess von Konzept bis zum fertigen Bauwerk soll in der ganzen Tiefe erfahrbar werden, von den Bedingungen des konkretes Orts, dessen Benutzern über die spezifische Problemstellung bis zum Entwicklung einer Lösung und deren eingendhändigen Realisierung".

[26] We would like to pint out at this point that the didactic experiences of the "learning by build-

ing" are not exclusive from Deplazes' Chair and that other professors and schools that follow this model exist. Among them, we would like to highlight the didactic experience done by the Emerson Studio of D-ARCH/ETH-Z with the construction of the MANIFASTA 11 Pavilion in Zurich in 2016 or the one done by Toledo's Architecture School of a Patio House refurbishment in Callejón de Menores in Toledo under the mentorship of José Ramón de la Cal and Javier Bernal professors during the lasts 5 years.

[27] It is important to point out that the epistemological root of what nowadays is known as learning by building is the constructivist theory of the Swiss psychologist Jean Piaget.

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