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6x6x6: INTRODUCING THE CONCEPT OF REUSE OF TIMBER MATERIALS IN THE 1ST YEAR OF ARCHITECTURAL EDUCATION

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ABSTRACT: 6x6x6 is a student design project in 1st year Architecture that takes place during the spring semester.

In 2022 the students designed a house in timber measuring a maximum of 6m x 6m x 6m. The project focused on teaching students how to use different timber construction principles and how to actively, and creatively, re-use structural timber components. The project had 3 parameters: a timber construction method, a hypothetical site, and a client.

The 6 timber construction methods were columns, beams, plates, trusses, shell, and solid log building (laft). For each construction principle the students were given a specific number of materials to be reused, for example 60 recycled columns 30 cm in diameter. The students produced a timber model of their project in the scale of 1:20 as well as a cross section drawing in the scale of 1:50

This project is the first-time students are introduced to timber as a construction material. They are instructed to look at their principle as more than just a technical requirement but something that inspires design. The result of the project for the students is a better understanding of timber as a construction method, how to incorporate reused materials into their projects, as well as dealing with how a client and a site influence a design.

KEYWORDS: Timber, reuse, education, construction principles

1 INTRODUCTION

In the UN's most recent climate report from March 2023 it was shown that the aim of reducing the global temperature increase to less than 1,5 degrees has become more unrealistic and that more drastic changes in society are needed to tackle the climate crisis [1]. Everyone needs to contribute but architects have an especially important role and responsibility. The building industry contributes up to 40% of the global C02 emissions through building, energy use and the demolition of existing buildings [2].

The climate crisis is immediate and gloomy, but it is important to remember that a crisis also offers new opportunities. The current situation allows us to rethink our way of designing architecture and educating future architects.

One of the clear consequences of the climate crisis and the building boom in Europe the last 10 years is that we need to build less new buildings. It's been suggested that 80% of the buildings that we will be using in 2050 are already built. So, transforming and re-using existing buildings will be a larger and larger part of how architects work.

There is a huge sustainable potential in reusing existing building materials and resources. Research shows that transforming existing buildings can reduce the amount of C02 emissions by 50% in contract to building new. This is mainly associated with the production of building materials and elements [3].

Tine Hegli, professor at AHO, emphasizes that we must have circular economic principles in the building sector: - to reuse resources that are already used would be the most radical approach in terms of reducing emissions [4].

Introducing ideas about reuse early in the education of architecture students is vitally important for the future of the profession. Reuse must be seen as an essential part of the design and building process and the earlier we can introduce this to students the better. The teaching team in

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first year architecture at AHO have been exploring different ways to thematise reuse in the projects the students work with.

2 REUSE AS A THEME IN ARCHITECTURAL EDUCATION

2.1 FUNDAMENTALS OF THE PROJECT

Students in first year architecture at AHO work on five main design projects throughout the first year of their studies. The projects become increasingly complex as students gain more experience. New parameters and more complex issues like context or construction are introduced with each new project. The fourth project in the year, which starts at the beginning of the spring semester is called 6 x 6 x 6 and has been a part of the course plan since 2020.

6x6x6 project is inspired by the house *Huset i Mellbyedalen* on Bygdøy designed by Terje Moe, completed in 1970. The house is a timber construction with a volume of 6m x 6m x 6m. Moe designed the space for himself and his family. The house contains a living / dining space, 2 bedrooms and an office. Moe designed and built most of the house himself. He had a retractable bench in the living room and a standard tool set which he used to make almost all the elements in the building. [5] This has led to an architecture which is easily understood and readable. It makes for an excellent case study for students to study because of the focus on constructions and creating space being completely interdependent.

The students design a project in timber measuring a maximum of 6m x 6m x 6m. The project focused on teaching students how to use different timber construction principles The project had 3 parameters: a timber construction method, a hypothetical site, and a client/ function. The 6 timber construction methods were columns, beams, plates, trusses, shell, and solid log building (laft).

In 2021 we introduced how to actively, and creatively, re-use structural timber components as part of the construction method.

2.2 MATRIX

6 x 6 x 6 refers to the size of the project the students will work on but also to a matrix we have set up to create enough variations between the three parameters to guarantee that no students end up with the same combination of factors.

The students receive a brief with all the required information for the project at the beginning of the spring semester. Students are introduced the project and the 6 construction methods. In the brief we include the matrix with the three parameters (construction method, client, site) and all sixty students. By staggering the 6 options in each parameter it is possible to create 216 unique combinations. This means that none of the 60 students will have the same project. If for example two students have the same client, they will have a different site or a different construction principle.

The matrix is really the DNA of the entire project- it guarantees that all the students work on similar but not the same project, it creates a dynamic class environment, inspiring students to discuss their project with each other without being protective of their own solution. The total work in the project enlightens all the students, it is not 1 project repeated 60 times but 60 individual projects.

The matrix also generates strange and contradictory combinations, for example a solid log building on pier edge, which instead of being problematic create interesting starting points for a project and tests the extents of the construction principle they have been given.

2.3 REUSE

In the 2021 project we included an element of reuse in the construction principle. This was to introduce students to the idea of re use of materials as an essential part of architecture in the future. Students were given a set number of materials to reuse so for example if a student was working with columns, they received 60 reused columns of a set dimension to be incorporated into their project. The students were free to rework the materials in any way they saw fit, for example dividing them or combining them. The students were not limited to only using the reused materials but were encouraged to incorporate them into their design as an integral part of the project.

2.4 SECTION

In the fall semester of their first year in architecture the students work mostly with models and plan drawings. The 6 x 6x 6 project time the first-time students being to work with section drawings as a method of representing a project but also developing the design of a project. The nature of the 6 x 6 x6 project forces students to work in section as the full brief is not possible on one floor plan, this makes the students work with more than one level and vertical connections in their project. Section drawings allow students to fully explore the projects in height as well as in plan.

Section drawings are also a fundamental way of understanding the construction method the students have been given as it encourages them to investigate the floor, roof, and wall construction. Finding out for example the largest span, which direction is the most efficient to span in, standard sizes for construction elements etc.

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Matrise

Student	Tomt	Konstruksjons-prinsipp	Beboere	Sparrings-partner
Hennie	mellom to gavler	Søyle	Paul og Eva	1
Maja	skog	Søyle	Julie	4
Mary	stup	Søyle	Louis	6
Cora Linn	skråning	Søyle	Simon	15
Hedda	skog	Skive	Paul og Eva	22
Hanna	elvebredd	Skive	Louis	12
Amalie K.C.	skog	Skive	Simon	4
Sigurd	stup	Skive	Aisha	6
Eine	skråning	Skive	Tom	15
Henrik	mellom to gavler	Skive	Simon	23
Jeppe	forblåst vidde	Skive	Aisha	26
Malin S.F.	mellom to gavler	Skive	Tom	1
Lars Tore	skråning	Skive	Paul og Eva	9
Jiro	mellom to gavler	Bjelke	Simon	2
Lina	elvebredd	Bjelke	Tom	27
Guro	forblåst vidde	Bjelke	Paul og Eva	26
Franziska	stup	Bjelke	Julie	18
Kariann	mellom to gavler	Bjelke	Aisha	2
Julie	stup	Bjelke	Tom	7
Brage	skog	Bjelke	Paul og Eva	5
Gutav	skråning	Bjelke	Aisha	16
Haakon	mellom to gavler	Bjelke	Simon	23
Magda	skog	Bjelke	Louis	22
Sofie	stup	Skall	Paul og Eva	7
William	skråning	Skall	Julie	10
Jenny F.H.	forblåst vidde	Skall	Louis	11
Marie	elvebredd	Skall	Simon	27
Joakim	skog	Skall	Julie	19
Martin	mellom to gavler	Skall	Paul og Eva	24
Martin J.	mellom to gavler	Skall	Simon	3
Teo	skog	Skall	Tom	14
Emanuel	elvebredd	Skall	Aisha	12
Sanna	skråning	Skall	Louis	16

Figure 1_ matrix

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Figure 2

Figure 3

Figure 4

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3 RESULTS OF STUDENTS' WORK

By the end of the project the students had produced an exciting and wide range of solutions to the parameters they were given. The students had a much deeper understanding of working with timber construction principles by the end of the project. Also, a whole the students learned more about each other's construction's principles leading an increase in the overall knowledge of the class.

Students produced a large 1:20 model of their project and detailed 1:50 drawings. The models in Fig. 2 and Fig. 3 act almost as structural prototypes, allowing students to text spans and thicknesses which relate closely to the real-world dimensions.

The influence of reuse varied from project to project. Some students willingly engaged with reuse as a theme, developing their own briefs and parameters beyond what was set out in the original project description. Some students found existing buildings which were for sale and actively reused these real buildings in their design. This gave their project an extra dimension of reality and tactility.

Other students struggled with differentiating between reused materials or regular materials, The authors believe this problem mostly relates to the hypothetical nature of the project. If students are dealing with a hypothetical material, it is difficult to differentiate or relate to it being new or re used.

4 DISCUSSION AND CONCLUSION

The authors found introducing an element of reuse in a student project in first year to be successful. Students engaged with the theme and were inspired by it. Some students actively incorporated it into their project as a key design driver. However, as it is the first year of their studies the students were limited by how far into detail they could go with reusing materials. More experience developing projects and working with detail drawings would be needed for the theme of re use to be more central in a student's project.
But as the first step towards moving architectural education to embrace the world of reusing timber elements we feel the project was a success.
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If 2023, we have also included re use of architectural materials and elements into a design project. However, this time the authors have found an existing building in Oslo which will be demolished in the coming year. Students have visited the building, map the existing materials there and have begun making both analogue and digital models of the elements which they will then use in their own project. The project will be finished by May 2023 and the authors believe this strategy of using an existing building to be even more effective as the students will have a tactile relationship to the material, they are re using. It is also a part of their final project, which is twice the length of the 6 x 6 x6 project. This will give the students more time to study the existing materials and explore how they can be used in different ways.

As final note, the authors find the including on reuse to be an inspiring and unpredictable aspect to add into students' design project in first year. The authors are still testing how best to do this but are committed to making reuse a permanent and essential part of the curriculum in first year architecture studio at AHO.

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