Crafting Circularity. A European Education Project Exploring Sustainable Construction Practices with Future Architects

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Abstract. Situated within the broader scope of the ERASMUS+ research project *Crafting Circularity: Rethinking Sustainable Design and Construction in Architecture Education*, the present paper is an early contribution on project-based learning-through-making methodologies and their implementation in architectural curricula. The construction industry exploits vast quantities of raw materials, produces more than a third of global waste, and causes a large portion of the world's carbon dioxide emissions. However, while new models tackling resource scarcity emerge in practice and an array of R-strategies is discussed within the research community, education is yet to adjust, architectural education in particular. If architects are a decisive agent of change, this needs to be distinctly reflected in the reorientation of teaching. This project discusses strategies for translating current research findings on circular construction practices into architectural education. The various components of the project are presented, along with first outcomes and transferable insights.

1 Scope

1.1 An Industry in Transition

The construction sector is a critical factor in the climate crisis today [1]. It uses a significant portion of both energy and our limited natural resources, and causes a large part of the CO2 emissions – all of which are agreed to be urgently and significantly reduced [2]. While the construction industry has a significant stake in this situation, a leading role nonetheless must be seen with architects, who are developing projects and shaping buildings and our infrastructure, eventually choosing building materials and moderating building processes [3]. Connecting society with the built environment, they are a decisive agent of change and can also change the way we think about our culture of building [4]. While various researchers and practitioners have taken on the issue and slowly explore alternatives based on the circular use of building materials, components or structures, the education of architects almost entirely fails to reflect on new design strategies for a more sustainable built environment. Therefore, the actual design practice in architectural education needs to be connected to the state-of-the-art knowledge and research on sustainable design; students and teachers must engage in resource-framed thinking [5], thus approaching availability-based design as a new paradigm for our building culture.

1.2 Project Framework

In the European context, it is often difficult to talk about *the* circularity, as there are quite different contexts with a specific local reality. There is, therefore, a need for a broader understanding of what sustainability and the circular economy mean and how they need to be understood in relation to other local building practices. Incorporating circular thinking and constructing buildings in the context of places are important elements of architectural education that need to be incorporated into future-proof architectural curricula [6].

The ERASMUS+ project CIRC-ARCH *Crafting Circularity: Rethinking Sustainable Design and Construction in Architecture Education,* discussed in this paper, is an international, cross-cultural collaboration on the integration of circular construction in architectural design education. Over a period of three years, five participating universities (Table 1) from different European contexts place the central topic of circular design in the center of discussion. They develop and test methodological tools around availability-based design, both in design studios and design & build workshops.

Table 1. Partners of CIRC-ARCH.

University	Teacher(s) involved
University of Antwerp, Belgium (lead)	Mario Rinke, Frederik Vandyck

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Amsterdam Academy of Architecture, Netherlands	Machiel Spaan, Jeroen van Mechelen
Norwegian University of Science and Technology Trondheim, Norway	August Schmidt, Arnstein Olav Gilberg
University of Liechtenstein Vaduz, Liechtenstein	Urs Meister, Carmen Rist-Stadelmann
University of Thessaly Volos, Greece	Maria Vrontissi

1.3 Background of Partners

The five partner universities of the project (Table 1) have complementary expertise in architectural design, construction, and technology, with links to local industries and extensive experience in design & build workshops. Three of the partners (Amsterdam Academy of Architecture, NTNU Trondheim, and the Institute for Architecture and Planning of the University of Liechtenstein Vaduz) have collaborated in two three-year *ERASMUS+* strategic partnerships from 2014-2020 (*Wood: Structure and Expression*, 2017-2020, and *Crafting the Façade: Reuse, Reinvent, Reactivate*, 2014-2017), as well as in several Erasmus Intensive Programs from 2003-2012, developing a broad knowledge of local construction cultures. The Department of Architecture of the University of Thessaly in Volos, Greece, has a long tradition in design & build workshops, often in international and inter-disciplinary collaborations (ma[K]e since 2005), while the Faculty of Design Sciences of the University of Antwerp, Belgium, assumes the project lead, building on an extensive teaching experience on 1:1 workshops and the recent input from two flagship international full-scale summer schools on circular construction (*Ephemeral Permanence*, Aalborg 2022, and *Re-claiming Ground*, Antwerp 2021) [8]. Most recently, all partners have collaborated in the workshop *100% Tree* in summer 2022, as a collective introduction to availability-based design, building a full-scale chicken shed with reclaimed timber coming from natural green/ disaster waste from the city of Amsterdam.

1.4 Circular Design Strategies in Architectural Education

In recent years, many architecture schools have gradually developed courses or new course contents which reflect and broadly integrate the principles of circular architecture in undergraduate programmes. These courses mostly focus on teaching the overall principles of circular economy and common maintenance strategies, i.e. the R-ladder strategies for circularity, in short: reduce, reuse, recycle. Students are generally taught that the greatest value of resource conservation lies in the prevention, then the reuse and ultimately the reprocessing or recycling of building materials. Unfortunately, most of this study content is limited to technical courses and finds only very limited access to the design studios. This is where the CIRC-ARCH project comes in and investigates how knowledge and methods from research and practice concerning the preservation and reuse of building components and structures can be systematically applied in student design projects. From the R ladder, ‚reuse' is chosen as the level that teaches students a higher degree of circular thinking and thus a shorter process cycle in relation to energy and resources. Project-based design & build workshops are chosen as the main format functioning as pedagogical tool to embed circular design thinking in architectural education, to efficiently introduce, explore, physically test, reflect on, and refine circular construction strategies in the building process.

1.5 Research hypothesis and questions

For this study, CIRC-ARCH draws on the cultural and methodological diversity of its partners to provide a broad overview of the situation and to test specific approaches. The overarching objectives of the project are 1) to gain an overview of the range of meanings of circularity in various European contexts, 2) to clarify the link and gap of circularity to design studios in the European architectural education landscape, and 3) to explore possibilities for construction education based on availability-based design through design studios and hands-on design & build workshops. CIRC-ARCH is rooted in the hypothesis that integrating circularity principles into the core of architectural education is possible and can lead to new, resource-oriented design approaches (availability-based design). A hands-on approach, such as the design & build workshop, creates a fruitful confrontation with limitations (e.g., availability) that lead to effective learning. The project explores strategies of reuse at different scales and contexts, with new insights also always informing next steps. As such, the project is also a knowledge platform that is constantly available to all interested educators [7].

2 Methodology

The overall endeavor consists of several components: a principal series of collectively run design & build workshops held in diverse cultural contexts, an array of theory courses and design studios run individually in local settings, as well as adjacent research comparatively detecting agents and networks of circular practices in architectural education and praxis (Table 2). Practices are field-tested on different scales, and theoretical influences and interdependencies are examined comprehensively, in a mapped construction industry landscape.

Table 2. Major activities and timeline of CIRC-ARCH.

Activity	Time
Kick-Off	March 2022
Workshop *100% Tree,* Amsterdam	August 2022

Workshop *Circular Tolerance*, Amsterdam	March 2023
Summer School *Circu/ability*, ERASMUS+ BIP, Antwerp	July 2023
Workshop *From Building to Building*, Trondheim	September 2023
Workshop *Layers of Permanence*, Volos	April 2024
Closing Colloquium, Antwerp	September 2024
Publication of Documentation	February 2025

2.1 The Design & Build Workshop: Learning-Through-Making Experiences

Design & build workshops deviate from conventional studio teaching methods by providing students with the opportunity to experience the reality of construction [9,10]. Regarding the focus on resources, they also very directly demonstrate precarious means. This approach encompasses availability-based design, where students first comprehend the nature, limitations, and capacities of existing resources before undertaking the design process. Additionally, the practical experience of building on-site facilitates the method of *bodystorming*, which involves simulating product usage through improvised tools and physical actions to generate solutions [11]. In this way, the participants internalize operating with the limitations of both the building materials and the specific building site [12,13].

The project revolves around a central series of three collectively run design & build workshops with students and teachers from all partner universities. Each workshop is held in a different cultural context and is related to one of the three phases of the project, exploring respectively a particular aspect of circular construction: reuse of components, harvesting and reusing materials, reuse of structures.

Embedded in an already established reuse culture, the first workshop in Amsterdam, Netherlands, in March 2023, explores the design & making practice based on and bound by available industrial building components. The second workshop in Trondheim, Norway, in September 2023, takes place in a rural setting and investigates the harvesting of building components from vacant buildings and their possible reusability. In a much more urban scenario in Volos, Greece, in April 2024, the third workshop studies the continued construction and reuse of building structures as a genuine notion of circularity in Southern Europe.

These full-scale exercises form the backbone of the project, allowing to highlight and discuss critical issues on circular construction in a most tangible way while exploring the immediate consequences of resources and design strategies through an intense building and reflecting process.

2.2 The Design Studio: Borrowing Circular Design Strategies from Research or Professional Practice

The partner universities also run studios individually, which tie in with the respective themes of the project, i.e., reuse of building components and structures. The reuse paradigm inverts the common design approach: the students first understand the nature, limitations, and capacities of the existing, and then design and build from there.

In a first studio *A Circular Workshop* (January - May 2023, Tutors: Michael Spaan, Jeroen van Mechelen & Catherine van Andel), the Amsterdam Academy of Architecture explored specific design strategies for a workshop in downtown Amsterdam built from harvested materials and showing the aesthetics of a circular structure. The Academy's next studio, loosely connected to the theme of the workshop in Trondheim, will address the material cycles and reuse possibilities of wood in the architectural design process. Students and tutors in Amsterdam are all involved in practice during the semester, which creates an intensive dialogue between traditional and new thought processes.

A studio at the University of Antwerp, on the other hand, deals with the reusability of building structures. In *Spaces of Transition*, (September 2022 - June 2023, Tutors: Mario Rinke & Robbe Pacquée) new and existing buildings are developed for urban, rapidly changing contexts in Brussels and Antwerp which should have the capacity to accommodate later changes. The studio is connected to a research project of a similar nature, which allows for an intensive exchange of research findings and testing in the studio context.

2.3 Agent and Networks Mapping. Tracing circular practices in architectural education and practice

Alongside the teaching activities, there are several research activities. These can be understood as layers of reflection on circularity in the construction sector in relation to architectural education, seeking insight into questions such as: What are the different conceptions and practices of circularity in different regions? What are the expectations, hopes and problems of an increasingly circular construction sector among the actors involved? And what do they see as crucial points in the education of architects?

And on the side of the universities: What activities for the integration of circularity in the design studios and making workshops do already exist, what are the problems and visions, and what is planned for the future? What do the students expect?

For this study, different formats are used: In ERASMUS+ Blended Intensive Programmes (BIPs) with most of the partners involved, networks of actors active in the building sector are identified, first locally for the respective contexts of the partners, then a superordinate one. In the process, influences, dependencies, power constellations and crucial interfaces are made visible, both for the current state and for a necessary future state. In a large-scale international survey, architecture schools in Europe are asked about their current situation and their plans. The aim is to make

both general trends and local disparities visible: How are the European designers of tomorrow educated to address climate-related challenges, such as material scarcity? Furthermore, surveys and interviews with participating students as well as other architecture teachers will be conducted.

3 Outcome and Discussion

3.1 First Design & Build Workshop: Circular Tolerance

3.1.1 Framework

Dealing with the reuse of available building components, the first workshop was held in Amsterdam in March 2023. It took place for eight days at MakerSpace, a workspace for the students of the Amsterdam Academy of Architecture, fully equipped for both conventional wood workshop and digital fabrication. Forty students coming from the five partner institutions (eight students per school) participated in the workshop, guided by nine teachers, and supported by the workshop technicians. The diversity of the students reflected the great differences in the understanding of circularity in different cultural contexts and educational institutions in Europe; ranging from first year bachelor students with elementary design training (Norway) to master students with an advanced background on circular design (Belgium, Liechtenstein), and senior students with limited to none exposure to circularity (Greece) to part-time student practicing professionals, already familiar with circular construction practices (Netherlands).

The work was conducted in groups, starting with smaller groups of five students for the material and site analysis, and converging into larger groups of ten students later in the week for the actual design and construction of four projects. The workshop objectives and assignments were gradually introduced, while fundamental theoretical input on circularity (the butterfly diagram, the R-ladder, Brand's layer diagram, circular design strategies, case-studies, and construction principles) was briefly discussed in context during the week.

The designs had to be exclusively based on a specific type and quantity of salvaged building components borrowed from local material suppliers. Eight sorts of components were available, previously used in building construction or public works, as part of the building structure or envelope, as interior or exterior component, as part of a larger configuration or as a single item (Table 3). However, as the material could not be eventually delivered in time on the site, the students had to simulate the original elements based on a concise catalog of elements making an educated guess about their previous use, actual condition and building potential.

Table 3. Inventory of available elements.

ELEMENT [materials]	**Measurements (mm), Quantity**
FRONT DOOR [wood, glass] origin: Schubertstraat, Tilburg	925x2011x40 192 pcs
WINDOW FRAME [plastic, glass] origin: Bontekoelaan, Utrecht	2060x1090x100 96 pcs
BEAM [laminated wood] origin: Gebruikte bouwmaterialen, Weert	4300x330x70 17 pcs
FENCE [metal] origin: Gebruikte bouwmaterialen, Weert	2360x1210x60 96 pcs
STEEL GRATE [metal] origin: gebruiktebouwmaterialen.com, Sint-Oedenrode	1570x535x25 30 pcs
WALL PANEL [glass, metal] origin: Dorpsstraat, Vianen	875x1445x100 35 pcs
TRAFFIC POLE [steel, concrete base] origin: Snellen, Utrecht	Φ100x1290mm, 300x300x300 35 pcs
BANISTER [wood] origin: Mammoet oude bouwmaterialen, Den Haag	Φ50x4000mm 27 pcs

3.1.2 Methodology

As in most project-based learning modules, this workshop addressed a real-world problem and had to deliver a pragmatic solution. In this setting, the project was located at a typical site, responding to the needs of an engaged client and the desires of a concerned community under the influence of an expanding city with increasing environmental damage.

Students were initially introduced to an "ill-structured" question, addressing a most contemporary problem. They were actively involved in independent inquiries and hands-on explorations, assisted by the teaching team via individual group desk crits and collective daily reviews. Finally, they had to materialize a fully authentic large-scale physical artefact concluding with an inclusive presentation of their work. Across this demanding experiential learning trajectory, they had to develop critical skills in design practices: critical thinking, problem-solving, creativity, communication, and collaboration.

The open-ended nature of the brief, as well as the intentionally explorative methodology of this module, prompted for a project-based vs. a problem-solving pedagogical approach. Although at times the students discussed a range of solutions in several loops (i.e. design for assembly/disassembly, universal joints with tolerances, …), they eventually had to focus on a few aspects, applying their theoretical knowledge, technical skills and design competences to finalize a certain concept and deliver a certain material configuration.

3.1.3 Implementation

PHASE A. Exploration of Available Components and the Site:

DAY 1. On the first day, each of the eight groups was given one component type to start with. The students built physical models on a scale of 1:20 and undertook hands-on explorations on the immanent properties and actual characteristics of their component, comprising studies of aggregations or modular assemblies of the same type (Fig. 1). At the end of the day, the students had to 'sell' their component as owners and experts to the other students and had to be aware of all the peculiarities when asked.

DAY 2. During the second day, the students developed in the same groups proposals of possible combinations with (at least two) other types of components. In bridging the familiar with the unknown material, they had to face and investigate an increasingly complex uncertainty. Using physical models on a scale of 1:10, they combined different element types, identified compatibilities, and understood further limitations or potential in reuse, making use of the knowledge developed earlier in each group.

DAY 3. On the third day, the entire group made a full-day visit to the site. In the same groups of five, they recorded their first impressions in place and participated in discussions with stakeholders, attempting to find an interesting location for their project (Fig. 2). The project site, a highly artificial, typically Dutch landscape, featured several layers of engineered interventions to control the water level for flooding the surrounding meadows. The site was particularly suitable as a starting point to introduce questions regarding the various degrees of permanence, the intended lifespan of fabricated constructions, and the varying temporality of the building elements, such as ground, foundations, structure, envelope, services, or use.

Fig. 1. Analysis of single components (Photo: Mario Rinke).

Fig. 2. Presentation of the site analysis to the client and the local community (Photo: Mario Rinke).

PHASE B. Design and Construction of Physical Artifacts:

DAY 4. On the fourth day, the eight groups were merged into four based on their desired location and intervention on the site. The groups were to develop site drawings and plans in the scale of 1:100 and 1:50 as well as a section in 1:20. The merged groups further developed their intervention, including a more precise choice of their possible locations. The merged groups were: 1+3 DOOR+BEAM, 4+8 FENCE+BANISTER, 5+7 GRATE+POLE, 6+2 PANEL+WINDOW.

DAY 5. On the fifth day, the groups refined their design proposals considering critical aspects of circular construction through hierarchical arrangements and joints (Fig. 3).

DAYS 6 & 7. The last two workshop days saw the production of large physical models in the scale of 1:5, which allowed to simulate the original components with elementary materials at hand (second-hand cardboard and wood/ plywood pieces). Several presentation modes complemented particular aspects of the designs: 1:2 mock-ups (Fig. 4), site models, exploded axonometric drawings for the whole configuration or for individual typical joints, inventories of parts, assembly sequence diagrams.

Fig. 3. Development of the group project with component combinations (Photo: Mario Rinke).

Fig. 4. Final mock-ups on 1:2 scale (Photo: Mario Rinke).

Fig. 5. Final presentation of the four projects to the local community in a temporary exhibition (Photo: Mario Rinke).

DAY 8. On the eighth day, the whole group of participants prepared the temporary exhibition and presented the projects they had worked on in an open discussion with guests (Fig. 5).

3.1.4 Discussion

From a content perspective, the workshop proved to be a catalytic setup to introduce critical concepts in circular construction. Thus, the following specific concepts were integrated and tested in a construction-driven design project.

- Availability-based design. Underlining the major importance of creating an informed inventory of the available reclaimed components, instead of a technical catalog of new materials. Highlighting the importance of a detailed understanding of the specific existing components for their reuse.

- Design for disassembly. Employing modular thinking and devising connections with sufficient tolerances to allow for assembly/disassembly. Using components as if they were to be borrowed (with no further drilling, cutting, …) and employing suitable joints (straps, fasteners, clamps, ropes) in configurations that allow smooth dismantling without further damage of the elements, thus ensuring their further usability.

- Design for adaptability and maintenance. Becoming aware of the varied degrees of permanence of each building layer and design accordingly. Highlighting the critical question on the intended lifespan of each design as a whole, as well as the expected lifespan of each component in a building configuration.

Finally, the actual shortcoming of the absence of the initially ordered full-scale building components proved to be an unforeseen opportunity to discuss a couple of critical issues pertinent to design & build practices in availability-based design in particular:

. The peculiarities of the supply chain of salvaged material need to be thoroughly understood and considered in a circular design process, as they define several of its aspects (type and quantities of components, timing and place of delivery, costs of buying, borrowing, or reusing, …) in a more complex interplay than in the linear mode; eventually unveiling emerging issues such as storage or transportation.

. Material resources need to be meticulously explored and characterized, identifying their properties and performance, but moreover comprehending their individual features that relate to all the traces of their past use(s)/ live(s) and define their unique reuse potential; inevitably bringing into the discussion major issues, such as material passports or certification.

3.2 Design Studios

3.2.1 Studio Foci

At the Amsterdam Academy of Architecture, the studio *A Circular Workshop* took place in spring 2023, followed by the studio *The lifecycles of trees and timber* in autumn. The aim here is to investigate how design of new or intervention with existing buildings can be stimulated in the studio based on available, specific components, and how these designed buildings can naturally allow such reuse of its building elements.

At the University of Antwerp, the studio *Spaces of Transition* is investigating how the design of adaptable buildings can be stimulated, allowing for various scales of changes from new urban relationships to user requirements. According to the concept of the *intelligent ruin*, the students design buildings that can react to new functional requirements over a long period of time, allowing to maintain or adapt their technical layers (structure, façade, circulation, room plan, building technology, etc.).

3.2.2 Discussion

The studios have likewise focused on specific methods that invert the conventional design approach. The students first examine the characteristics and limits of the given, be it reused components or buildings, which may also allow their further use for other purposes, and then develop precise designs for the given requirements.

- Availability-based design. Underlining the importance of a deep understanding of the individual character of the reclaimed components as an essential design basis.

Mediating the limitations of the given and the overarching design intentions can lead to unexpected architectural qualities. Where components are used in unusual roles or positions, a new reading of the components of the building, its origins and possible future also emerges.
- Design for adaptability. Highlighting the temporality of the building purpose and its user profiles, reflecting on the permanences of functions and their associated architecture. Understanding the necessity for strategically arranged layers of permanence within a building, i.e., light vs. structural walls, main and secondary circulation, and their respective building materials.

3.3 Survey in Architectural Education

3.3.1 Survey Structure

The international scope and corresponding geographical coverage of the *ERASMUS+* project *Crafting Circularity* is deployed to conduct an international survey to gain insight into the local state of architectural education: how are the European designers of tomorrow educated to address climate-related challenges, such as material scarcity? In particular, we probe (1) how availability-based design principles are generally embedded in the theory and studio curriculum, and (2) how the method of design & build workshops is deployed as a didactic tool, on the theme of circular construction or otherwise. Where are which emphases being placed, and how do international architecture programmes relate to each other? In addition to the higher goal of accumulating knowledge, the survey also seeks to build a network for sharing expertise on architectural education in the transition to a sustainable construction industry.

The survey commences with a concise profiling of the architectural education programme to understand which tradition (fine arts, engineering, etc.) underlies the curriculum. Then, both for the topical section (circular building in studio and theory) and the didactical section (design & build workshops), programme directors are firstly asked generic open questions and secondly invited to respond to a sub-questionnaire on the courses in question.

Regarding the embedding of circular construction issues in studio and theory education, the ambition is to gain insight into how changing paradigms engender changes in the curriculum. Does this awareness resonate among students, and is it reflected in their individual pathways (e.g., through electives)? Which debates are addressing this transition and where do they find their origins? Does the institution deliberately choose to focus courses specifically on 'sustainability' or 'reuse', or is it rather a thinking underlying every course? How is academic research and/or teachers' (circular) building practice related to their architectural education?

Next, the survey addresses the incorporation and prominence of design & build workshops in architectural curricula. Are those part of the training (for a long time) and has the digital revolution, especially after the Covid period, changed their relative importance? Are those modules autonomous or incorporated into studio assignments? What weight is given to design & build workshops in the curriculum? Are they compulsory subjects or limited to summer schools and electives, and what maturity do participating students have? Finally, the survey probes what insights -other than those in theory and studio teaching- are gained by students through the physical confrontation with the building site, building materials, construction process, financial aspects, as well as with other actors (and students).

3.3.2 Discussion

The online survey was distributed only recently to the European schools of architecture that are on the list of the European Association for Architectural Education. To ensure a broad response, the mailing was carried out through all partner institutions of the project. As of today, the submitted responses do not yet allow for any extrapolation or review. From the initial feedback, however, the impression is that there are indeed already well-established technical-constructional courses on circularity. However, these are largely separated from the operation of the studios. Furthermore, the participants indicated that hands-on exposure is very helpful for learning constructive-design strategies.

The authors would be delighted to include further interested architecture schools in the survey. Those interested in participating are invited to contact the authors.

4 Conclusions

The first steps of the project presented in this paper seem quite promising and open a broad set of new insights.

The survey across European architectural curricula delivers the first concrete data to largely corroborate the initial hypotheses, which is underpinned by the first small-scale survey among participating students: largely varying degrees of absorption of circular thinking within Europe, mirroring the large diversity of circular practices in the construction industry. Teaching assignments demonstrate how the state-of-the-art knowledge on circular construction can be implemented in architecture education, by exploring the benefits of exchange. The workshop, allowing for novel teaching practices, highlights critical issues, such as resource availability, procurement, storage, reuse, or detailing. The first design & build workshop in Amsterdam allowed the introduction of critical concepts in circular construction, particularly through the practical handling of specific components: availability-based design, design for disassembly, design for adaptability and maintenance.

The first workshop also showed how important the physical presence of the building components in availability-based design is. The next workshops will deal with the given building materials on a full scale. In addition, more space will be given to reflect on the many steps of analysis and design that are new to the students.

Regular discussions in smaller groups will be held to provide a systematic reflection-in-action.

The project is a productive platform to share educational objectives, discuss learning methodologies and revise pedagogical tools per se, or towards the integration of circular thinking in architectural design. Its structure proves to be effective in both initiating and refining questions and practices, provided a reflection-on-action component is activated. The work is framed to yield a rich basket of concrete data, in quantitative or qualitative mode, depicting deficiencies, gaps and missing links, to support curricular reforms in architectural education, regarding content, format, methods and tools, or strategies.

Furthermore, the international scope and cross-cultural mapping activities of the project, bring forward a range of notions of circularity in architectural education, as well as various patterns of circular construction in building practice in different cultural contexts across Europe, worth of further study and discussion in future endeavors.

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