

Education of architecture students in the light of the European Green Deal

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ABSTRACT: In the pursuit of efficient use of resources, the European Commission has launched the European Green Deal (EGD) policy initiatives with a particular focus on energy efficiency in buildings. To gauge architecture students' preparedness to design in line with the EGD guidelines, two surveys were carried out at a faculty of architecture in Poland over two consecutive years. The results of the 2019 survey revealed that the majority of students (88%) were not convinced that they could design an energy efficient building. To bridge the gap between the practical and theoretical knowledge, changes were introduced in the History and Theory of Contemporary Architecture course in 2020, and afterwards the survey was repeated. A significant improvement has been achieved as the majority of the course participants declared that they could design a climate resilient, energy efficient building based on a circular economy model. However, the ultimate conclusion from the survey was that deep building renovation oriented towards increased energy efficiency still needs to be better addressed in university curricula for architects.

INTRODUCTION

The European Green Deal (EGD) set of policy initiatives was launched by the European Commission in 2020 with an aim to making the EU countries' economy sustainable and to overcome such critical challenges as climate change and environmental degradation. This growth strategy should help to transform the European Union into:

...modern, resource-efficient and competitive economy, where there are no net emissions of greenhouse gases by 2050, economic growth is decoupled from resource use, no person and no place is left behind [1].

Therefore, the EGD provides an action plan to boost the efficient use of resources by moving to a cleaner, circular economy, and to restore biodiversity and cut pollution [1].

One of particular concerns of the EGD is the improvement of energy efficiency in buildings. This is related not only to new sustainable building design, but also to the modernisation of existing building stock in Europe. It is a burning issue and the current rates of renovation of public and private buildings should at least double. [2].

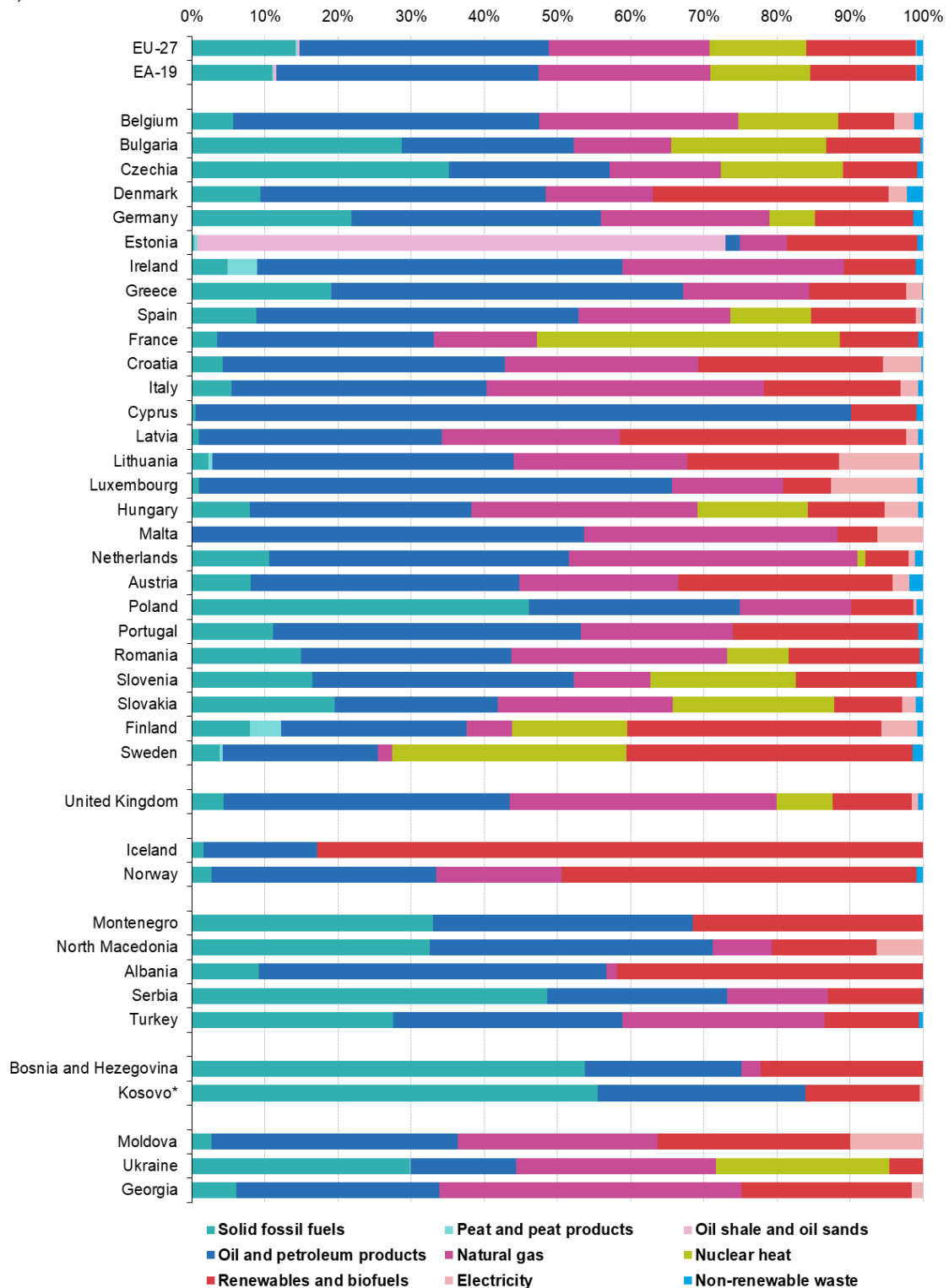
Consequently, architects have to ensure that buildings are climate resilient and their construction and performance is in line with the circular economy model with a specific focus on energy efficiency in buildings.

As a result, a new renovation initiative has been unveiled by the European Commission in 2020 with an aim to launching an open platform for the buildings and construction sectors, architects, engineers and local authorities to work together to develop innovative financing options, promote energy efficiency investments in buildings and pool renovation efforts into large blocks to benefit from the economies of scale [2].

This topic is particularly relevant to Poland where the fossil fuel energy consumption is one of the highest in EU countries (Figure 1) [3]. Typical heating demands in older buildings in Poland range between 240 and 300 kWh/m², reaching as much as 400 kWh/m² [4]. Considering that buildings are responsible for about 40% of total energy demand and about a third of greenhouse gas emissions, of which about two-thirds are attributed to residential and one-third to commercial buildings [5], immediate actions have to be undertaken in the building sector.

Following the EGD, in October 2020, the European Commission launched the New European Bauhaus initiative, which will be a driving force to bring the EGD to life in an attractive, innovative and human-centred way. It will be a movement based on sustainability, inclusiveness and aesthetics to bring the EGD closer to people, so that everyone is able to feel, see and experience the green transformation [6]. However, it is the role of the European universities to update their architectural curricula and to provide the new generations of graduates with the knowledge and skills necessary to design the truly sustainable environment in line with the EGD goals.

Gross inland energy consumption by fuel, 2018 (%)



* This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.

Source: Eurostat (online data code: nrg_bal_c)

eurostat

Figure 1: Gross inland energy consumption by fuel in European countries (%), 2018 (Source: Eurostat (nrg_bal_c)) [3].

NEW CONTENTS IN EUROPEAN UNIVERSITY CURRICULA

In the first two decades of the 21st Century, most of the European universities have included sustainable architecture in their curricula for architects both on the Bachelor's and Master's level. Simultaneously, the issues of climate responsive design or climate resilient architecture remain underestimated. Some European universities, such as Delft University of Technology (Netherlands), Cranfield University (UK) or Warsaw University of Technology (Poland) have introduced various elements of circular economy in their curricula for architecture students, mainly in the form of design studios

and workshops. However, the actual education curricula do not reflect enough recycle processes and management of building waste [7]. The importance of the integrated interdisciplinary design model is confirmed by multiple universities that declare their holistic approach to the architects' education [8][9]. Attempts at integration of environmentally sustainable architectural design courses with other courses have been undertaken by some educators [10]. Nevertheless, the actual university curricula do not provide a sufficient background for the 21st Century engineers [11]. At the same time, on the job market companies are looking for graduates with knowledge in renewable energy, sustainable design, energy efficient buildings and circular economy [12]. The introduction of the EGD by the European Commission will increase this trend for the next few years.

With an aim to gauging the students' perspective and opinion on their knowledge regarding sustainability, energy efficiency in buildings, climate resilient architecture and circular economy, two consecutive surveys were carried out among students in the Faculty of Architecture at Wrocław University of Science and Technology (FA-WUST), in 2019 and 2020. The results of the surveys confirmed that the key educational challenges of the EGD need to be addressed to prepare young engineers to design in line with the EGD priorities.

TWO SURVEYS ON EDUCATION IN ENERGY EFFICIENT AND CLIMATE RESILIENT BUILDING DESIGN BASED ON THE CIRCULAR ECONOMY MODEL

The first on-line survey among the students of architecture was carried out in 2019, as part of the consultation before the launch of the EGD initiatives. The survey was fully anonymous and voluntary. Fifty-six students of the 7th semester (i.e. the last semester of the 1st level engineering studies) participated in the survey, answering the following six questions with *yes/no/not sure* options available:

1. Do you believe that you are ready to design a contemporary building?
2. Do you believe that you are ready to design an energy efficient building?
3. Would you like to undertake an existing building's deep renovation project oriented towards increased energy efficiency?
4. Do you feel capable to design a building with the application of renewable energy?
5. Could you provide some examples of climate resilient building design that you have used (or could use) in your architectural projects?
6. Could you explain the basic rules of the circular economy model on the example of a building and/or a city?

Each question allowed for extra comments. The results of the 2019 survey are presented in Figure 2.

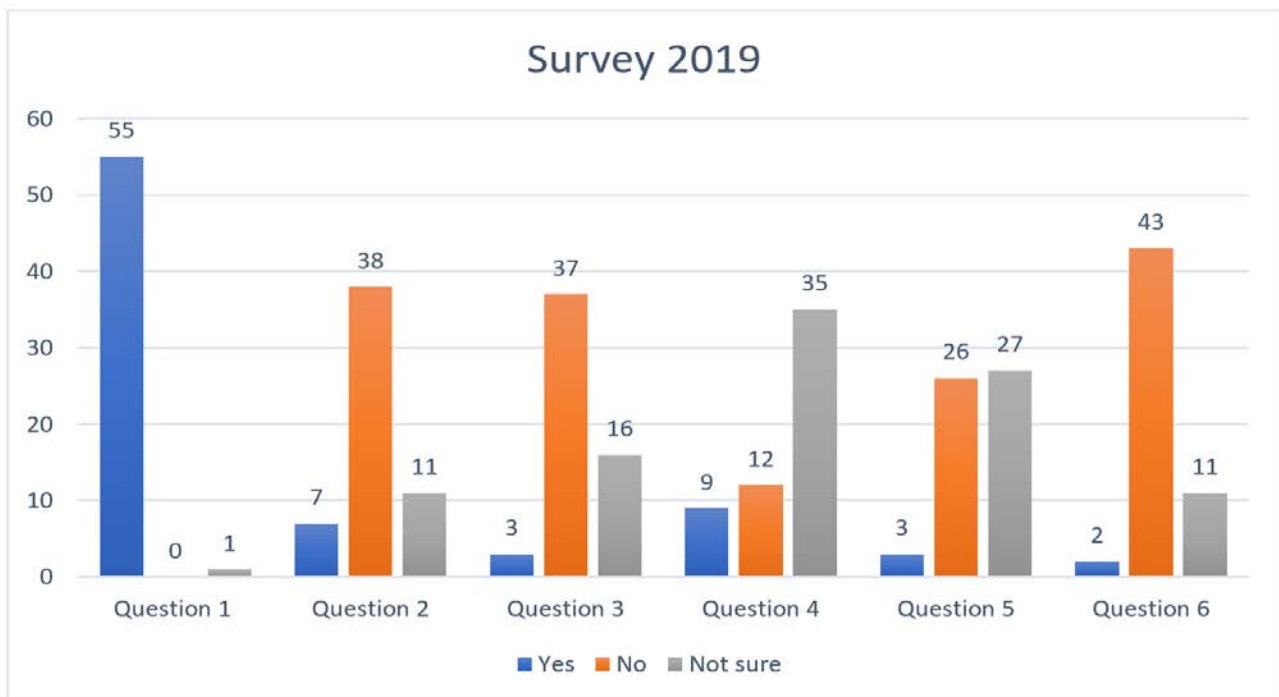


Figure 2: Results of the survey on architects' education in energy efficient and climate resilient building design based on the circular economy model (2019).

The results of the first survey brought about the following conclusions:

1. Fifty-five out of 56 students (i.e. 98% of the respondents) believed they were ready to design a contemporary building, but only seven persons (12.5%) thought they were able to design an energy efficient building. As much as 38 students (68%) said that they were not able to design an energy efficient building and 11 persons (20%) were

not sure if they could do it. This was truly disquieting as it meant that the majority of young architects might have problems to address one of the most important challenges of the EGD.

2. Only three students (5%) confirmed their readiness and willingness to undertake an existing building's deep renovation project oriented towards increased energy efficiency. Thirty-seven persons (66%) answered negatively to the same question and 16 persons (29%) were not sure if they could do it. Some of the respondents left similar notes indicating that they preferred to design new buildings than to work on the renovation of existing building stock because they believed it was more creative. This attitude was alarming because it showed that the students did not understand the importance of the buildings' renovation in the light of their low energy performance and its influence on climate change.
3. Solely nine students (16%) felt capable to design a building with the application of renewable energy, while 12 respondents (21%) answered they could not do it. The most surprising fact was that 35 persons (62.5%) chose the answer *not sure*, which could be interpreted as the lack of understanding how an architect might apply renewable energy in a building. This finding identified a critical educational gap.
4. As few as three students (5%) claimed that they could provide some examples of climate resilient building design that they had used (or could use) in their architectural projects. The examples provided by the students were adequate, although limited to passive heating and cooling strategies. Almost equal number of students stated that they were not able to give any examples (26 persons i.e. 46%) or that they were not sure if they could do it (27 persons i.e. 48%), which in fact meant they could not.
5. Only two students (3%) were able to explain the basic rules of the circular economy model on the example of a building and/or a city and their explanation of the model was correct. The overwhelming majority of the respondents (43 students i.e. 77%) answered negatively, while 11 persons (20%) were not sure if they could do it, and in fact, they could not as no further comments were added.

Based on the participants' comments, it was noted that the majority of students did not comprehend the concepts of climate resilient design and circular economy, and they did not understand how an architect might apply renewable energy in a building. Also, most of the survey participants were not familiar with the issue of energy efficiency in buildings. The analysis of the survey results lead to some important observations regarding the course content at the FA-WUST. To bridge the gap between the practical and theoretical knowledge some changes were introduced in the course History and Theory of Contemporary Architecture for the academic year 2020/2021. The main outcome of the survey was an extension of the issues of sustainable and bioclimatic architecture, to which such topics as energy efficiency in buildings, climate resilient design and circular economy in building and city scale were introduced. On the basis of the first survey's conclusions, the teaching method regarding renewable energy sources in contemporary architecture has been modified, to make it more practical. The class involved students' active participation in didactic discussion based on case study analysis. Multiple efforts have been undertaken to make sure that the students understand the aforementioned concepts and are capable to apply them in their architectural design.

In 2020, in the continuation of the research, a similar group of 7th-semester students, who had already participated in the History and Theory of Contemporary Architecture course were invited to participate in an identical survey. Seventy-two students took part in the second stage of this research. The results are presented in Figure 3.

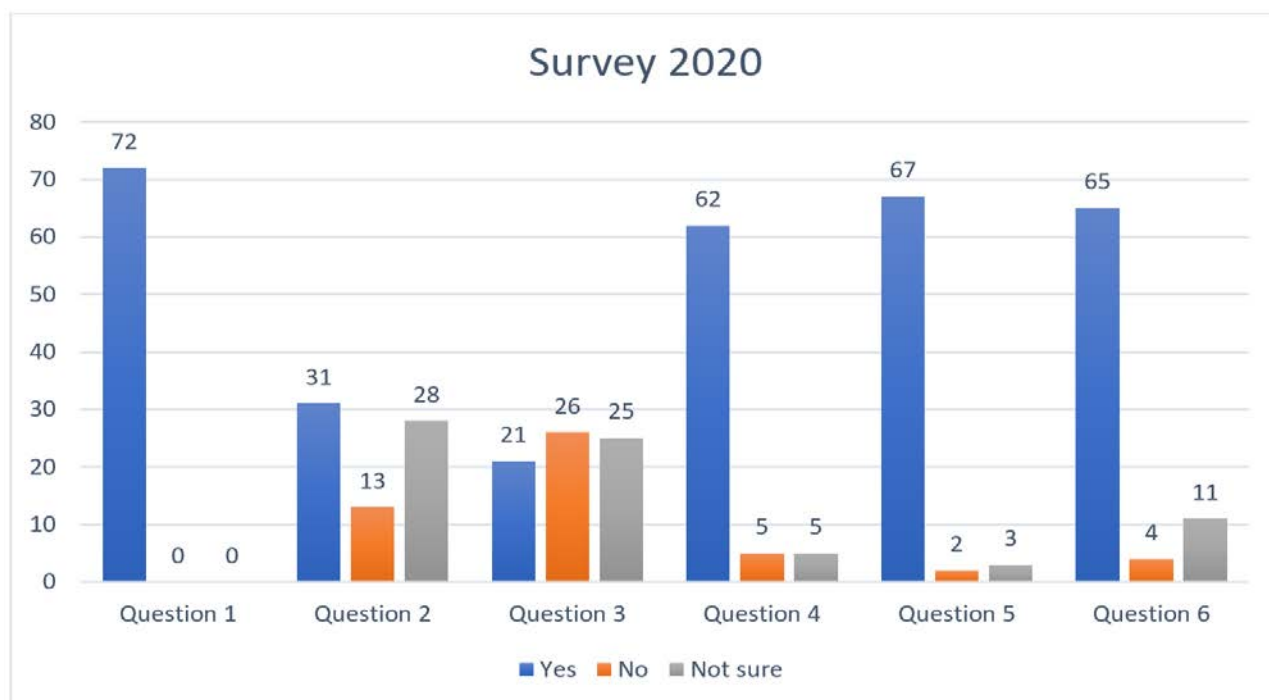


Figure 3: Results of the survey on architects' education in energy efficient and climate resilient building design based on the circular economy model (2020).

It was observed that the answers in the second survey were significantly different. To the best knowledge of the author, other courses' contents have not changed. The results of the second survey brought about the following conclusions:

1. All of the 72 students (i.e. 100% of respondents) believed they were ready to design a contemporary building, but less than half of them (31 persons, 43%) thought they were able to design an energy efficient building. Only 13 students (18%) said that they were not able to design an energy efficient building and 28 persons (39%) were not sure if they could do it. The observed improvement was significant, but not complete, especially in design studios, as seven students commented that theoretically they knew how to do it, but never checked this in real-life conditions, so their answer was *not sure*.
2. Twenty-one students (29%) confirmed they were ready to undertake an existing building's deep renovation project oriented towards increased energy efficiency. Twenty-six persons (36%) answered negatively to the same question and 25 persons (35%) were not sure if they could do it. This time the percentage distribution of responses was quite even. It was noted that some students were more aware of the importance of the buildings' renovation in the light of their low energy performance and its influence on climate change, but still were not convinced that they could undertake this challenge. This led to the conclusion that practical exercises involving deep building renovation oriented towards increased energy efficiency should be introduced to the design studio, so that the students get more confidence and practical knowledge in this field. Otherwise, there is a risk that future architects will continue to underestimate the importance of this issue.
3. The majority of students i.e. 62 persons (86%) believed they were able to design a building with the application of renewable energy. Only five persons (7%) answered they could not do it and another five respondents (7%) were not sure. This allows to believe that the level of understanding of how an architect might apply renewable energy in a building has significantly increased in comparison to the previous survey. This finding indicates that the critical educational challenge has been properly addressed.
4. Sixty-seven students (93%) claimed that they could provide some examples of climate resilient building design that they had already used (or could use) in their architectural projects. The examples provided by the students were adequate and diverse. Solely two students (3%) were not able to give such an example and three respondents (4%) were not sure if they could do it.
5. As much as 65 students (90%) were able to explain the basic rules of the circular economy model on the example of a building and/or a city and their explanations were correct. Only four respondents (5.5%) answered negatively and three persons (4%) were not sure.

Most of the examples provided in answers to questions 4-6 would come from the case studies analysed during the History and Theory of Contemporary Architecture course, which means that the students embraced the opportunity and increased their knowledge regarding the critical challenges of the EGD. It needs to be pointed out that due to Covid-19 limitations in 2020, students spent more time exploring on-line sources, which was also observed by Brzezicki [13]. Moreover, the positive influence of contemporary architecture education on students' creativity was endorsed by Węclawowicz-Gyurkovich [14]. Also, the findings presented in this article, strongly indicate that the new educational contents introduced to the History and Theory of Contemporary Architecture curriculum had a strong influence on the students' understanding of energy efficient and climate resilient building design based on the circular economy model as basic elements of the EGD.

CONCLUSIONS

The goals of the European Green Deal (EGD) launched by the European Commission in 2020 are oriented towards EU countries' sustainable economy, environmental safety and climate change resilience. One particular concern of the EGD is the improvement of energy efficiency in buildings. This is related not only to new sustainable building design, but also to the modernisation of existing building stock in Europe. In this light, the European university curricula must provide the young generation of architects with the knowledge and skills necessary to design energy efficient, climate resilient buildings based on the circular economy model. With the aim to check if architecture students were prepared to fulfil the EGD demands, two consecutive surveys were carried out at Wrocław University of Science and Technology.

The results of the 2019 survey revealed that the majority of students (87.5%) were not convinced that they could design an energy efficient building. Ninety-seven percent of the respondents did not comprehend the concepts of climate resilient design and circular economy. Close to eighty-four percent of them did not understand how to apply renewable energy in a building. To bridge the gap between the practical and theoretical knowledge, some changes were introduced in the History and Theory of Contemporary Architecture course in 2020, and afterwards the survey was repeated. All the participants of the second survey took part in the extended course History and Theory of Contemporary Architecture, which resulted in a significantly increased understanding of renewable energy application in buildings declared by 86% of students. Ninety percent of students correctly explained the rules of circular economy on the example of a building and/or a city.

The vast majority of the respondents (93%) found it easy to provide some examples of climate resilient building design that they had already used (or could use) in their architectural projects. A considerable improvement was observed in terms of energy efficient building design as 43% comprehended this concept. However, the issue of deep building

renovation still needs to be better addressed in university curricula for architects. Therefore, practical exercises involving deep building renovation oriented towards increased energy efficiency should be introduced to the design studio, so that students get more confidence and practical knowledge in this field. Otherwise, there is a risk that future architects will continue to underestimate the importance of this issue. Finally, based on the two surveys' results the author is confident that the new educational contents introduced to the History and Theory of Contemporary Architecture curriculum had a strong positive influence on the students' understanding of energy efficient and climate resilient building design based on the circular economy model in line with the EGD.

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