2024
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# Discussion on the Reform of Teaching Mode of Architectural Design Based on Green Building

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**ARTICLE INFO**

Received: 10 Feb 2024
Accepted: 27 Apr 2024

**ABSTRACT**

The novel pedagogical approach proposed in this study has the potential to be adopted by teachers at colleges of architecture in an effort to enhance the quality of design education in the interest of pro-ecological and sustainable development. Using algorithms and parametric logic, EASED's inputs are the design options and its outputs in terms of density efficiency, ecological footprint, and energy efficiency. The model itself consists of the definitions and techniques of computation that map the input variables to the outputs. While the outputs of density efficiency, ecological footprint, and energy efficiency are all computed using the same input parameters, this method is holistic in nature. Six criteria, which include both quantitative and qualitative data, are used to each part of the evaluation. These criteria are picked from among the outputs computed on the sheets that came before this one. The output value that was computed for the project has to be compared to a reference value using a scale of scores ranging from 0 to 100 in order to assess whether or not the project had a satisfactory performance with regard to the criteria in question. The reference value may be very high (with a value of 100/100), or it may be relatively low (with a value of 50/100). Collaboration across disciplines, multi-link cooperation, and shared goals must be prioritised in green construction curriculum. The ultimate purpose of green architecture design education and practise is to boost the quality of scientific research, develop top-tier architectural design talent, and provide people with high-quality green places to live.

**Keywords:** Architectural Design, Interior Design, Architectural Education.

## INTRODUCTION

In recent years, people have come to recognise the value of universities as catalysts and examples of society growth towards sustainability. Although there have been widespread requests for sustainability education to be included into academic curriculum, this approach has yet to be fully implemented in the classroom. The ambiguity, multi-dimensionality, and complexity of the concept of sustainable development contribute to this unfavourable situation because they make it challenging for research and teaching units to develop methods for putting sustainable development into practise and educating students for sustainable development. A further challenge is the dearth of professional development opportunities for educators in the subject of sustainable development (Alkaher & Avissar, 2018).

Educating and researching the rising concern for sustainable development in architecture presents a formidable task. Interdisciplinary, multidisciplinary, and Tran's disciplinary study and education do not adequately reflect the necessary approach. Nonetheless, it is of great concern to researchers and educators because integrated systems thinking faces substantial conceptual and institutional impediments to progress. There are a few concerns: Is there a method for research and teaching that span several disciplines to flourish in modern academic institutions? How can we overcome the obstacles that prevent us from effectively blending education and research? It seems that progress in both research and education will be sluggish without clear, strong, ongoing leadership, as well as support, incentive, and rewards for effectively merging "two tracks" in academic institutions (Ashford, 2010).

## RELATED WORKS

Due to the large amount of resources required to complete architectural projects, sustainability has been noted as a major challenge in the design process. Architects have a duty to help in the worldwide effort to restore and maintain ecological balance. Activities that reduce negative effects on the natural environment and improve the quality of life are referred to as sustainable design procedures. As part of their curriculum, architecture schools teach students to create solutions to the environmental challenges that have arisen as a consequence of modern society's excessive consumption. More and more universities are offering courses with a focus on preparing students for eco-design in the spirit of sustainable development. Yet, it has become clear that training in this area calls for advancement and change. Design responsibility concerns are not given the same emphasis as environmental knowledge, despite the fact that education in ecological and sustainable design is increasingly seen as the focal point of many educational programmes. Teaching architecture students merely the basics of environmental protection is not enough to ensure their success in the area of sustainable design. Students of architecture need to be taught to take ownership of their work and to persuade other architects, builders, financiers, developers, customers, and end users to embrace environmentally friendly practises. It seems that the phrase "sustainable" applies accurately to design solutions, whereas the term "responsible" is more often seen as a quality of the designer. The 'designer accountable for the project' should foresee not just the design's environmental consequences, but also its social and environmental outcomes. It is not enough to simply introduce students to ecological design concepts in the hopes that they would adopt the concept of sustainable development in architecture and put it into reality (Ashour, 2020).

Clearly, there is a movement in sustainable design education away from siloed information and towards integrated systems that support and encourage multidisciplinary work. The teaching of sustainable architectural design requires a comprehensive approach that considers all relevant factors. Architects, cognizant of the fact that the world is always expanding and changing, should create designs that do more than just satisfy present needs; they should anticipate and accommodate future demands and the expectations of a diverse population. Students should learn how architecture impacts not just its users but also society and the environment as a whole, since the goal of design is to assure human health, safety, and well-being.

Building future architects' sensibilities, knowledge bases, and design abilities is why architecture education is so crucial. It is the responsibility of educators to acquaint and educate students in the methods of sustainable architecture via careful observation, analysis, and comprehension of the existing environment. Motivating and inspiring future architects to adopt an interdisciplinary, multidisciplinary, and transdisciplinary approach to "green architecture" and ecological sustainability is essential (Ashford, 2010; Ashour, 2020).

As a result, it's crucial to teach kids about these issues from an early age in their own communities, and then to continue that education in higher education, where students can learn how to diagnose problems and devise solutions that will have a positive impact on the environment for the long term. The phrase "deep ecology" has been used to describe a way of life and a long-term movement in response to the environmental catastrophe. It explains the issue, why it exists, and what kind of educational and practical steps may be taken to fix it. This method of thinking first emerged in Norway around the turn of the 1970s (Kulasiewicz, 1993; Næss, 2002; Abram, 2011; Næss, 1998, Fox, 1991; Jaglarz, 2015). The authors' study technique was founded squarely on the profound ecological attitude towards nature that is supported and suggested by the Norwegian ecologist as a springboard for innovative brainstorming and, by extension, ecologically sound environmental design. Two core tenets of deep ecology have informed the educational approaches that have been taken with students:

The term "bioregional development" refers to an approach to planning and building that is grounded in a specific area. This concept is associated with bottom-up initiatives in regional ecologies. Each of these steps affects the global influence in the long run.

Arne Naess, the founder of the philosophy of deep ecology, described the Norwegian friluftsliv principle as the satisfaction of forming a bond with nature. Nils Faarlund took this notion and adapted it to the urban environment by planting forests and parks across the city. Construction of Ecological Learning Parks and other examples of green eco-architecture on the fringes of major cities. Without having to leave their homes, city inhabitants may now benefit from direct interaction with animals and ecological education thanks to new ecostructures. In addition, they mould an area with an unconventional spatial arrangement and audiosphere consistent with the sound ecology (Kulasiewicz, 1993; Næss, 2002; Abram, 2011; Næss, 1998, Fox, 1991; Jaglarz, 2015). Also, the authors built their study technique on cutting-edge ideas in sustainable development and ethics of responsibility. Instead of seeing sustainable development as a fad, a burden, or an unnecessary complexity, we should see it as a chance to look forward and be ready for what's to come. One feels responsible for the lives of future generations when they are aware of the need to respect and defend enduring values and when they are willing to behave in a sustainable manner and to participate in practical, reasonable contribution to sustainable environmental development (Ragheb, El-Shimy, & Ragheb, 2016; Stamm, 2019).

The ethics of sustainable development is generally considered to be compatible with the ethics of responsibility advanced by German philosopher Hans Jonas. The scope of human endeavours has been expanded so much by technological advancement that a fresh perspective on accountability is essential when dealing with disruptive breakthroughs and other forms of technological development. His ecological mandate was to "act such that the results of your activity are consistent with the persistence of true human existence." Recognize that they alone are accountable for their activities' outcomes (Feria & Amado, 2019). As such, sustainable development is seen as the ability to provide for the requirements of the present without compromising the ability of future generations to enjoy the same quality of life that we enjoy now. Just like in other spheres of human activity, the health, safety, comfort, and social interaction of individual users are all considerations in sustainable growth in architecture. The term "sustainable development" refers to an approach that takes into account the economic, social, and ecological consequences of technology and the built environment for both people and the natural world (Ragheb, El-Shimy, & Ragheb, 2016; Stamm, 2019; Jaglarz, 2015). Optimal use conditions—such as those for health, hygiene, and aesthetics—are achieved through the integrated, multi-directional activities that comprise the design of ecological and sustainable architecture, all while having a low impact on the surrounding natural environment and using as few natural resources as possible.

The primary focus of sustainable design is on preserving systemic harmony. the interaction between the user, the structure, and the surrounding nature Functionality, efficiency, and environmentally-friendly operation and processes, such as the rational and efficient use of water, energy, and materials, are the foundation of "green buildings" and the eco-equipment housed inside them (O'Donnell, 2018). So,Keep these things in mind the goal of the study was reform of teaching mode of architectural design based on green building. The purpose of the student survey (interior design) was to get insight into students' overall familiarity with, and interest in learning more about "green architecture," as well as the influence that course material and class discussions had on sparking that interest.

## METHODOLOGY

Studies in deep ecology focused on multidisciplinary pre-design research on the localization of established subjects, including those related to the construction of eco-housing complexes that took into account the local environment and culture. They represent an expansion of the three pillars of deep ecology, which are place-based development, free-range living, and hands-on environmental education. The strategy involved the strategic placement of student-designed amenities such as forest kindergartens, eco-educational sensory pavilions, ecological education centres, and recycling facilities in residential areas, as well as the proximity to existing forests and parks that will be preserved and transformed into Ecological Education Parks. The courses were designed using a synthesis approach that took what worked in practise and used it to improve the whole process.

In order, the following were put through their paces:

- The study's reliability and validity are both affected by whether or not the location chosen is located in a suburban or fully urban setting, and by how often forests and parks are located nearby (Method of analysis and synthesis). Veracity of a second-level experimental presentation of an original approach to interdisciplinary study.
- Control enclosure tasks performed by students at appropriate times (Method of analysis and synthesis and In Situ Method implemented as: drawing presentations of an interdisciplinary topic and practical tasks—environmental education through practise revitalization of public spaces within the Campus of the Faculty of Architecture) ensure that interdisciplinary issues are introduced with purpose and effectiveness into the educational process.
- The study's overall spatial composition, including the efficacy of computer-assisted energy efficiency simulations of planned layouts and the energy balance of items. How often and how well students choose a broad range of subjects from deep ecology courses.

## Layout of the Device

The study consists of two architects and one engineer expertise and the results of the literature research formed the foundation upon which EASED was built. The primary motivation for the creation of EASED was to investigate how alternative design decisions affect the efficiency of constructed buildings in terms of density, environmental effect, and energy consumption. The ultimate goal has been to find the best possible solution for these design decisions.

Using algorithms and parametric logic, EASED's inputs are the design options and its outputs are the Results in terms of density efficiency, ecological footprint, and energy efficiency. The model itself consists of the definitions and techniques of computation that map the input variables to the outputs. While the outputs of density efficiency, ecological footprint, and energy efficiency are all computed using the same input parameters, this method is holistic in nature. Since changes to any one input may affect all three outputs (density, ecological footprint, and energy efficiency), it's important to search for optimal input values while keeping all three factors in mind.

Use of the model is recommended for preliminary design decisions. The input parameters include the definition of the building typology, which is used to evaluate the impact of the building type on density efficiency, ecological footprint, and energy efficiency, and to determine the ideal building typology. This model was constructed with the programme Microsoft Excel. The user may define calculation formulae that run automatically when input values are supplied, and the results are immediately updated if the input values are changed. It was selected due to its convenience in both model development and case study application.

The goal in developing EASED was to create something that could be used immediately. The layout was created with the project designer in mind, with the goal of making their work as simple as possible. The blanks are labelled, and the remainder of the document is locked so that the model's defining components can't be changed by accident (titles, formulas, results, and graphics).

The following is a table displaying the interconnected parameters of EASED's 9 sheets. The first page is the preface. Explains what the tool is for and how to use it. The following six pages represent the following six groups of input parameters: 1. Building; 2. Ground Floor; 3. Density; 4. Open Spaces; 5. Ecological Footprint; 6. Energy Consumption. The first four are decisions made throughout the design process. Both the fifth and sixth categories are dependent on the design decisions made in the previous category. Each of the 6 papers is formatted the same. The first section of each page is reserved for the input values. Data relevant to the user's project should be entered into the appropriate cells; definitions and comments help clarify what information is expected. The results that are automatically computed per the defined formulae are shown in the second section of each page. With our study methodology, we integrate inputs and outputs from several sheets and connect various design factors to maximise density efficiency, environmental impact, and energy efficiency. There are explanations of these equations and some of their definitions in the comments on each page.

## Building

To complete the building sheet for a project, the designer must provide the following information: the total height of all buildings in the project; the total number of stories and square footage of all floors in each story; and the total number of stories and square footage of all floors in each story for all building types in the project.

These parameters are used to derive two outputs:

Highest height is the height of the tallest building in the project (in metres), and total floor area is the product of the floor surfaces of all floors multiplied by the number of floors in the project as a whole (unit: m2).

Floor One

Several outputs are derived from data entered on the Ground Floor sheet, which includes the size of the lot, the ground floor of the buildings, outdoor parking, and service roads. Total buildings ground floor area, total outdoor parking area, total service road area: sum of each kind of area for the complete project (unit: m2) (unit: m2), Construction Site Size = (Ground Floor Area + (Parking Space Area + (Service Road Area)) (unit: m2), Lot size minus constructible land size equals non-buildable land size (unit: m2), Each building's footprint (unit: % of the lot area) is calculated by subtracting the total ground-floor area, total outdoor parking area, total service road area, construct land area, and non build land area from the total lot area. and The ratio of a building's total floor area to its lot size is known as the floor area ratio.

### Density

The designer is required to provide demographic data for the project's target audience. First off, housing units need to be specified in terms of their total number of bedrooms, total interior size (in square metres), total number of units, and total number of residents. Second, details about the workplace, such as the square footage of offices and the number of full-time employees, are required. Finally, the project team needs to grow to include more permanent members. The following outcomes are produced by combining these inputs with those of other sheets: Quantity of dwellings: the total of all apartment units in the development. The sum of each apartment's square footage by the total number of apartments is the total interior space of the building (unit: m2), Population of the building calculated by multiplying inhabitants per unit by the total number of units. The average ratio of an apartment's interior square footage to its number of occupants, expressed in square metres per person per year (m2/resident). Same sort of calculations for total office space, total permanent office personnel, internal space per permanent office staff, and total other permanent office staff The sum of the building's permanent inhabitants, permanent office workers, and permanent office workers in addition to those who don't work directly with customers makes up the building's total permanent users. Population density may be calculated as the number of people living in buildings as a percentage of the total number of people living in lots (users/ha). Vacant areas.

Open space supply and green open space allocation are the main topics of this document. Private open areas for dwellings, workplaces, and other project uses (including details such as open area type, size, number of users, and number of dwellings) and public open areas need input (area). The designer must also explain whether or not the projects have green structures and deep soil zones (area in m2).

The results are tallied using the formulas presented in the Density sheet: Total private open space for dwellings, private open space per inhabitant, total private open space for workplaces, private open space per inhabitant, total private open space for other uses, total private open space, total public open space, public open space per inhabitant, total deep soil area, total green structure area, total green open space area, and total green open space area per inhabitant.

### Footprint in the Environment

No designer-supplied data is needed for this sheet; rather, a universally applicable input is provided in the form of the built-up area conversion factor. This multiplier is used to translate the "land areas" (expressed in global hectares) needed for bioproductive purposes from the "built-up areas" (expressed in hectares) necessary for building development when calculating an ecological footprint. This conversion factor has a value of 2.51 gha/ha, which is global hectares per hectares. According to the Ecological Footprint Network's definition, Three outcomes are derived by crossing the factor with other outputs: Ecological impact of developed areas is calculated by multiplying the project's total developed area by a factor called the "equivalence factor of developed areas" (unit: gha), The ratio of the project's ecological footprint to its total floor area, expressed in global hectares per square metre (gha/m2). The ratio of the ecological footprint of developed land to the number of people permanently housed in buildings; expressed in hectares of land area per person.

### Use of Resources

The document provides just a basic framework for estimating the project's energy needs. The designer must categorise interior rooms as either "residential," "office," or "retail" to determine the appropriate level of energy efficiency. These classifications were established in accordance with the energy efficiency regulations in place in Australia. When it comes to energy efficiency in buildings, certain level of energy consumption (measured in megajoules per square metre per year) is assigned a certain number of stars, with the number of stars rising as consumption lowers (**Table 1** and **Figure 1**).

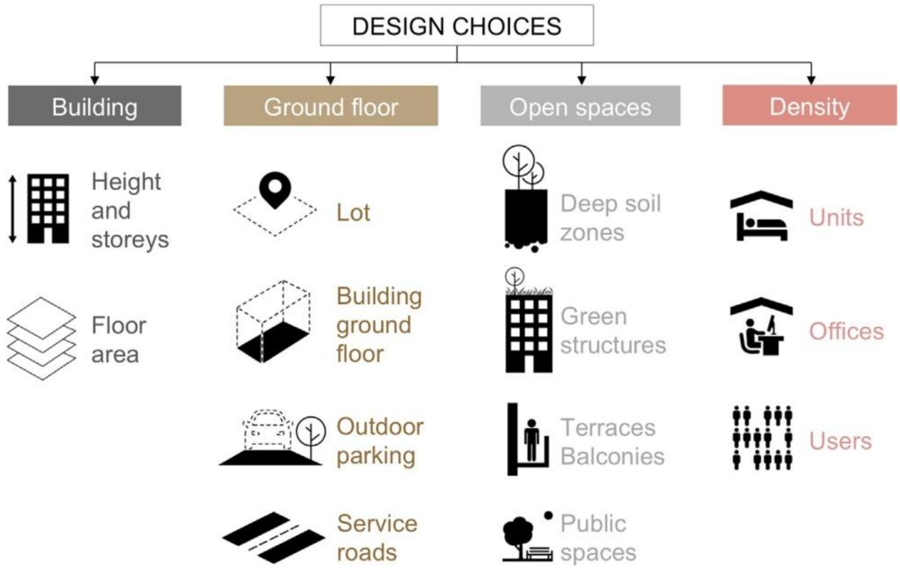


**Figure 1.** Design Choice

**Table 1.** Definition of the Three Categories of Spaces for Energy Consumption

| Residential Area | Office Area | Retail area |
|---|---|---|
| Age care | Offices | Shops |
| Hotel and accommodation | Health centre | Cultural facilities |
| Residential Units | Education institute | Sport Activity |

## RESULTS AND DISCUSSION

### Evaluation

Calculating and presenting the performance of the project in relation to three components of sustainable design, namely liveable density, sustainable land use, and energy efficiency, is the goal of this sheet. Six criteria, which include both quantitative and qualitative data, are used to each part of the evaluation. These criteria are picked from among the outputs computed on the sheets that came before this one. The output value that was computed for the project has to be compared to a reference value using a scale of scores ranging from 0 to 100 in order to assess whether or not the project had a satisfactory performance with regard to the criteria in question. The reference value may be very high (with a value of 100/100), or it may be relatively low (with a value of 50/100). The norms or standards for construction in Australia provide the reference values, while optimal alternatives in terms of sustainable performance provide the other values.

The final assessment is given in the form of three radar charts, one for each facet of sustainability.The purpose of evaluating a project's liveable density performance is to determine how well it strikes a balance between the density efficiency of the project (the high population density that it hosts) and the liveability of the project, which ensures a high quality of life despite the project's population density (enough internal space, open space and green space) (**Table 2** and **Figure 2,3**). The following six factors are evaluated:

- Interior space per person for residential units
- Interior area allotted for regular employees in offices and other locations
- Private open space per occupant for residential units
- Exclusive outdoor space allocated to each member of the regular office personnel
- The total area of public open areas
- The total area of green and open places

Sustainable land use performance evaluates the trade-offs between construction and build land footprint, deep soil area, population density, and ecological footprints to determine how a project can support a big population without forfeiting precious land. Six metrics for production were selected for benchmarking against established norms( **Table3** and **Figure 4**).

- Leaving a trace in construction
- Construction of a land imprint
- Total deep soil area
- The ecological impact of developed land expressed as a percentage of total floor area
- Density of the population
- Ecological foot print of each occupant on built-up land

**Table 2.** Liveable Density

| Liveable Density | Rating Percentage | m2 Resident or Staff |
|---|---|---|
| Interior space per person for residential units | 65 | 40 |
| Interior area allotted for regular employees in offices and other locations | 30 | 12 |
| Private open space per occupant for residential units | 75 | 14 |
| Exclusive outdoor space allocated to each member of the regular office personnel | 28 | 9 |
| The total area of public open areas | 14 | 2025 |
| The total area of green and open places | 25 | 3958 |

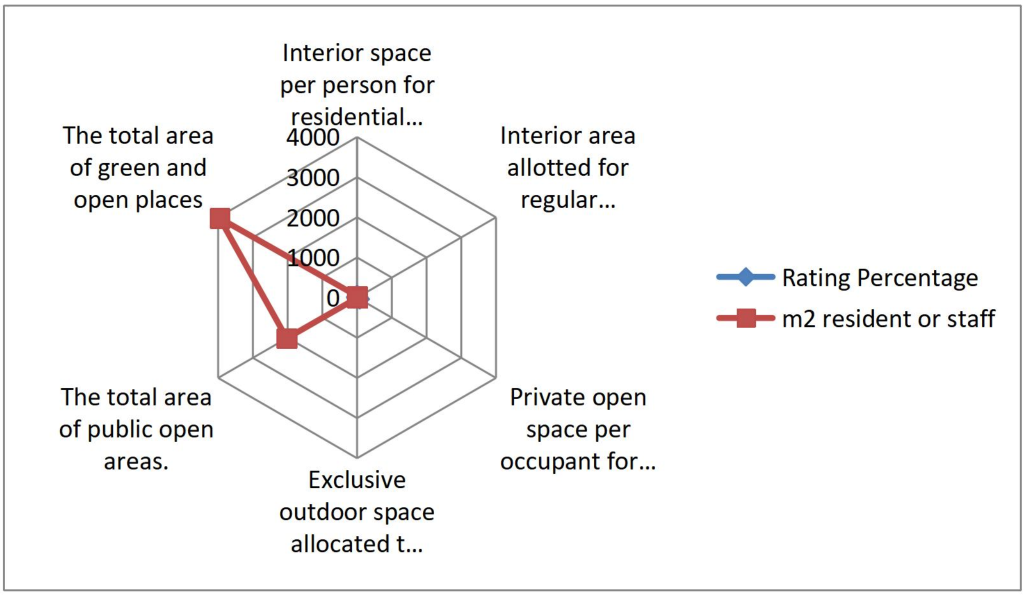


**Figure 2.** Graph Showing Liveable Density

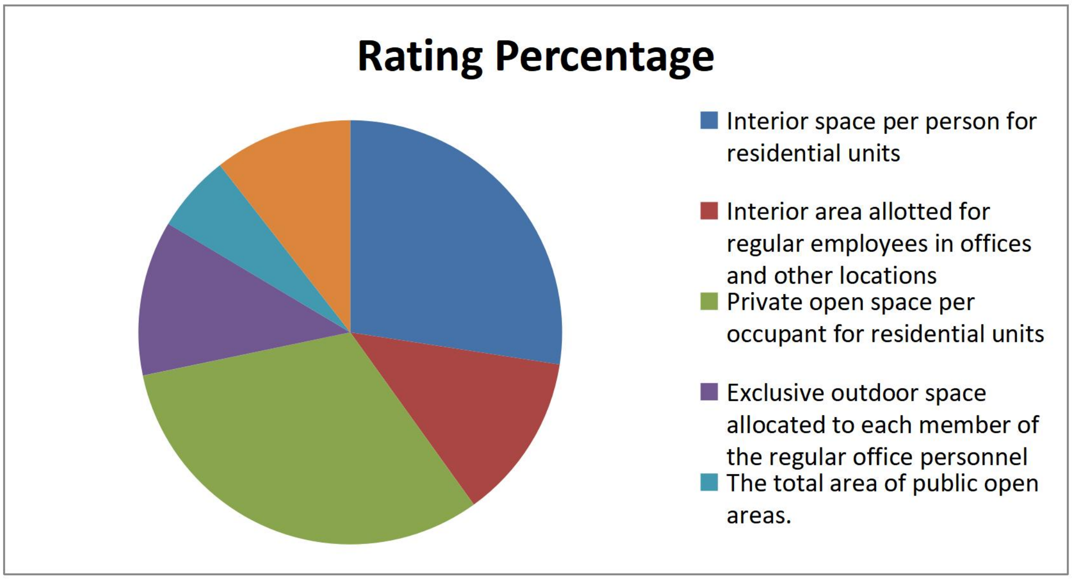


**Figure 3.** Rating Percentage of Liveable Density

**Table 3.** Sustainable Land Use

| Sustainable Land Use | Rating Percentage | m2 Resident or Staff |
|---|---|---|
| Leaving a trace in construction | 50 | 40 |
| Construction of a land imprint | 60 | 50 |
| Total deep soil area | 20 | 2999 |
| The ecological impact of developed land expressed as a percentage of total floor area | 25 | 1279 |
| Density of the population | 80 | 1321 |
| ecological foot print of each occupant on built-up land | 10 | 117 |

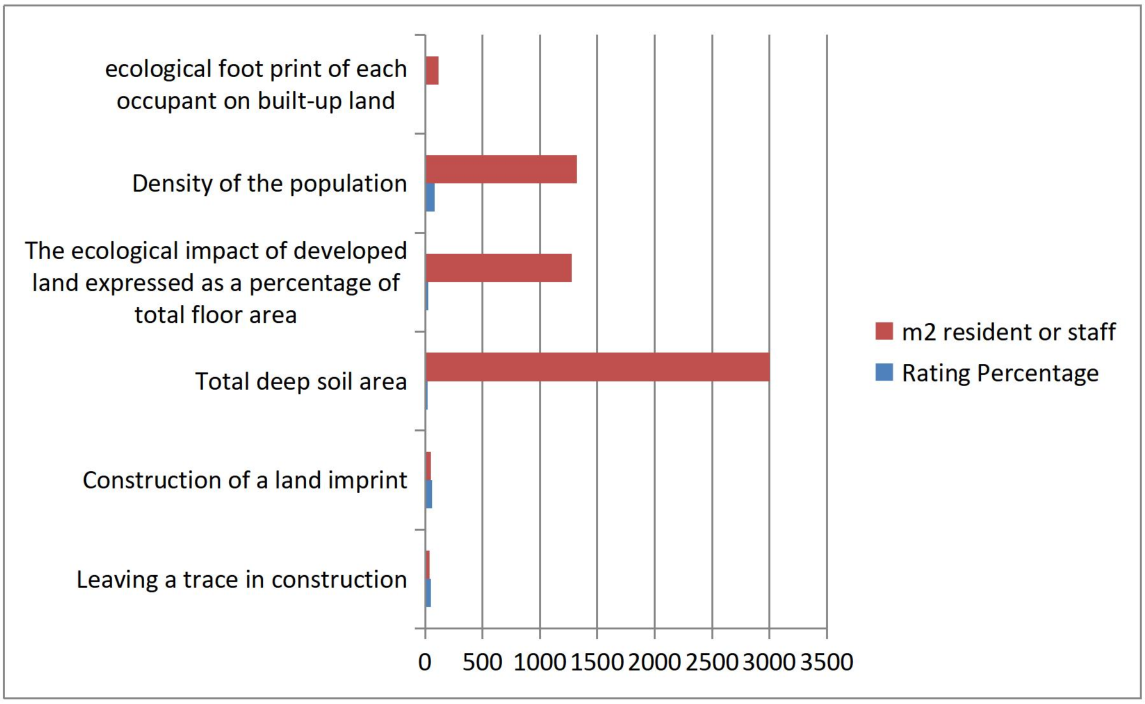


**Figure 4.** Sustainable Land Use

Energy efficiency performance is the sum of the following six criteria, which represent the relative importance of different types of space in the overall energy consumption of the project (**Table 4** and **Figure 5**):

- Use of energy in areas that resemble residential settings
- The usage of energy in areas resembling offices
- The amount of power used in areas resembling stores
- The proportion of residential-type areas in the overall energy consumption
- A portion of the overall amount of energy used by office-type spaces
- A portion of the total energy used by retail and similar types of venues

**Table 4.** Energy Efficiency

| Energy Efficiency | Rating Percentage | MJ/m2.an |
|---|---|---|
| Use of energy in areas that resemble residential settings | 40 | 60 |
| The usage of energy in areas resembling offices | 60 | 101 |
| The amount of power used in areas resembling stores | 50 | 807 |
| The proportion of residential-type areas in the overall energy consumption | 81 | 3013210 |
| A portion of the overall amount of energy used by office-type spaces | 22 | 75001 |
| A portion of the total energy used by retail and similar types of venues | 12 | 325973 |

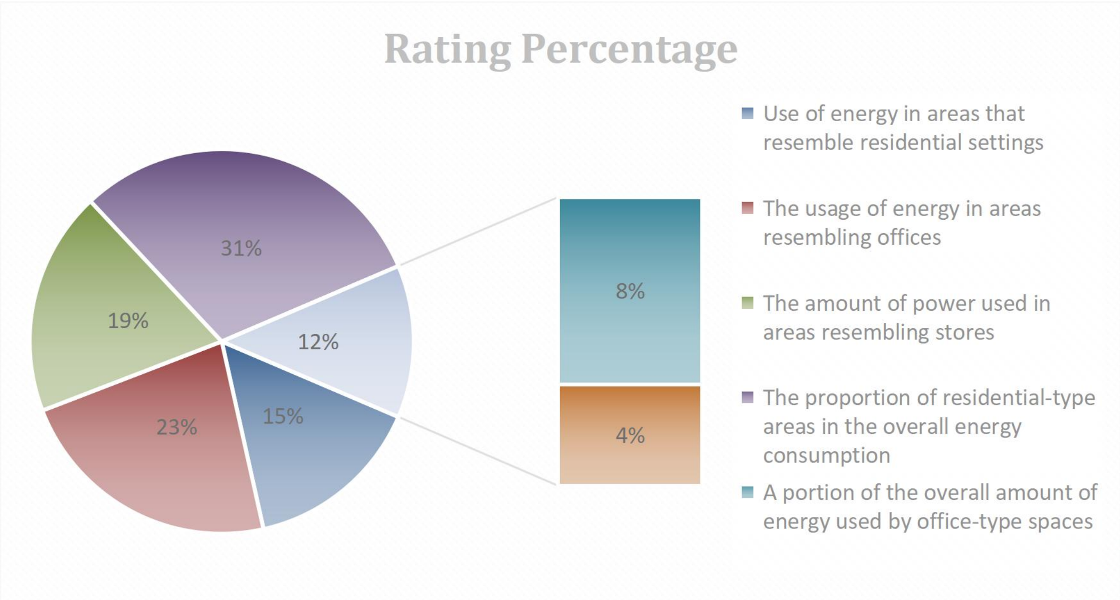


**Figure 5.** Energy Efficiency

The Evaluation sheet should include three findings related to the study topic. Quantitatively summarising the project's sustainable performance on a scale from 0 to 100 relative to baseline data, This synthesis assessment provides a method for comparing the sustainable performance of many projects or variants of the same project. EASED provides a direct visualisation of the many and complex relationships between the parameters considered, as a single change in the project design (say, the area of residential unit, or the building footprint) may change several outputs and impact the performance on the three aspects (liveable density, sustainable land use, and energy efficiency). In this study, a holistic approach was sought, and the Evaluation sheet serves as an interface for the designer to learn about the relationships between various design decisions and how they affect the project's long-term sustainability.

The Evaluation of Equipment

With the intention of putting EASED through its paces, it was chosen to have Master level students from Griffith Architecture's Advanced Architecture Studio 2 use it during a design exercise. Students in this architectural workshop were tasked with conceptualising a mixed-use complex for an actual location. Skyscrapers, high-rises, and everything in between are all fair game, but all of their ideas must achieve exceptional sustainability in terms of environmental impact.

For a total of 13 weeks, split into two distinct halves, this design process took place. An individual's first three weeks were spent on a site study and master plan design concept, and the subsequent five weeks were spent on developing the mixed-use development design at architectural and technological scales (from 1/200 to 1/20). Throughout the course of the second phase's five weeks, students collaborated to expand upon suggestions that had been chosen in the first. They paid considerable attention to the refinement of engineering concerns (structure, acoustic, light, and HVAC, for instance).

During this design challenge, students were given EASED to use as a resource for eco-friendly design. It was a tool designed to help people think about four specific goals:

- An analysis of how well their project meets the criteria for sustainable performance
- The determination of the design decisions that either have a beneficial or detrimental effect on the environmentally friendly operation of their project
- The optimization of the design decisions in order to obtain the greatest possible degree of sustainable performance in their project
- The provision of assistance with regard to choice-making throughout the design process

During week 4, after students had completed their analysis and had begun the design process, EASED was introduced to them. There was a one-hour lecture explaining the instrument and its history in the context of the research endeavour, and then a one-hour training session. During this lesson, the students learned how to properly complete the forms by following along with a blueprint of a recently constructed building complex in close proximity to their own site. They choose this model because it had many characteristics with their own project, including the same scope, climate, and city setting. The pupils were given a separate PowerPoint presentation with all the data they would need to use the programme. Every page included definitions and explanations, as well as an examination of the outcomes and a rating of the example. Students received two copies of EASED at the conclusion of the session, one pre-populated with data from the example and the other blank for their own use (**Figure 6**).

Students instructors reviewed each student's progress each week for the following two weeks throughout the mixed-use development design phase by conducting interviews on the students' usage of EASED. The purpose of the review was to find out the following about the student's use of the tool: • If the student has opened the file and begun filling it out; • If the student has had any difficulty using the tool so far, or if the student has any questions, remarks, or comments on the tool; • If the student has used the tool in the development of his or her project, and if so, what, why, and how the tool was used (**Figure 6,7** ).

Students were required to provide a written and visual summary of their work at the conclusion of this stage. In particular, they had to prove that their plan was sustainable and that the selected typology was appropriate in terms of energy efficiency, density, and the amount of land it would need. Along with the finalised EASED form, a report detailing these problems was expected. When all projects were turned in, they were reviewed by a jury made up of the studio's instructors as well as invited expert architects. Students were asked about their experience with EASED and its relevance to their design project after the review day . There were five standards used to judge responses in this poll. A mix of both multiple-choice and free-form questions was used to evaluate each criteria. One measure for judging how well a product works is how involved students are in using it. The answers to these four questions define four distinct degrees of dedication. If the student has accessed the tool, they have completed the first level. If the learner has begun filling out the tool, they have progressed to the second level. Once a pupil has completed the form once, they have unlocked the third level. Students who have completed many versions of the tool and made adjustments to their original version are considered to have reached the fourth level. Students are asked just yes/no questions on their actions, with no room for interpretation. Usability and comprehension are also included in the second criteria for assessment. In this section, we want to learn whether the students had any problems completing the questionnaire. There are two distinct types of challenges that might arise. The first section of the questionnaire deals with issues associated with the tool's handling or usability. Such examples are: file opening, sheet flipping, writing in orange cells, adding/removing rows, saving, and closing. Thereafter, the queries shift their attention to any confusions users may have in mastering the resource. The outputs, the "Results" page, and the "Evaluation" sheet must be understood in addition to the necessary input parameters.

The questions are closed-ended, requiring the student to indicate with a single answer whether or not they encountered any difficulties. If a student indicates frustration with the tool in any way (by answering "yes" to any of the questions or by describing an experience that was otherwise problematic), that student must provide an explanation.The third criteria for assessment is on how well EASED contributes to and improves the design process. First, we want to know whether the student has made any adjustments to their project as a result of using this tool. It's a yes/no question, and if the student says "yes," they have to elaborate on why they made those changes. The second inquiry is designed to unearth whether or not the instrument was useful to the student in making judgments throughout the project's development. This is a yes/no question, and if the student chooses yes, they must provide an explanation. The extent to which students have adopted and customized the resource is the focus of the fourth assessment metric. In the first place, it tries to show whether students have taken parts of the tool and incorporated them into the final product (whether on their presentation documents or orally). The questions centre on four distinct types of information taken from the tool: actual data or results, the structure of the 'Results' page, graphical representations of the evaluation criteria, and interpretations of the data. The questions have a single correct answer (either "yes" or "no") and are thus closed-ended. Second, they inquired as to whether or not students would utilize the tool for personal projects in the future if it were not required. It is expected that students will respond with a yes or no.

The students' constructive criticism of the resource is the fifth criteria. This section of the survey is designed to elicit succinct comments from students on the resource. In the first set of inquiries, we are interested in how simple it is to use and comprehend. The second set of concerns the practicality and importance of relaxed in relation to a sustainable approach to design.

All of these inquiries are closed-ended; in order to elicit more nuanced and critical responses, respondents must choose one of four possible options: disagree, rather disagree, agree, or neither. At the conclusion of this criteria is an open-ended comment area where students may share their thoughts, ideas, and recommendations.

To complete the design exercise, students worked in groups on the final development design, using EASED once again. The first four weeks of this last phase were very much like the prior phase. As part of each group's weekly evaluation, students were asked about their experiences with the tool. At the conclusion of development, they had to provide both a written and visual summary of their project, as well as a report on sustainable concerns and a revised version of the tool. All of the submitted proposals were subjected to a comparable evaluation.

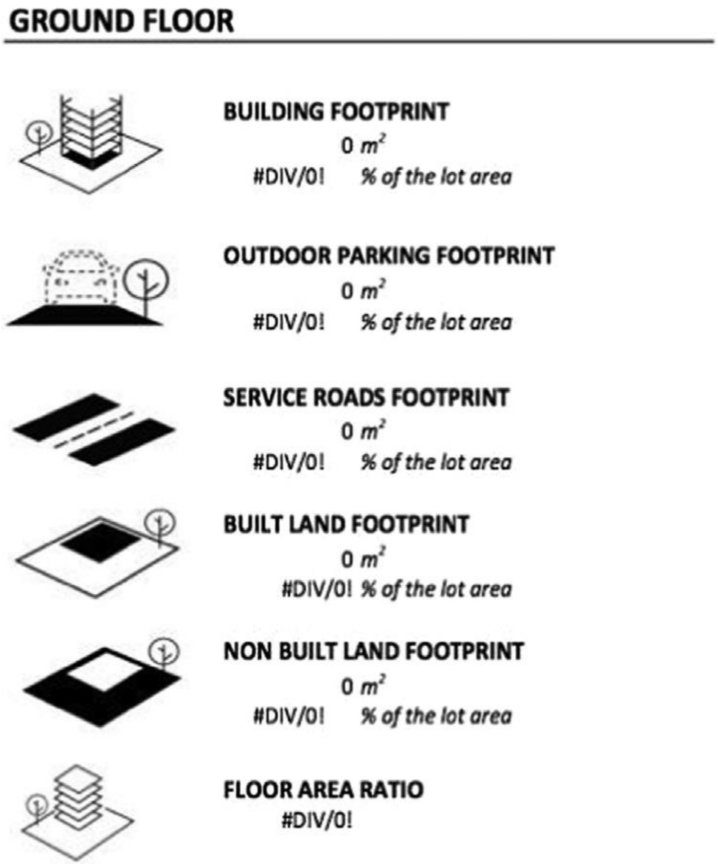


**Figure 6.** Eased Tool

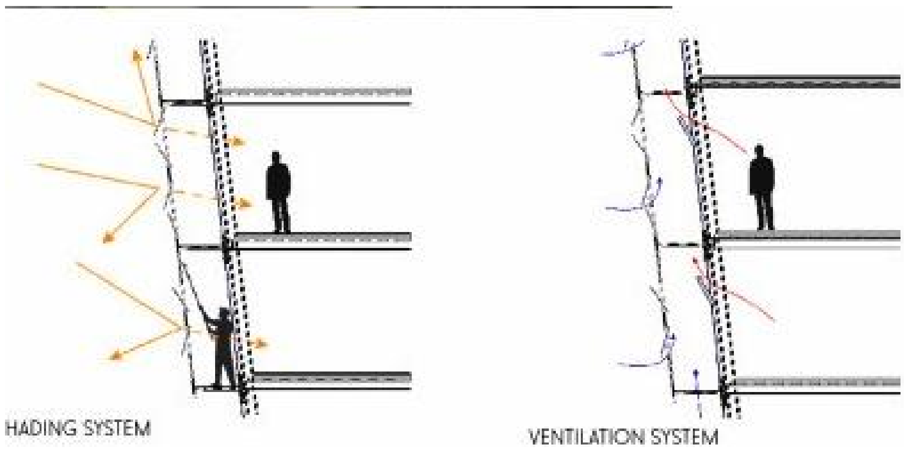


**Figure 7.** Learning of Eased Tool by Architecture Design

Students were given a week after their proposals were reviewed to make changes in light of the feedback they received. Student feedback on EASED's utility for their design project and its implementation at this stage was solicited once more after the final submission was made. Three types of comments were used to evaluate EASED's usefulness for future architects. The first aspect addresses the educator's evaluation of the tool's implementation. Teachers provide this feedaback after reviewing the projects weekly in studio and after analysing the students' final submissions and presentations. Second, there is the examination of students' EASED reports, which includes comments on those reports' completion. The developers of EASED conducted this study. The third kind of data is the students' reflections on their own usage of the tool, as expressed in the results of the survey they were required to complete twice.

It is important to highlight that for each of these three types of feedback, both the individual and group stages were analysed independently and thereafter. These various kinds of response were analysed using the same four criteria as the survey's main analysis:

- Acceptance
- Dedication
- User-Friendliness
- Involvement and Contribution to the Design Process
- Appropriation

The outcomes of the individual and subsequent group phases are mentioned below.

## Discussion

Study of the EASED reports supported this, revealing a lack of completeness, careless input (filling in the incorrect area), congruence with the project (data filled in does not match to the specificities of the project), and comprehensive verification, all of which skewed the findings. Several of the students even used the erroneous version of the programme throughout their projects since they used the sample data provided in the tutorial. Just 30% of the class managed to submit error-free EASED reports. All students reported opening EASED at least once and beginning to fill it out, although 5% revealed they did not complete it the first time they began it, and only 29% changed anything from the first draught of their report. Although 39% of students cited a lack of time as their major excuse, 10% cited confusion over how to use the tool or how to submit their data (Esteves et al., 2018; D'Amico & Pomponi, 2019).

These findings are frustrating, of course, because the one student who did access EASED in a timely manner (and was able to fill in a first version and show it to the teacher) provided proof of the relevance of the tool by allowing the instructor to ask him or her questions and initiate a conversation about the project's long-term viability and ways to improve it.

As a whole, these preliminary findings demonstrate the critical importance of participation in realising the goals of EASED. All teachers face the problem of limited time, but in the architectural field it poses the dilemma of prioritisation for students: how to get them to see that EASED will help them improve their conceptualization and design skills in the long term. The fact that students still had issues using EASED after a two-hour introduction that emphasised hands-on practise highlighted yet another difficulty.

Simplicity of Use and Comprehension

Because of the students' disinterest, it was difficult to determine whether or not they had any trouble using and comprehending EASED (criterion 2). The original EASED session lasted just two hours, but it was clearly clear that certain pupils had trouble with it. Questions about the tool's functionality (such as how to delete or add a row), the data required (such as which area to fill in for the floor area: with or without the walls), EASED's given hypothesis and references (such as why the lobby of buildings is considered residential, Is the Star Rating System international), and, most importantly, the tool's limitations were raised (Jaglarz, 2016).

These introductory inquiries provide a good summary of the several avenues for enhancing the instrument and a means of gauging the minimum proficiency required to make use of it effectively. All the students were in their fourth year of architecture school, however they varied in their Excel skills and knowledge of environmental terminology.

Thus, it is recommended that all users be brought up to the minimum needed level of competence before being taught EASED. Last but not least, just one student presented the EASED report findings on his project panels and elaborated on them during his oral defence. Two students wrote a concise summary of the EASED report to shed light on the findings and provide some crucial insights into the project's long-term viability. It's possible that the other students didn't fully grasp the significance of the EASED findings to their research because of this.

In general, the study of the EASED reports corroborated the prior findings that the students had some difficulty utilising and comprehending the instrument. There were several wildly inconsistent outcomes, such as very low or high readings, which likely resulted from incorrect data entry. Erroneous data entering may be associated with misunderstanding the required input parameters. Concerning the private open spaces of the residential units, for instance, many errors were made, especially in regards to the number of users for these spaces; in many cases, the students gave the total number of users that could use private open spaces in the project, when the actual data needed was the number of users per private open space. Because of this blunder, crucial data for determining the project's liveability, such as the average amount of private open space per user, was rendered inconsistent. It's also worth noting that most students didn't bother to change the default settings for energy use, instead opting to leave the pre-entered data as is. Once again, this might indicate that the pupils missed this point (Celadyn, 2020).

The data from the survey strongly supports these conclusions. When asked about usability during the independent phase, respondents had the most trouble when trying to delete or add a row (29% of respondents). In terms of readability, the poll found that almost a quarter of students (24%) had some trouble comprehending the required input parameters, and nearly a third of students (29%) had some trouble understanding the assessment rubric. The outcomes were likewise difficult to interpret for several pupils (19%). Despite this, 100% of students who tried out the tool found it either very simple to use (32%) or easy to use (39%). (one student did not answer this question). Seventy-six percent of students completely felt that the instrument was simple to use, while the remaining 19 percent somewhat agreed (Dammarell, 2019).

In sum, these findings show that students did not have perfect success with the EASED tool, despite their reports of its ease of use. Despite the fact that most students believed they were using it appropriately, data analysis revealed otherwise. They were utilising the EASED tool improperly and had no idea what they were doing. This type of discrepancy between what students think their instructor expects and what they actually produce is common in the classroom. This finding highlights the need for improved instruction on the EASED tool to aid students' use and comprehension of it. In addition, it might be beneficial to provide students with detailed comments on their file following the assessment, highlighting areas where they can improve; and to provide this feedback in direct proximity to their project, demonstrating how EASED can aid them in the design process (Sherman et al., 2020).

Involvement and Assistance in the Design Process

Because of this, we can move on to the next criteria, which is the part played by and assistance supplied by EASED throughout the design process. Since that almost all students only accessed and completed EASED towards the phase's conclusion, it's safe to assume that it had little to no part in the students' design thinking. Based on the findings of the weekly review, it appears that they did not make use of the tool as a design tool, a helping or guiding tool, or as a means of arriving at a more satisfactory answer to the original question of how to create the most sustainable architectural project possible given a specific context. In the best case scenario, EASED's sole involvement in this stage was to provide students with an assessment tool once they had completed their designs. Nonetheless, this post-evaluation was not really finished, as the students did not take any perspective on the results and their meaning for the project, as evidenced by the fact that the vast majority of students did not mention the sustainable performance of their project during their final presentation (Cichowska, 2019; Lucchi & Delera, 2020).

As the tool does not maintain track of the many file versions that correspond to the modifications made in the project, it is not straightforward to determine the tool's function and benefit in the design process when analysing the reports. Yet, it is safe to assume that if EASED played a substantial part in the design process, the file would be correctly filled, with careful consideration given to the necessary data since it has a direct impact on the outcomes that are subsequently employed in the design process. Reports from each step of the case study add up to show that the tool was neither utilised as a design tool with full knowledge, nor as a support for the growth of the project.

Students' views on EASED's usefulness in the design process were divided in a recent poll. Just 14% of students made any changes to their assignment using this tool during the individual phase, while 29% said it helped them in making some choices. The 'Critical feedback' section's responses provide some light on these nitpicks. Although the majority of students (57%) agreed or strongly agreed that the instrument was useful in assessing the long-term viability of their project, the minority (5%), who both strongly disagreed and disagreed, expressed doubt. Answers to the question "do you believe the tool was appropriate to assess the sustainable performance of your project?" fall along the same fault line. With the query, "do you believe that the tool allowed you to determine the influential factors over the sustainable performance of your project?" the similar about 50/50 split can be seen. Overall, 33% of students strongly agreed or agreed that the tool helped them in their design process, whereas 14% strongly opposed or disagreed and 10% were undecided (Fairs, 2021).

All of these findings show that the students did not grasp the purpose of EASED, which was to aid them in designing for greater sustainability. From a 'assignment' point of view, they were only exposed to the tool's assessment results section. This implies that students will need to be given an explanation of the tool's purpose and its benefits to the project and the process, if not actual demonstrations of those benefits. To this end, it may be useful to provide a tutorial on a "bad" building, one with poor sustainable performance, and use it to demonstrate to students how to boost that building's performance, which factors have the most impact, and how to use that knowledge in their own design decisions.

Theft and Misuse

The students' inability to fully appropriate and personally use the tool during the individual phase is shown in the report they submitted at the very end of that phase. They lacked the time to learn the technology and, more importantly, analyse the data in light of their project. Hence, as previously said, during the individual phase, just one student included findings and graphics from the tool on his presentation boards, and only briefly discussed it during his oral presentation. Just two students took the time to write a report outlining their experience with the tool, its application to their project, and their interpretation of the findings in their own words.

There is not much that can be learned about students' appropriation and individual usage of the instrument from a study of reports, either from the individual phase or the group phase. This is because the file's editing capabilities are limited; the students cannot add new rows or lines, alter the appearance of the sheet's names, colours, or comments, etc. It is still possible to discern some details on the instrument's appropriation. Some students may not have really claimed ownership of their work since, for instance, they did not identify themselves or their project on the first page. Several students, however, went the extra mile to elaborate on their projects inside the cells, including information such as the function, location, or even a proposed name for the defined area.

## CONCLUSION

Collaboration across disciplines, multi-link cooperation, and shared goals must be prioritised in green construction curriculum. The ultimate purpose of green architecture design education and practise is to boost the quality of scientific research, develop top-tier architectural design talent, and provide people with high-quality green places to live. One of the most reliable means of achieving these goals is to include sustainable practises into architectural curricula from the start.

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