ETH zürich

AI & Design

Digital Transformation for Circular Construction

Semester Project FS24

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Phase 1

Research

Artificial Intelligence is a powerful tool in the current world. It is becoming increasingly evident that AI has a huge potential in the field of (circular) construction, especially in the design processes involving complex decision-making while making use of large volume of existing data. AI is defined as "the ability of a computer to perform activities usually performed by humans, like writing or analysing data" (Copeland, 2024). In circular construction, some of these activities are:

- Pre demolition auditing
- Robotic deconstruction / dismantling / disassembling
- Material sorting / recycling

Although, to be able to use it effectively for design in our project, we need to be aware of the following aspects.

What can AI do? What are the inputs and outputs?

AI in construction design can handle a wide range of tasks, from initial design conception to the optimization of material use and the assessment of structural integrity. Inputs and outputs can be categorized as:

Input data: AI systems process a vast array of data types. In our case, the potential data inputs are including but not limited to

- Materiality of the existing structure (Kunsthalle, Zürich): Information on the materials available from the existing structures or stock, including their physical properties, current conditions, and quantities.
- Principles of circularity: Data regarding how materials can be reused or recycled in the most efficient way, minimizing waste.
- Basic design principles, goals and regulations: Architectural standards, user requirements, structural and sustainability regulations and aesthetic preferences.

Output data:

- Optimized design proposals: proposals that make the best use of available materials while sticking to design principles and circularity concepts.
- Material use plans: detailed plans on how to use the reclaimed materials effectively, including cutting patterns, assembly instructions, and reuse strategies.
- Visual representation: AI-generated images or models visualizing the proposed designs, allowing for easier interpretation and modification.

AI tools available and their properties:

There are quite a lot of generative design tools available ranging from text-based models to image-based architectural plan generators.

- AI image generators
    - creates visual representations of potential designs based on input data. Particularly useful for exploring aesthetic options and for visualizing how reclaimed materials can be integrated into new structures.
- Generative Design Software
    - Helps explore a vast design space to find optimal solutions that meet predefined criteria, such as material usage efficiency, structural integrity, and environmental impact. Tools like Autodesk's generative design capabilities are examples where AI algorithms generate design alternatives based on goals and constraints defined by the designer.
- Simulation and modelling tools
    - Simulate how designs perform under various conditions, predicting structural behaviour, energy efficiency, and material longevity. This helps in refining designs to enhance sustainability and durability.

Initial proposal

To create a 15 AI generated image storytelling representing how we can use AI tools to generate visual propositions for the conceptualization of circularity in design and construction.

Re stated proposal

In order to make the project result more interactive, as well as to show the whole process, we will create an interactive website. In this website we will share the findings and results of the iteration exercise with the different AI image generators, the prompt template used and the different options we have used.

Objective

To explore different AI image generators and how can they be beneficial during the design process to achieve circularity. As well as to explore the limitations and constraints of such technologies.

Also, after thinking it thoroughly, we concluded that the design process for circularity requires at least the following three topics:

- Culture
- Repurposing
- Modularity

Result Visualization

We plan to showcase our results through a series of images, as described below.

What do our images capture: they portray the design process from an AI perspective and circularity in different aspects of circularity (modularity, culture and repurposing).

Audience: make it as simple and easy as possible for any kind of person to understand it, even if they are not educated in architecture / construction.

Narrative/emotions: match design process to AI tools by trying to portray emotions such creativity and inspiration.

Tool: we started by making a taxonomy of the AI tools available for our purpose, by classifying their technology, company, and availability in the market.

Figure 1. Exemplary AI generated image by Curry J. Hackett

- ChatGPT / OpenAI
- Gemini / Google
- ImageFX / Google test kitchen
- Copilot / Microsoft

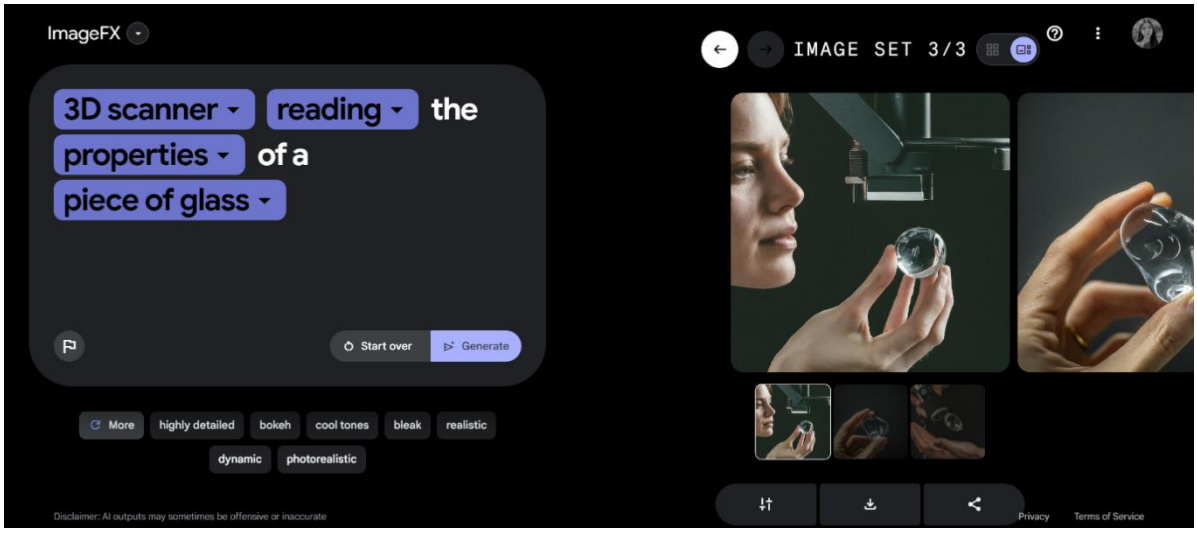


Figure 2. First AI generated images by the team

Methodology

1. Experimenting with different prompts to generate first images based on the description of the space and concept.
2. Complement images with photoshop creating collages if necessary.
3. Give the picture back to the AI and ask for a description and use it as next prompts as a part of algorithm development and refinement.
4. Create a website to register the design process of the images generated as well as to create a visual taxonomy of the different inputs and outputs

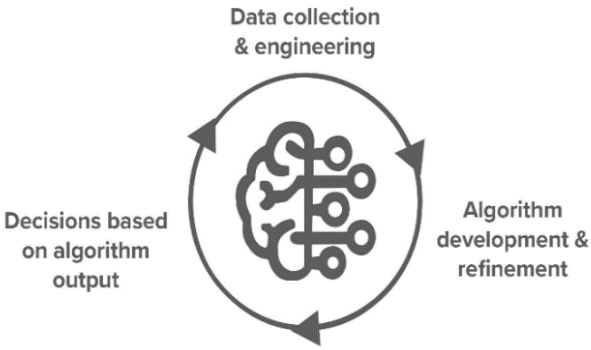


Figure 3. AI processing

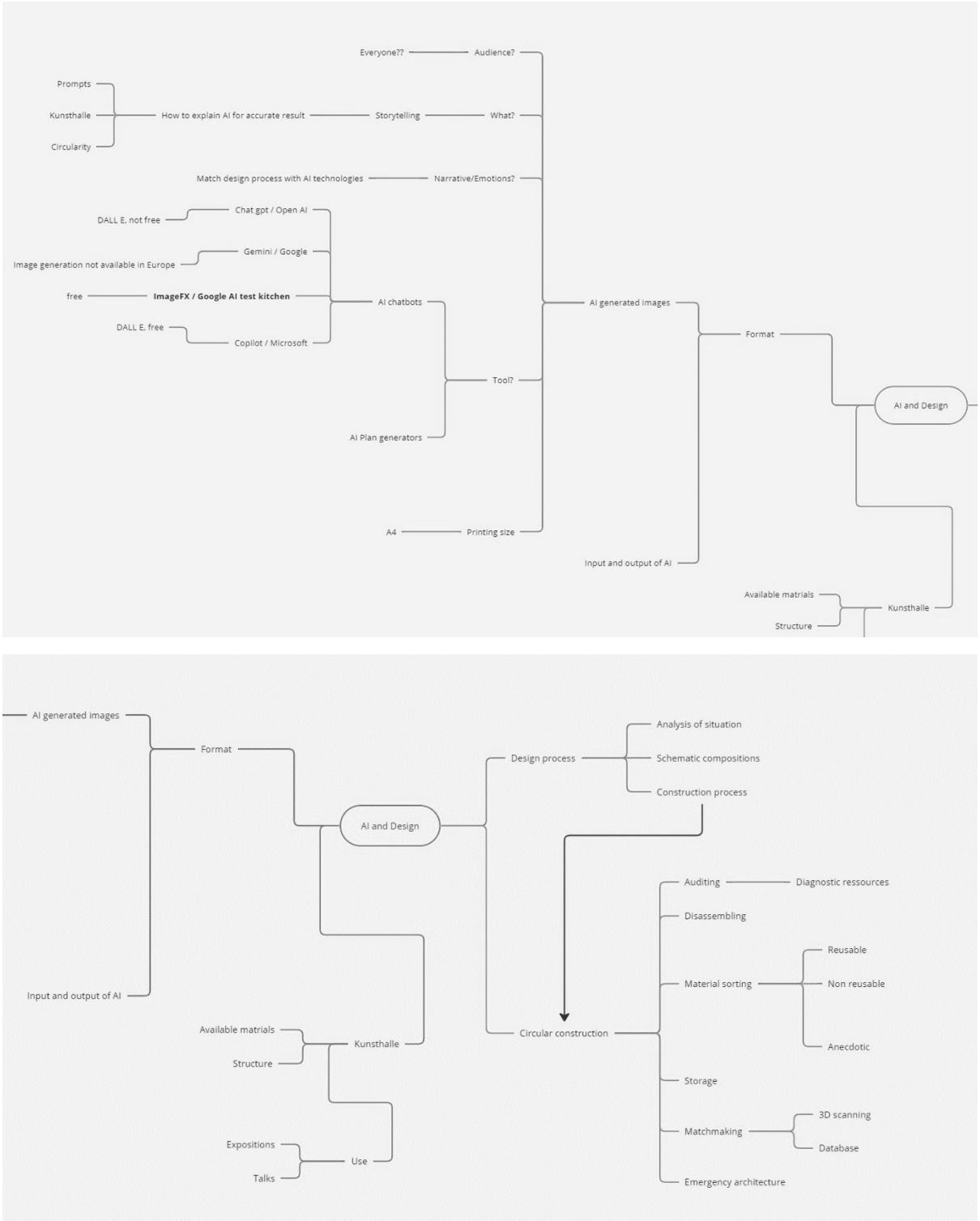


Figure 4. Initial brainstorming

"Architecture, then, becomes a result of collective decisions, where the advancements of AI intersect with the aspirations and values of society. It's within this ***interplay*** *that the evolution and impact of architecture find their resonance and significance" (Valencia, 2023).*

Phase 2

Goal of the semester project

Definition of our main goal of this project work:

We want to create a template of a single initial prompt which a user could use in an AI generator to help them to incorporate during their design process the following three aspects of circularity. For each aspect a template of a prompt will be created so the user can seek inspiration from AI in the incorporation of following the specific aspects.

1. Cultural:
   In this template the goal is to use local materials of the chosen location and use them in a cultural traditional design.

2. Repurposing:
   In this template the goal is to incorporate the possibilities of repurposing a chosen object or material in a clearly defined purpose in a building by inserting a picture of the object to be repurposed.

3. Modularity:
   This template should include modularity of certain element designs for a chosen location and purpose in the design process of the user. It should emphasize the use of easy deconstruct-able material.

The different outputs of the results with the different dropdown bars will be shown together on a website.

Draft iterations

Modularity

First prompt: trial of different AI image generators

I want a design of a [type of building] which incorporates the aspect of modularity. Use a single type of [material] [element] for the [part of the building] of the [type of building]. The [type of building] should also be easily deconstructable.

Type of building:	school
Material:	precasted concrete
Element:	plate
Part of building:	wall

Results in Midjourney:

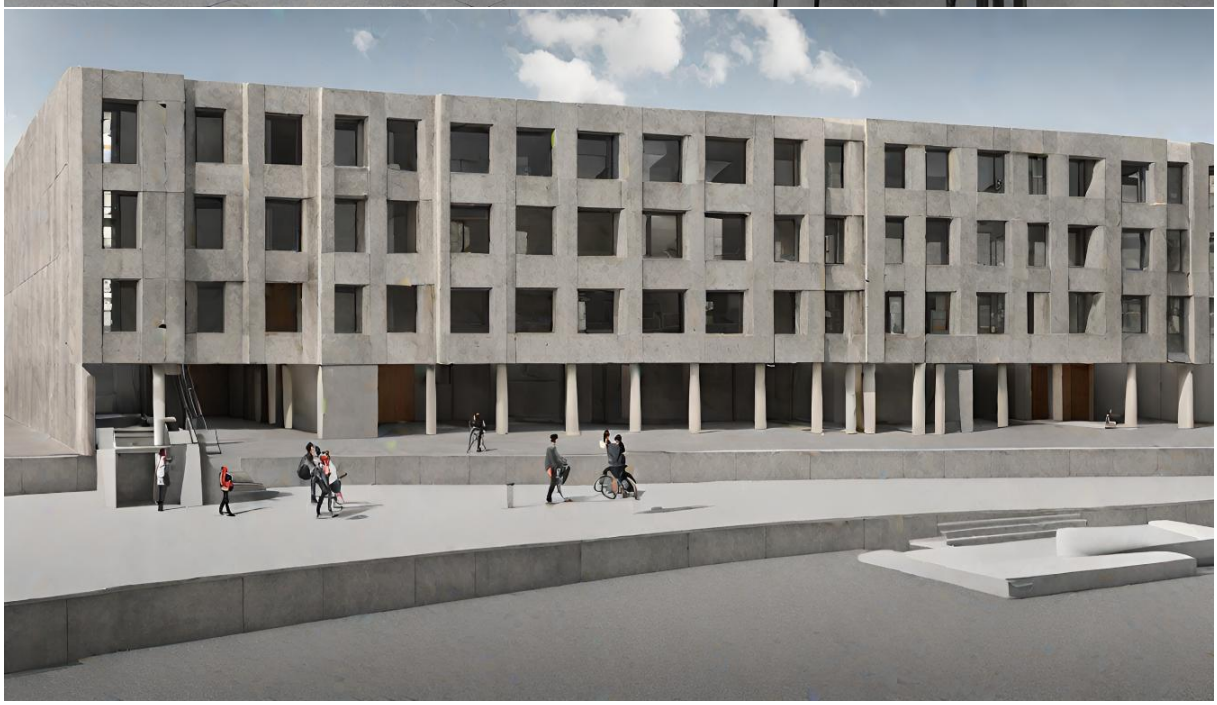
The realism of the picture is striking and could be confused with real photos. An inspiration could be taken from these. Even though the prompt isn't well structured. Some nature aspects are included despite the prompt didn't ask for it.

Results in ChatGPT4 (DALL-E):

With that exact Prompt ChatGPT started to give me an answer and not an image. So, I changed the start to "Create and Image of a design…".

Rather unrealistic forms, vehicles not correctly created. The prompt didn't ask for it. General design could give some kind of inspiration but not very realistic. Aspect of modularity is still quite well applied.

Results in Runway ML:



Interestingly the only one to give me an interior design of a classroom. The rest are rather uncreative and basic design. The focus lays on the building, which is good, but it keeps the components simple.

After this little assessment DALL-E created the most unrealistic image, but it may enhance creativity in the users' eyes. Midjourney has the strongest mix between creative design and realistic incorporation into a landscape and look. Runaway keeps it simpler but ticked the boxes some of modularity. All three AI generators understood the material. The specification of the roof was irrelevant to all generators, maybe the prompt needs more specification about the other parts of the building. The precasted elements can clearly be seen in the Midjourney generations.

Cultural

First prompt: trial of different AI image generators

An interior photography of a renovated [location] traditional house made from repurposed [name of local material]. The [elements] of the house must clearly show they can be easily disassembled in the future.

Location: Swedish
Type of local material: wood
Element: walls

Results in Midjourney:

Results in ChatGPT4 (DALL-E):

Results in Runway ML:

When it comes to circular construction, one of the main aspects is to reduce the embodied CO2 produced by the materiality/activities. Thats why we decided to consider and study the approach to circularity from different cultural contexts. These local materialities usually add up to the longevity of buildings thanks to their adaptability to their local environment. They also add biogenetic benefits contributing to the overall life cycle. In our prompt given to the 3 different AI image generators we observe that the use of local materials can easily be implemented in modern Architecture. In the template prompt we decided to focus on interior photography because we consider inner spaces key to have a user-friendly approach to design. Midjourney gave us very interesting and realistic approaches, while ChatGPT was more successful to represent the disassembling purposes and runway played much more with the architectural elements and opening.

Repurposing

Results in DALL-E:

Step 1 - First prompt (Picture 1):

I want [X] alternatives showing how the element from the attached picture of [building/element] can be repurposed in a new setting. With a circular mindset, your generated pictures should show how the building/element can be used in other use cases, so that we preserve the material.

The thought process of creating the initial mainstream prompt was to give details on how the AI should generate pictures for repurposing. When giving the picture on the "cart-table" to Chat GPT, the output was simply another table which the AI had added plant to. To conclude the AI does not understand what I am looking for, it interprets a circular mindset as adding plant to the table, therefore the prompt must be more specific regarding the exact output wanted.

Step 2 - Adding to initial prompt for specification (Picture 2): use cases for the [building/element] I want to explore is to turn the [building/element] into [A piece] or another element.

This time the output was more realistic. A reason is that I specifically stated the possible use cases. It still gives an animated/visualisation concept. But for this stage it could be of use for a realistic artistic touch. This time there is a clear connection between the frame of the table and what role it plays; A tabletop repurposed as a modern closet's sliding door or a partition wall in an office, with the table frame as the support structure.

Step 3 - Further refinement of prompt (picture 3):

Adding: I want the doors or elements to be as realistic as possible

Removing: "With a circular mindset"

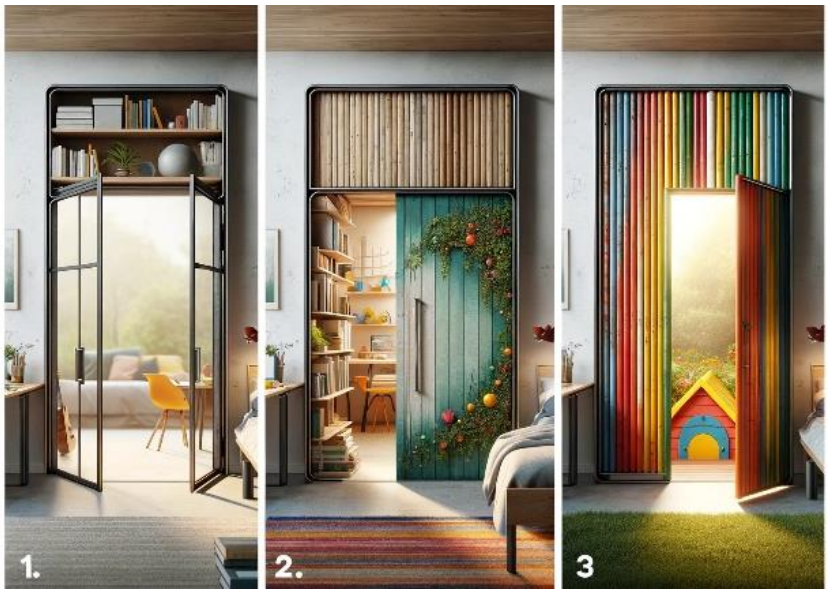
By making the mentioned changes there were hopes to see a more creative way of using the tabletop for a door and perhaps the metal framing as a door frame. Also, to not get a too mainstream picture, with elements being circular just due to the inclusion of the word circularity in the prompt. Instead, the distinction of the use case got even more abstract, and you lost track of where the materials where being repurposed in the generates pictures.

To conclude, the most sought-after prompt was already achieved after the first correction. Here you could see some of the material from the legs of the table which to the left in picture 2 are now a door frame. Finetuning your prompt after this step requires careful navigation due to misinterpretations. The effect of adding too many parameters and subtracting already existing ones reduces the desired outcome, it messes with the directions given and results in a more mainstream output. Overall, this is not the most straightforward tool and requires precise inputs to make it (somewhat)t useful.

Input image (same for the different AI generators):

Picture 1:

Picture 2:



Picture 3:

Results in Runway ML:

Step 1 - Same initial prompt as DALL-E (picture 1):

The program did not understand that I wanted another use case. It simply transformed the table to wooden material, misinterpreting the “circular mindset” part.

Step 2 - Adding to initial prompt for specification, like in DALL-E (Picture 2):

When adding the specific use cases, nothing changed, the output was still the same table.

Step 3 - Altering the prompt like in DALL-E and turning strength to 100% (picture 3):

There is no improvement in this scenario either. There is a different looking table but still no response to the part in the prompt regarding repurposing.

Step 4 - Making the prompt significantly simpler (picture 4): “Make the table look like a door”

The following prompt resulted in a door, still there is little to no evidence that the table have been the inspiration to the door.

To conclude, when getting an element different to the input object, you must turn the strength closer to 100%. The strength controls how much to transform the structure of the original image. Unless the strength is set at 100%, the picture gives you a blurry variant of the input picture. A longer description makes the output less favorable. A short description leads you in the right direction, but you cannot see any resemblance that the materials come from the table. It is too hard to get a creative repurpose output given the trials listed above. Taking this into consideration, Runway requires more investigation on image-to-image generation and is currently not a feasible option. Trials were also made with the “Erase and replace” tools, which also deviated from the desired outcome.

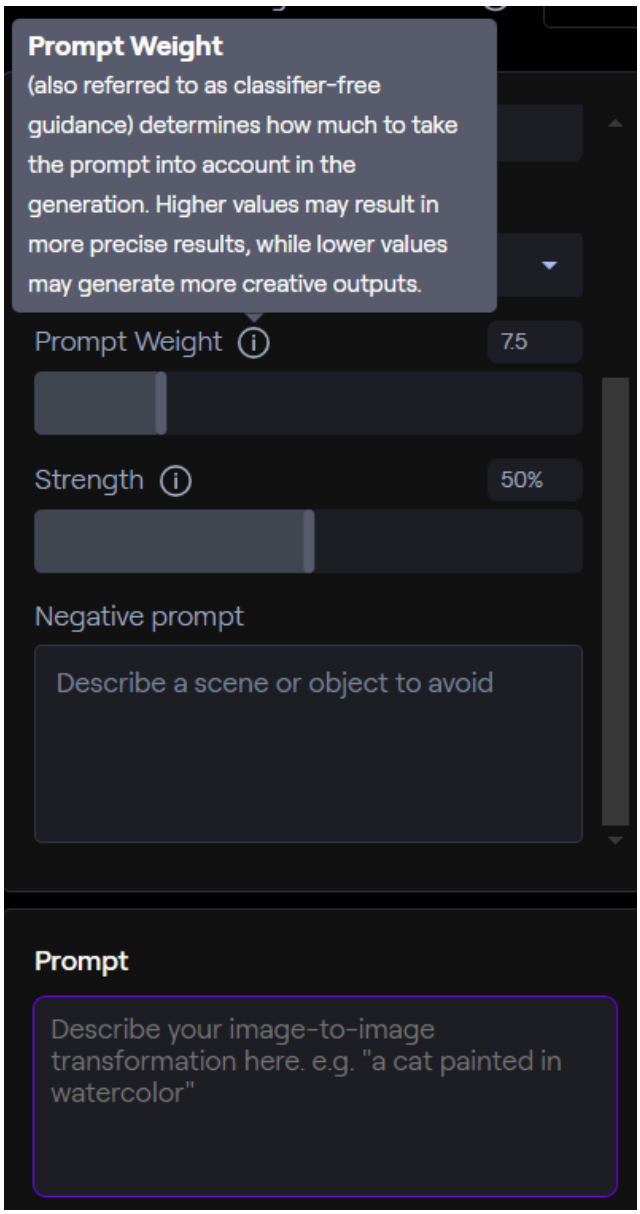
Picture 1:

Picture 2:

Picture 3:

Picture 4:

Prompt complexity:



Results in Midjourney:

Step 1 - Same initial prompt as DALL-E (picture 1):

Midjourney focused on repurposing the legs of the table to make it into a designer furniture. This is so far the most creative, realistic, and usable outcome of the initial prompt.

Step 2 - Adding to initial prompt for specification, like in DALL-E (Picture 2):

The refinement worked, we now got more creative suggestions on how to repurpose the table. Again, we got a usable creative solution to repurpose the table into a sink.

Step 3 - Altering the prompt like in DALL-E (Picture 3):

Losing the input of “with a circular mindset” and adding “I want the doors or elements to be as realistic as possible” negatively affected the result, thus verifying that or previous prompt yielded more useful results.

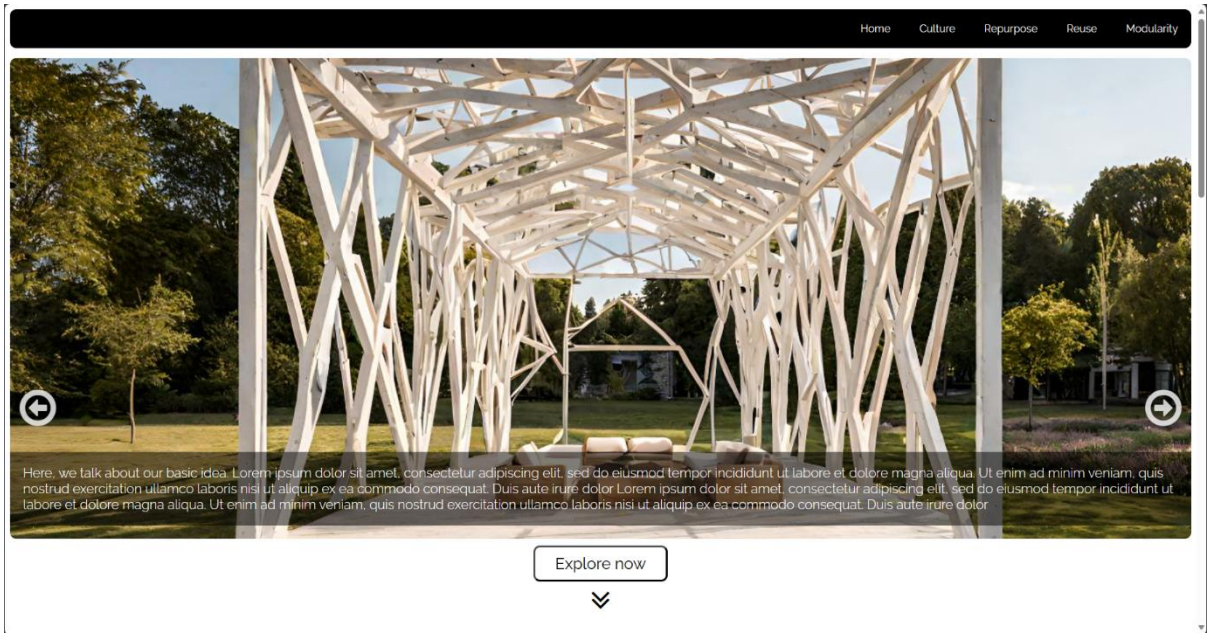
In conclusion, Midjourney has so far proved to be the most useful AI generation tool when it comes to image-to-image generation, yielding creative and useful outputs which can be used as a source of inspiration for a repurposing project.

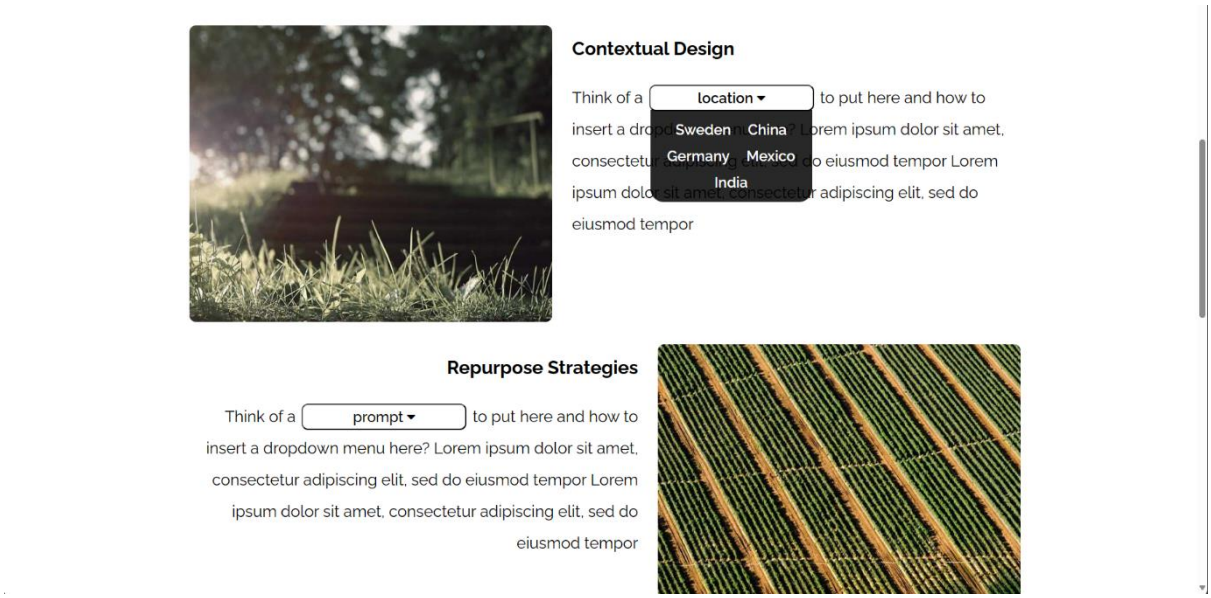
Picture 1:

Picture 2:

Picture 3:

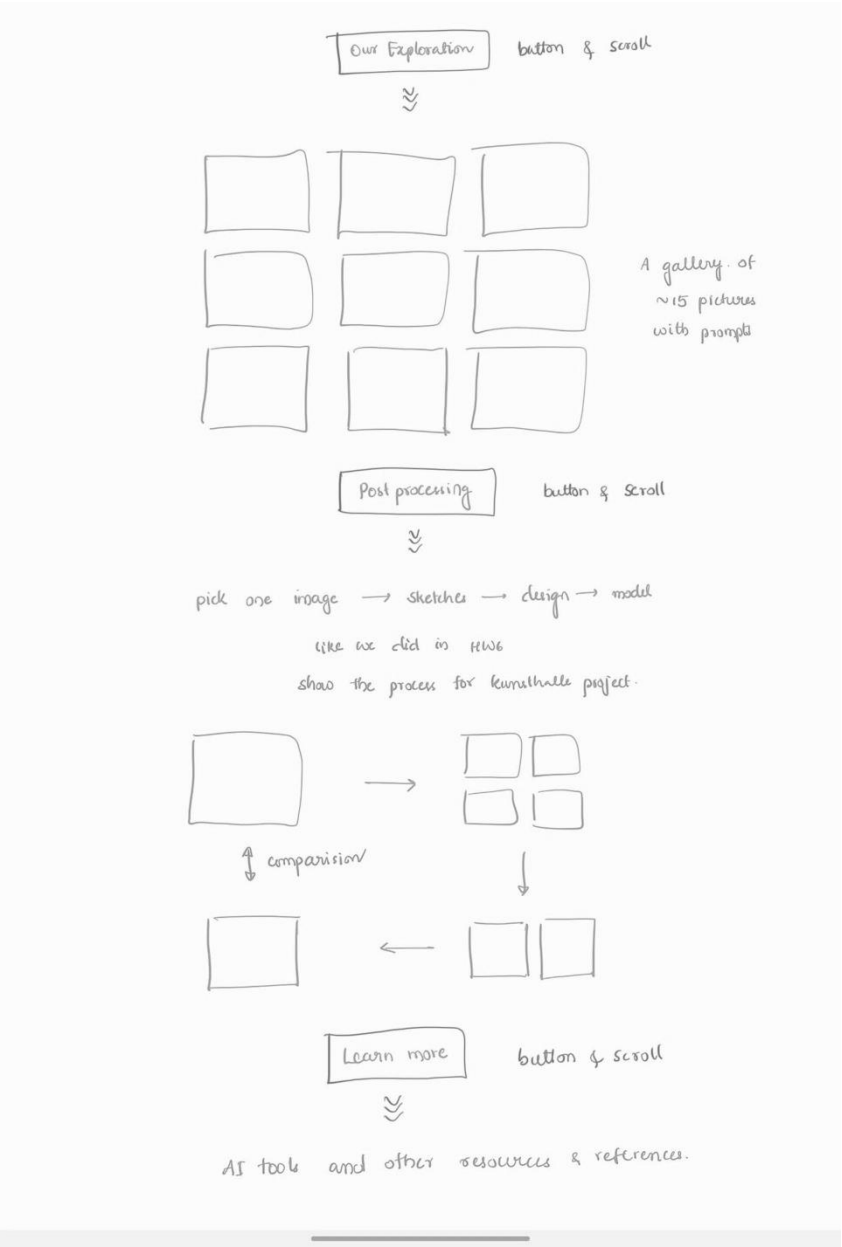
Draft website





Our main objective with the website is to have a platform where people can interact with our results as well as to register all the process, we implemented to achieve this semester project.

On the website we want to have the 3 different aspects we have considered at the beginning of this phase, with the option to change some components from the prompt given to the different AI image generators and in that way, make easier to look for specific results.



Apart from the interactive part, we also intend to add a gallery of images showing our process of exploration, including the cases where AI failed to generate useful images. In the end, to conclude the process, we would also like to develop a design specific to Kunsthalle project inspired from the images generated. This process will be showcased in the “post-processing” section, with all detailed steps and a final comparison between the generated image and the final design.

We have programmed a prototype of this website using HTML and CSS on Visual Studio Code.

Phase 3

Final iterations / Midjourney vs Runway ML

Modularity

After an assessment of the results, the focus of the modularity theme is put on the interior of buildings. The template should incorporate just two dropdown bars which describe the place and the to be used material as a specific element. This simplification of the prompt is needed because the AI image generators don't get more precise with a detailed description of the topic. The generators take some key words within the prompt to create the image. Describing in more detail those key words could confuse the image generator. For example, the use of the world "circular" should be avoided in the case of "circular construction" as the output starts to make circular objects.

This can be seen in the following text to image generation with following prompt:

Create an interior space of a modular [kitchen] which could be assembled and disassembled easily. The concept of modularity within circular construction should be incorporated into the design. As the main building material [timber plates] should be used. The singular elements need be distinguishable from one and each other.

Because of this reason the prompt template is simplified even further. The following prompt will be used for the definitive iterations about the help in the AI & Design in the topic of Modularity.

Template prompt used for different iterations. Sixteen different combinations will be compared with each other in Midjourney and Runway ML.

Create an interior space of a modular [Type of room] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [Material Element] should be used. The singular elements need be distinguishable from one and each other.

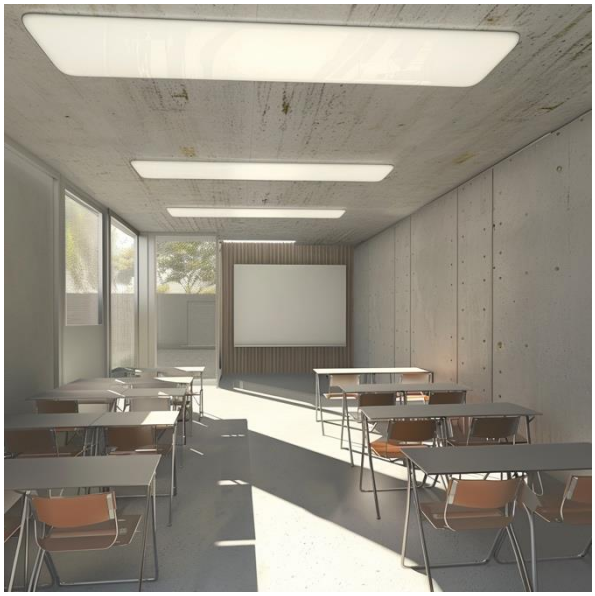
Type of room: classroom, exhibition hall, hotel lobby, kitchen

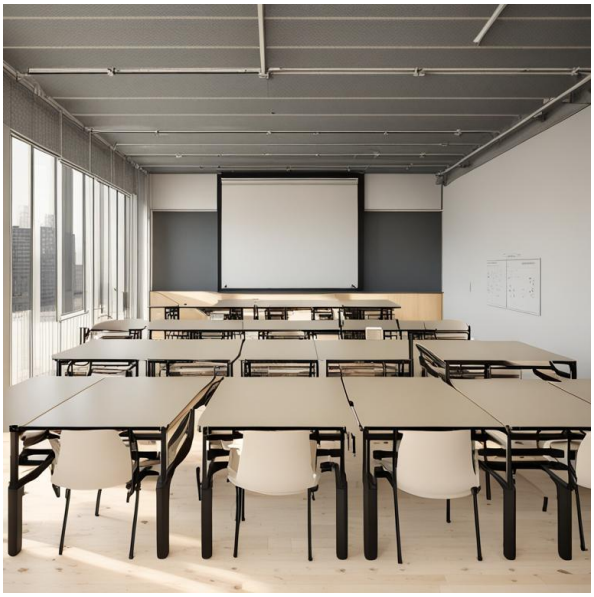
Material element: precasted concrete plate, Steel beams, timber beams, glass plate

In the following prompts the generated image from Midjourney will be show on the left and the one from Runway ML on the right side of the page.

A classroom made of different elements:

Create an interior space of a modular [classroom] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [precasted concrete plate] should be used. The singular elements need be distinguishable from one and each other.

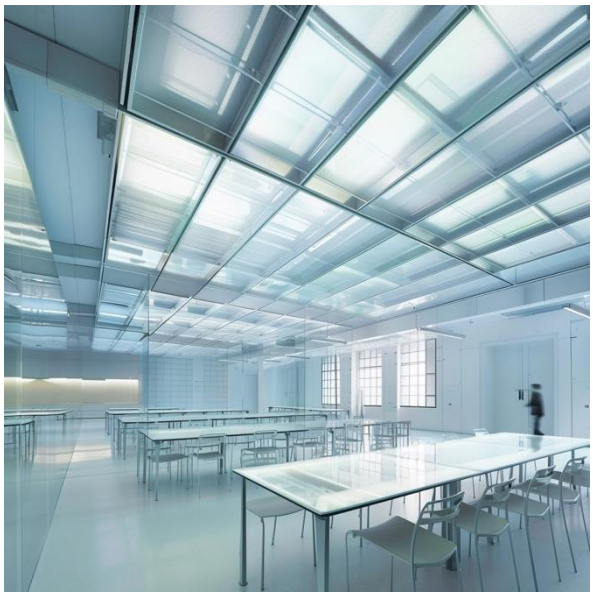




Create an interior space of a modular [classroom] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [steel beams] should be used. The singular elements need be distinguishable from one and each other.

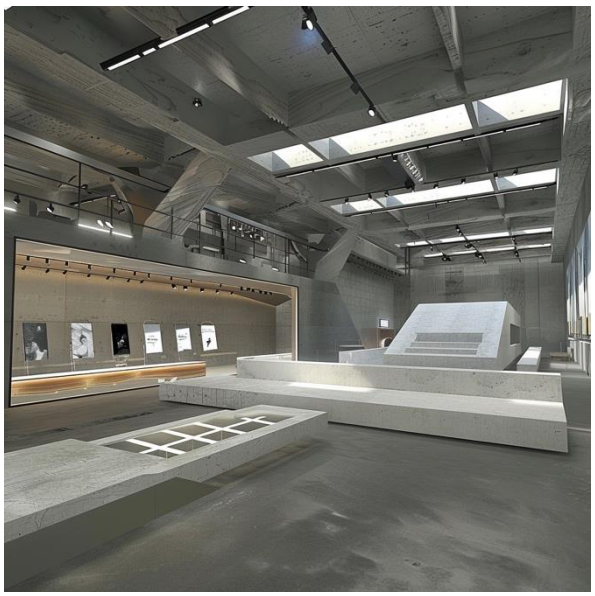
Create an interior space of a modular [classroom] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [timber beams] should be used. The singular elements need be distinguishable from one and each other.

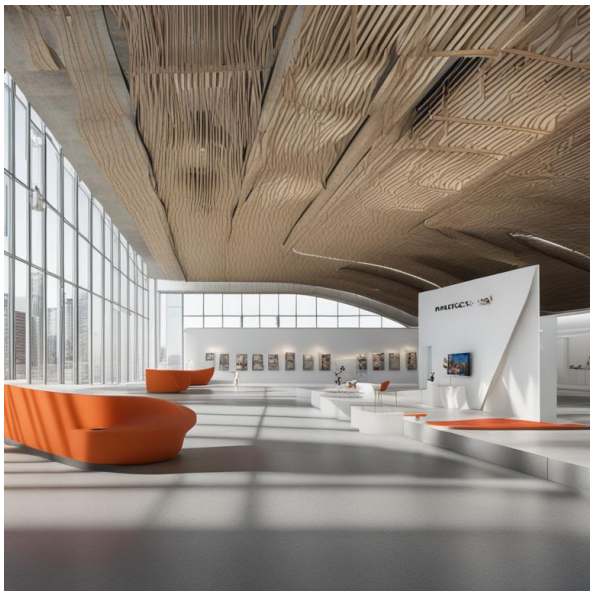
Create an interior space of a modular [classroom] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [glass plates] should be used. The singular elements need be distinguishable from one and each other.



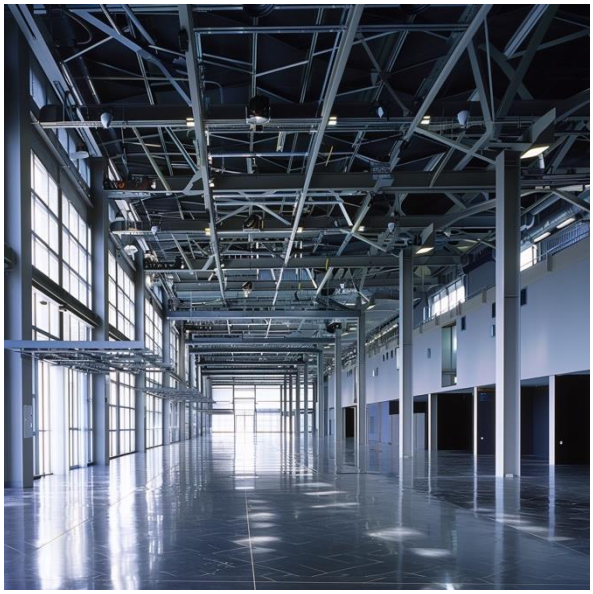
An exhibition hall made of different elements:

Create an interior space of a modular [exhibition hall] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [precasted concrete plates] should be used. The singular elements need be distinguishable from one and each other.

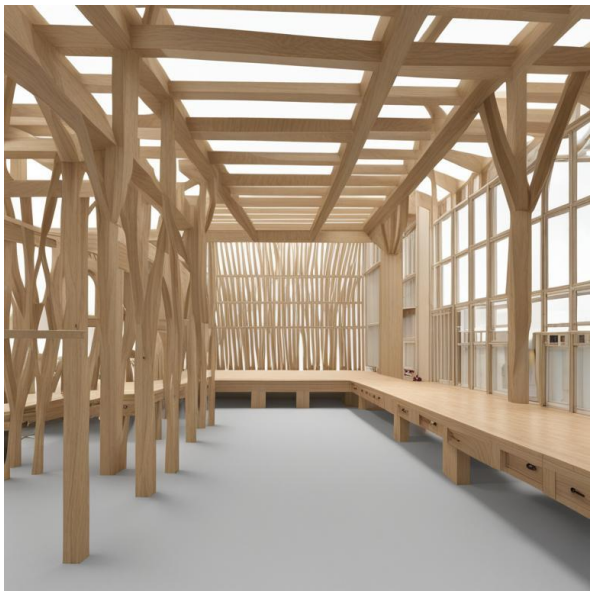




Create an interior space of a modular [exhibition hall] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [steel beams] should be used. The singular elements need be distinguishable from one and each other.



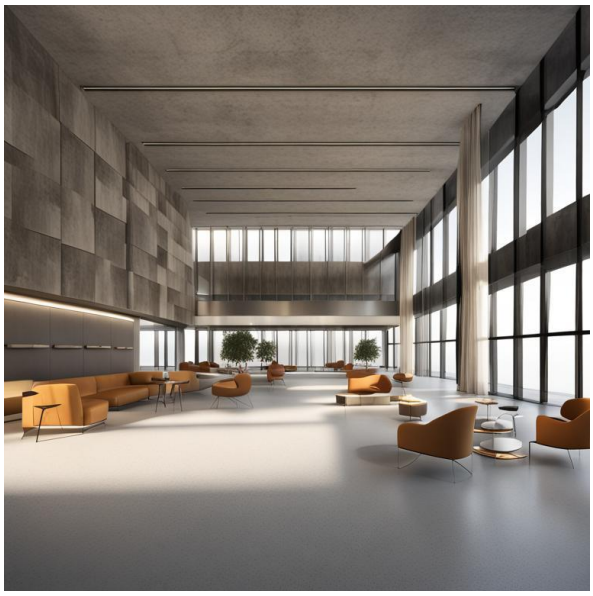
Create an interior space of a modular [exhibition hall] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [timber beams] should be used. The singular elements need be distinguishable from one and each other.



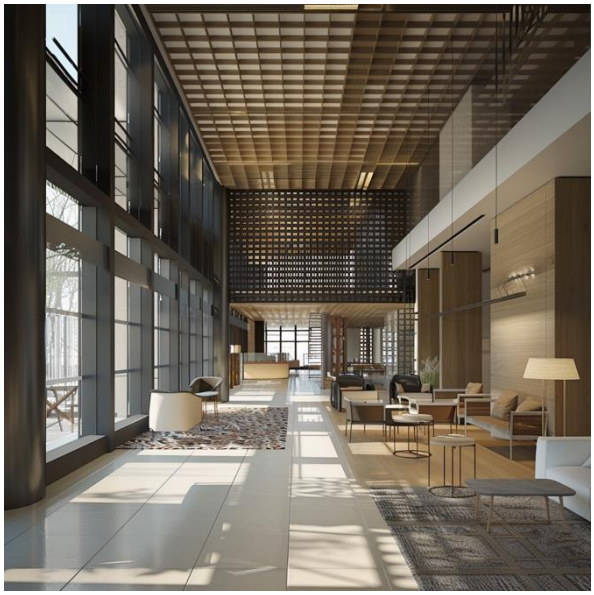
Create an interior space of a modular [exhibition hall] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [glass plates] should be used. The singular elements need be distinguishable from one and each other.

A hotel lobby made of different elements:

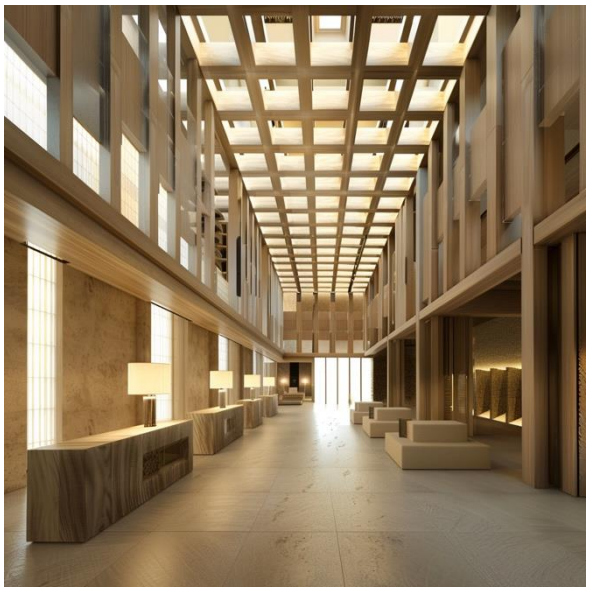
Create an interior space of a modular [hotel lobby] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [precasted concrete plates] should be used. The singular elements need be distinguishable from one and each other.

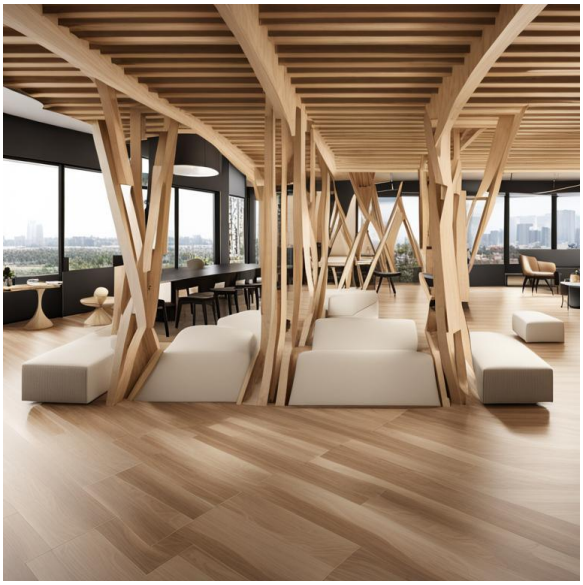


Create an interior space of a modular [hotel lobby] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [steel beams] should be used. The singular elements need be distinguishable from one and each other.

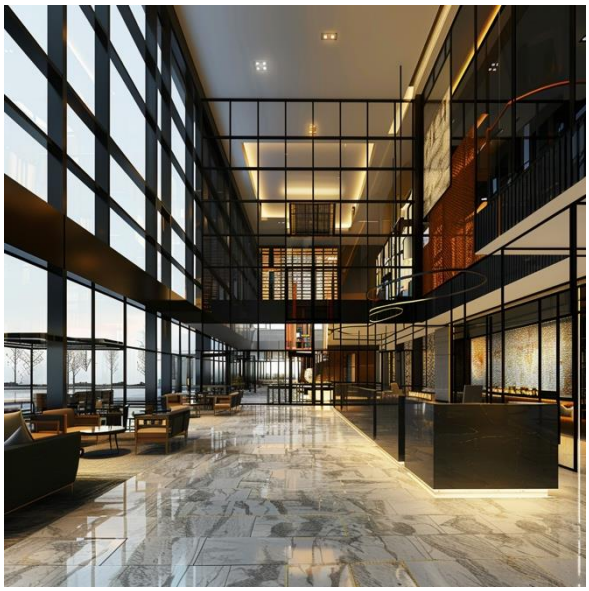


Create an interior space of a modular [hotel lobby] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [timber beams] should be used. The singular elements need be distinguishable from one and each other.





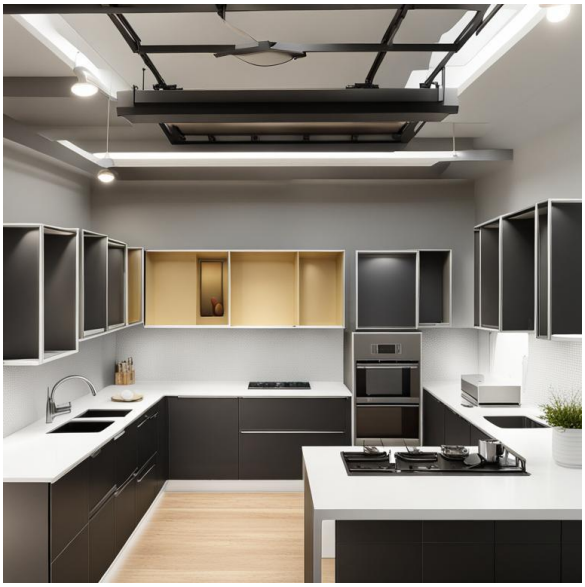
Create an interior space of a modular [hotel lobby] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [glass plates] should be used. The singular elements need be distinguishable from one and each other.



A kitchen made of different elements:

Create an interior space of a modular [kitchen] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [precasted concrete plates] should be used. The singular elements need be distinguishable from one and each other.

Create an interior space of a modular [kitchen] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [steel beams] should be used. The singular elements need be distinguishable from one and each other.



Create an interior space of a modular [kitchen] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [timber beams] should be used. The singular elements need be distinguishable from one and each other.

Create an interior space of a modular [kitchen] which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material [glass plates] should be used. The singular elements need be distinguishable from one and each other.

The different combinations showcases that the concept of modularity is very difficult to represent graphically. Despite this issue in certain cases the created image could give an insight in how the available material and its materiality could be used in an interior space. The most “modular” material is the timber beam. In all scenarios the modularity of it can be seen and imagined. The most difficult material to recognize the modularity in the generated image is the glass plate followed by the steel beam. Often the size of those materials is predetermined and are difficult to implement in a specific design. The precasted concrete is a very specific element which is hard to assemble and is statically not as stable anymore in a reuse scenario. The generations show that those elements could be used as facades or, in the example of the kitchen, as the kitchen counter.

One of the difficulties is the lack of information about the specific element. A user could specify more the element that it wants to incorporate in a design. Often the AI image generators use the asked material elements as the roof of the interior. In those cases, this possibility could really be used during a design process of where the available element could be place. All images can just be used as an inspiration for what is possible and not as a definitive design for the modularity aspect. This was also the goal of the creation of the template to show that with certain key words the AI generators can help to create something useful for the inspiration of the designer. It should still be used with care and just in a preliminary stage of the design. In later design stages the AI generators still aren’t reliable enough to create useful design that can improve the modularity of a construction project.

In general modularity shouldn’t be used as an aesthetical design feature rather as a technical feature to improve the building. Modularity is supposed to exist in the technical framework of a building and be as subtle as possible within a building. For this reason, using the modularity aspect of circular construction in the aesthetical part of the design process using the AI image generators shouldn’t be as popular as intended

Cultural

An [artistic] photograph from a [Swedish] contemporary museum, with focus on the local materiality. The [museum] must clearly show its elements and how they can be disassembled and repurposed.

Style:	Artistic
Culture:	Swedish
Typology:	Museum

An [artistic] photograph from a [Swedish] contemporary school, with focus on the local materiality. The [school] must clearly show its elements and how they can be disassembled and repurposed.

Style:	Artistic
Culture:	Swedish
Typology:	School

An [exterior] photograph from a [Swedish] contemporary museum, with focus on the local materiality. The [museum] must clearly show its elements and how they can be disassembled and repurposed.

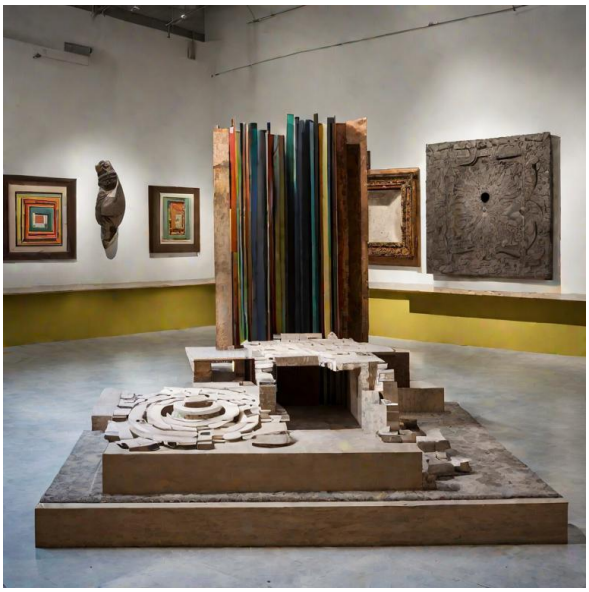
Style:	Exterior
Culture:	Swedish
Typology:	Museum

An [exterior] photograph from a [Swedish] contemporary school, with focus on the local materiality. The [school] must clearly show its elements and how they can be disassembled and repurposed.

Style:	Exterior
Culture:	Swedish
Typology:	School

An [artistic] photograph from a [Mexican] contemporary museum, with focus on the local materiality. The [museum] must clearly show its elements and how they can be disassembled and repurposed.

Style: Artistic
Culture: Mexican
Typology: Museum



An [artistic] photograph from an [Mexican] contemporary school, with focus on the local materiality. The [school] must clearly show its elements and how they can be disassembled and repurposed.

Style: Artistic
Culture: Mexican
Typology: School

An [exterior] photograph from a [Mexican] contemporary museum, with focus on the local materiality. The [museum] must clearly show its elements and how they can be disassembled and repurposed.

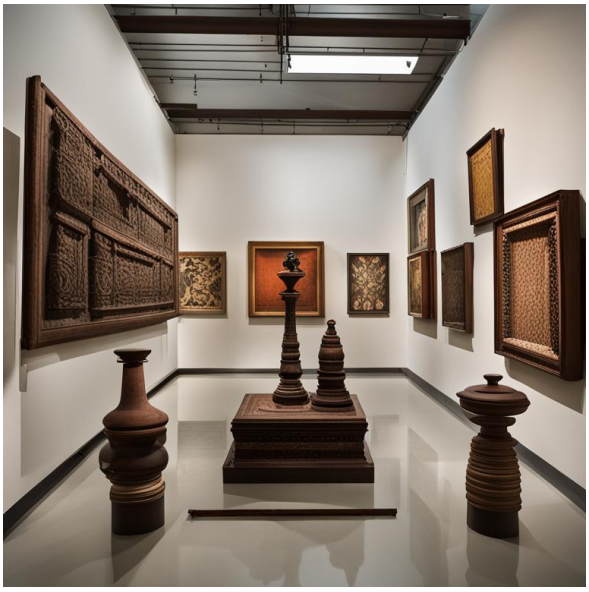
Style: Exterior
Culture: Mexican
Typology: Museum

An [exterior] photograph from a [Mexican] contemporary school, with focus on the local materiality. The [school] must clearly show its elements and how they can be disassembled and repurposed.

Style: Exterior
Culture: Mexican
Typology: School

An [artistic] photograph from an [Indian] contemporary museum, with focus on the local materiality. The [museum] must clearly show its elements and how they can be disassembled and repurposed.

Style:	Artistic
Culture:	Indian
Typology:	Museum



An [artistic] photograph from an [Indian] contemporary school, with focus on the local materiality. The [school] must clearly show its elements and how they can be disassembled and repurposed.

Style:	Artistic
Culture:	Indian
Typology:	School

An [exterior] photograph from an [Indian] contemporary museum, with focus on the local materiality. The [museum] must clearly show its elements and how they can be disassembled and repurposed.

Style: Exterior
Culture: Indian
Typology: Museum

An [exterior] photograph from an [Indian] contemporary school, with focus on the local materiality. The [school] must clearly show its elements and how they can be disassembled and repurposed.

Style: Exterior
Culture: Indian
Typology: Museum

An [artistic] photograph from an [Chinese] contemporary museum, with focus on the local materiality. The [museum] must clearly show its elements and how they can be disassembled and repurposed.

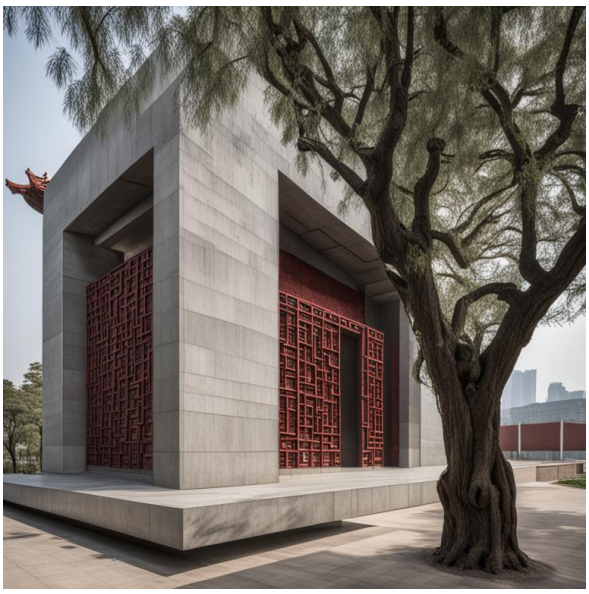
Style: Artistic
Culture: Chinese
Typology: Museum

An [artistic] photograph from an [Chinese] contemporary school, with focus on the local materiality. The [school] must clearly show its elements and how they can be disassembled and repurposed.

Style: Artistic
Culture: Chinese
Typology: School

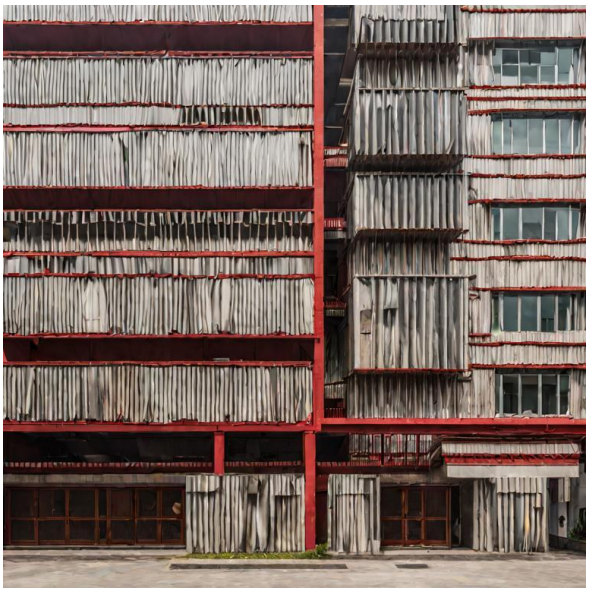
An [exterior] photograph from an [Chinese] contemporary museum, with focus on the local materiality. The [museum] must clearly show its elements and how they can be disassembled and repurposed.

Style:	Exterior
Culture:	Chinese
Typology:	Museum



An [exterior] photograph from an [Chinese] contemporary school, with focus on the local materiality. The [school] must clearly show its elements and how they can be disassembled and repurposed.

Style:	Exterior
Culture:	Chinese
Typology:	Museum



During this final stage of analysis for the cultural aspect of circular construction, we had to mark constraints and limitations to our iterations. We have noticed that both Midjourney and Runway ML gave us the best results when it comes to the understanding of our prompts, so we decided to keep working only with these AI image generators in order to bring the iterations to a more compacted result and make a more detailed comparison. As shown in the previously presented images, we have given the exact same prompt to the AI, nevertheless we have obtained images with considerably differentiation.

This template has 3 specific concepts that we decided to change, and users will be able to change as well within our website. Those concepts in the cultural aspect iterations were *style, culture, and typology*. The reason why we chose those concepts was because we consider them to be strongly related to the circular aspect of local and vernacular architecture, also, to check if the AI was able to recognize the local materiality and needs of the place by itself, and how it was able to apply circularity to different scenarios. After having done all iterations and analyzing the results we observe significant differences when it comes to both AI image generators, for instance Midjourney has a more realistic approach to the images, but Runway creates more interesting spaces.

Nevertheless, the most important differences are shown among the style and typology, but mainly within the *cultural side*. There is a clear difference between Sweden and Mexican, and the Indian and Chinese iterations. The first two cultures always came out clean and the spaces looked well treated, meanwhile with the last two cultures the spaces usually looked old and misused. We think one reason could be that AI only takes available information from the internet to produce their images, and it could be that the available information and images from the internet of these two countries are usually evoking the same feeling as we get from the AI image generation. We concluded that, even though AI image generators can help us to understand the visual imagery of cultures, we need to be critic about their outcomes since it is only visualized by what is on the internet right now, which could be full of misconceptions, or even racists approaches.

Repurposing

Repurpose the [Material] to become a [Use case]

Type of material: Concrete slab, brick, timber beam, steel beam

Use case: Furniture, park bench, coffee table, another product

Midjourney, Runway ML and DALL-E will be compared in their possibilities and limitations regarding repurposing in circular construction. An input image in combination with the derived prompt mentioned above will be used to examine each tools capability.

The table below will give insight into each AI tools optimized prompt structure, its results, and authors verdict. Worth noting is that previous attempts involved using more "messy" input pictures, such as those with multicolored backgrounds and more complex structures/products, which made it difficult for the AI tool to handle the prompt and specifics of the input picture. DALL-E in particular struggled the most out of the three tools to deliver useful results under these conditions. However, providing simpler contexts and using the upgraded version of DALL-E after the GPT-4o launch significantly improved the usability of DALL-E but also the other two tools. So, for this analysis, each object is a distinctive isolated building material with a white background to reduce the input complexity. See below the example input and output of a concrete slab a and brick.

Tool Comparison

Midjourney	
Method	- Concise prompt, too much text results in confusion. - Using “/imagine” to create image-to-image prompts. - Using a Midjourney Bot in a Discord server.
Results	- Realistic and useful output. - Minimalistic change to input material. - More creative response when prompt is “smaller” (has less tokens). - Does not respond well to diffuse prompts, need targeted output from the user.
Verdict	- Good, useful outputs, realistic use cases. Can customize output simply after final render. - The user needs to prompt with a distinctive target in mind, not enough with “another product” or “furniture” in the prompt mentioned above.
Ranking	Useful: 3 Creative design: 2 Ease of use: 1

Runway ML	
Method	-Trying out different prompt weights and structure transformation. - Exploring styles; 3D render, Architecture, Abstract etc.
Results	- Like Midjourney, important to state main objective first. - Structure transformation needs to be greater than 70% to get useful results. The downside is the low level of resemblance with the input image with this threshold. - No significance changes when altering the prompt weight.
Verdict	- Hard to finetune prompt weight and structure transformation. If structure transformation is low, the output stays the same and will not respond to the prompt. If it is too high, it will become something completely different. - Desired output was generated when switching to Runway MLs text-to-image generation.
Ranking	Useful: 1 Creative design: 1 Ease of use: 1

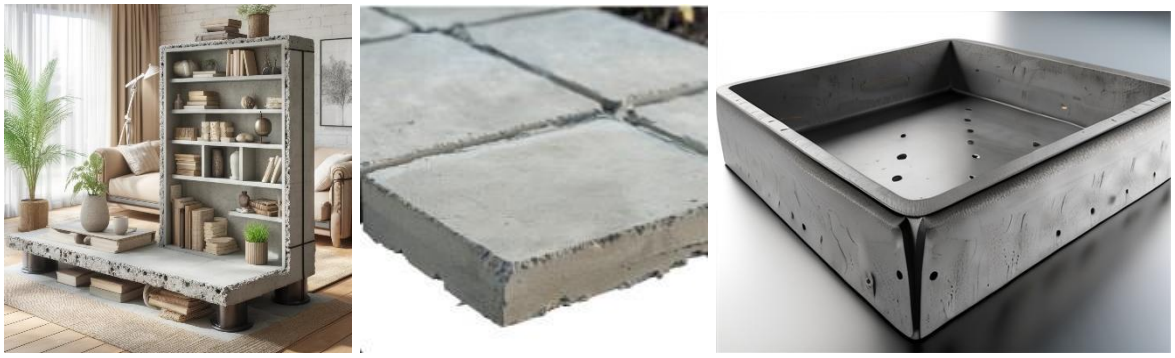
DALL-E	
Method	- Altering prompt lengths. - Trying new request for existing prompts. - Using a new “conversation” for each generation to not get a bias from previous requests.
Results	- Creative and realistic output, compared to output prior to GPT4o. - DALL-E put the repurposed material in a context environment. Midjourney also did this well. -Only model to really function without having a specific target output e.g. could handle “furniture” instead of having to put living room coffee table. - If one does new requests in same “conversation” then DALL-E follows the same path. E.g. if the previous “furniture” output was a bookshelf, the next will be the same unless specified other. - Output prompt can also drift away to become an abstract/unrealistic output if the same “conversation” is used for too long.
Verdict	- Yielded asked for output images. - Simple to modify the prompts for a new output. - Easiest tool to get started with. Low technical barrier to entry, simply copy and paste picture and insert prompt.
Ranking	Useful: 2 Creative design: 3 Ease of use: 3

Example input:

Example output – Repurpose the concrete slab to become a coffee table – (1)DALL-E, (2)Midjourney, (3)Runway ML

Example output – Repurpose the concrete slab to become a park bench – (1)DALL-E, (2)Midjourney, (3)Runway ML

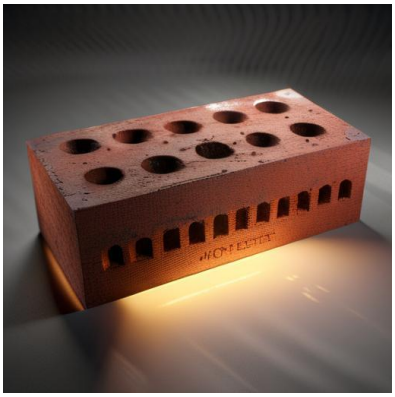
Example output – Repurpose the concrete slab to become another product – (1)DALL-E, (2)Midjourney, (3)Runway ML



Example input:

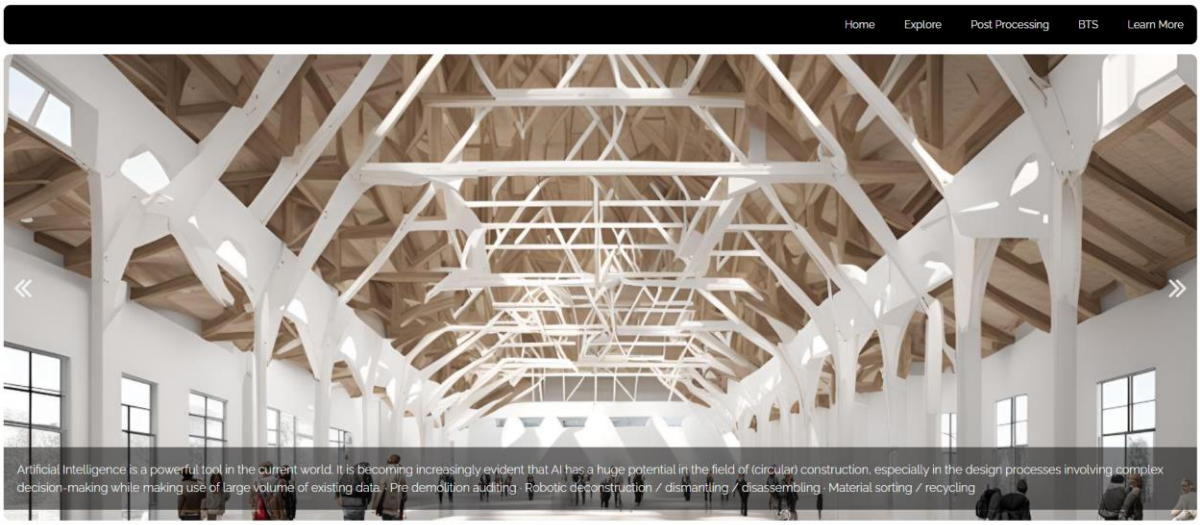
Example output – Repurpose the brick to become a coffee table – (1)DALL-E, (2)Midjourney, (3)Runway ML

Example output – Repurpose the brick to become another product – (1)DALL-E, (2)Midjourney, (3)Runway ML



Final website

Link to the website: [Can AI really help?]



Contextual Design

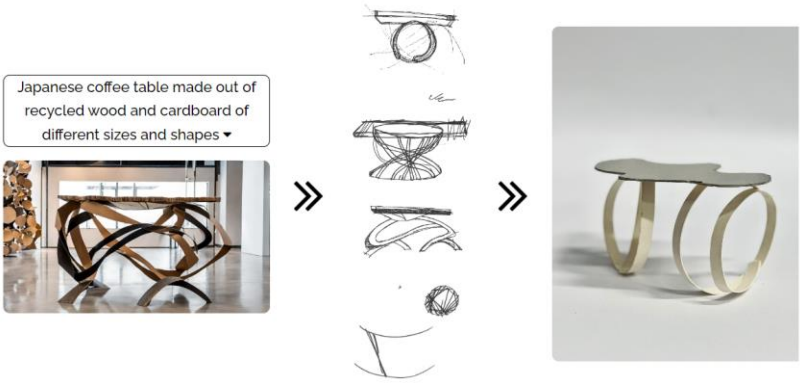
An exterior photograph from a Chinese contemporary school with focus on the local materiality. The structure must clearly show its elements and how they can be disassembled and repurposed.

Modularity in design

Create an interior space of a modular exhibition hall which could be assembled and disassembled easily. The concept of modularity within construction should be incorporated into the design. As the main building material timber beams should be used. The singular elements need to be distinguishable from one and

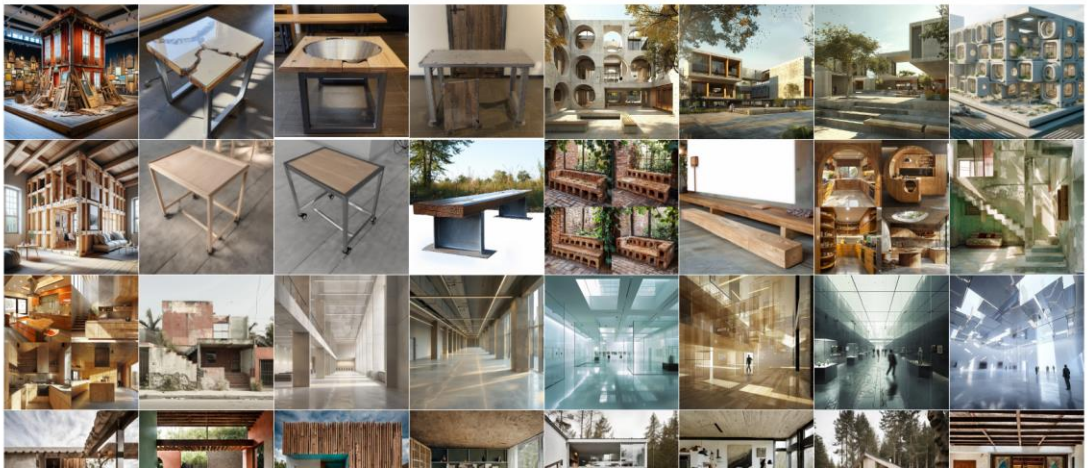
Post Processing

The generated images are not always feasible in design. So, it helps only as a tool to collect information and draw inspiration from them. Designers can however process and refine the designs further with sketching and prototyping. Here are a few examples of furniture design.



BTS - Behind the scenes

While AI manages to inspire the designers, it also fails terribly sometimes (actually most of the time). The large language model does not really understand the content of the image, it rather focuses only on pixel information and text matching. Here are some interesting examples or lets say bloopers of the work.



Conclusion and discussion

During the realization of this project, we have gathered some important information about AI image generators as well as with different circular construction aspects. Probably the most important thing we have learned is to keep ourselves critical about what AI generators are giving us as output. First, we need to understand the way the real elements and materials work and then apply this knowledge to what we are seeing in the AI generators. It is important to remark that AI only creates images based on what is already available in the web, therefore it might not create something necessarily authentic or attached to reality. It is of great importance for us as the users of AI to stay critic about this technology and use it responsibly during the design process.

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