A Bio-Based Lab Pavilion at TuDelft
as a Beacon of Innovation

INTERGRADING KINETIC FAÇADE TECH WITH ARCHITECTURE

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INTRODUCTION

This is a project that concerns:

Integrating kinetic facades with architectural narratives. In simple terms, how the media and kinetic features of a building skin can create emotions and tell stories

Marios Psalidopoulos

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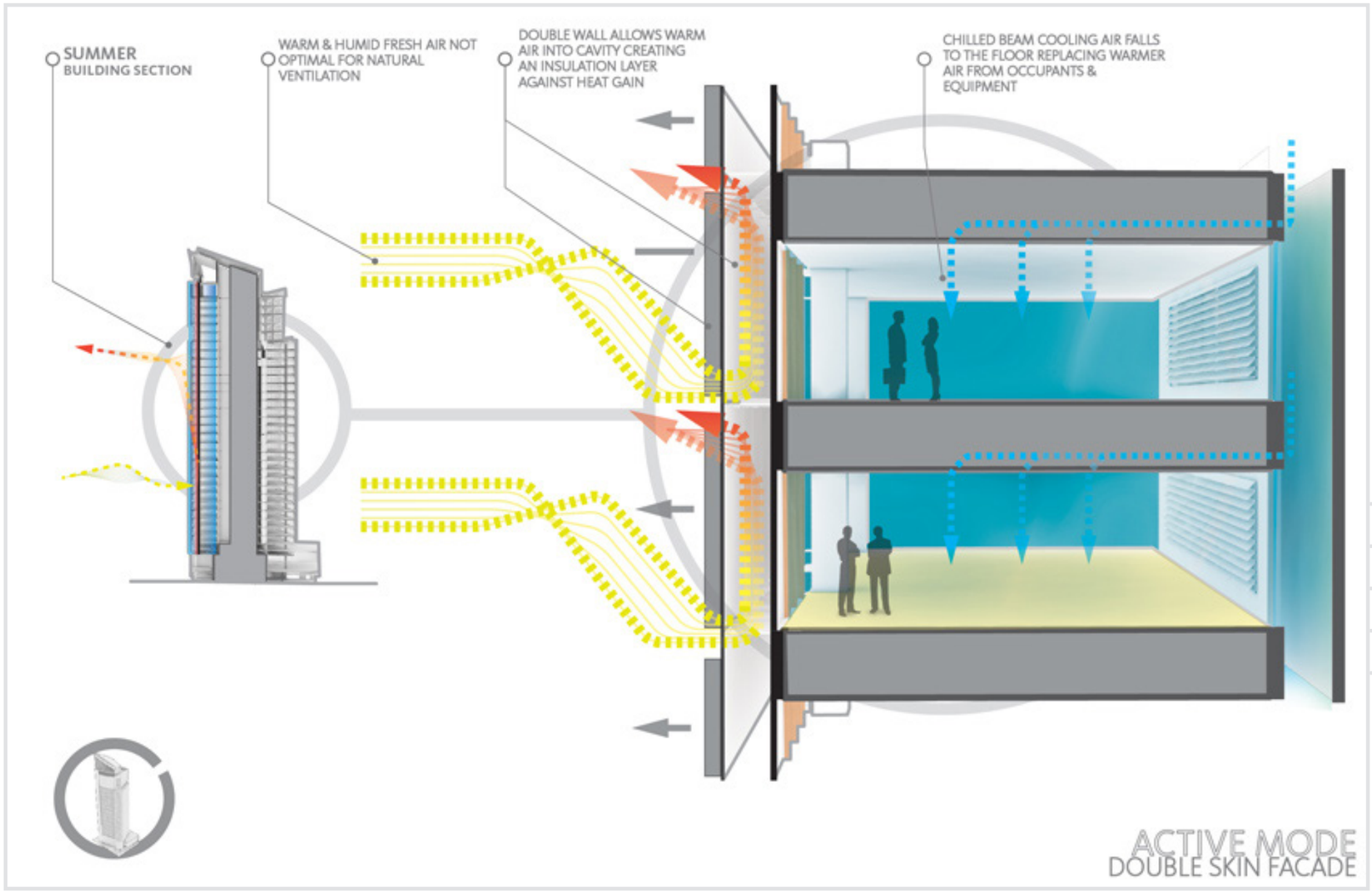


Fig 1. Illustration of an adaptive building skin oriented towards its ourside environment and occupants

CHAPTER 1

Exploring Kinetic and Media Facades in Architecture

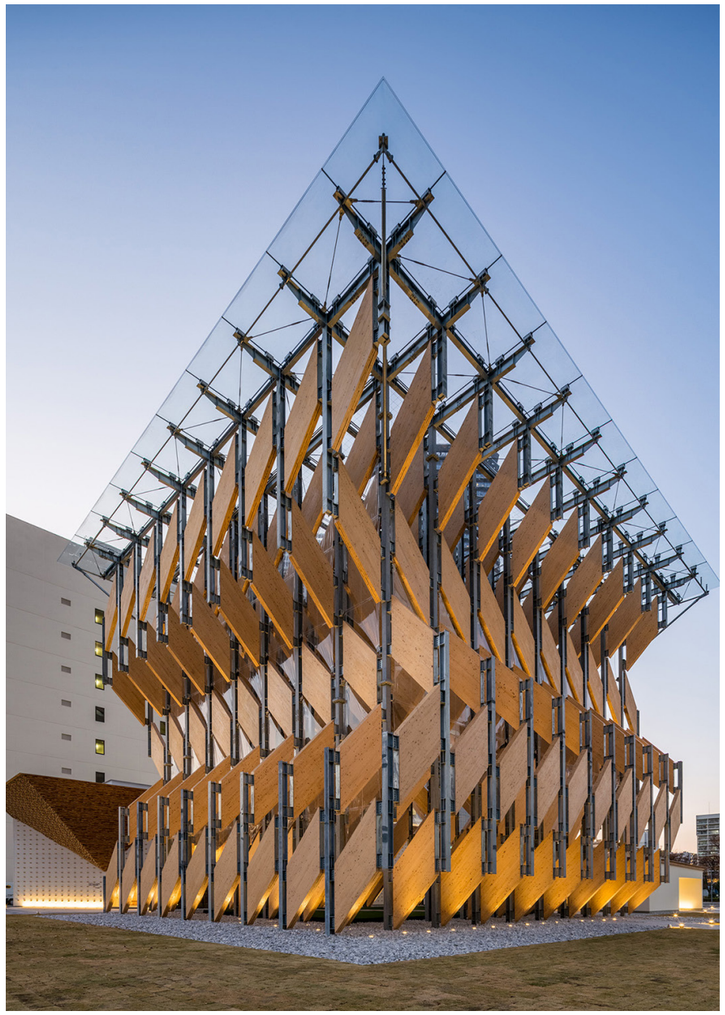
The research conducted for this report, and inspired by the design of the Bio-Based Lab's façade at TuDelft Campus, delves into the dynamic world of 'kinetic' and 'media' facades, which embody a range of terms such as active envelopes, kinetic facades, dynamic walls, and high-performance building skins. These terms, even if being varied, can be collectively described as exterior walls capable of responding adaptively to both external and internal conditions of a building, effectively acting as conduits for energy transfer (p.6).

Therefore, the kinetics, in this context, are defined as spatial transformations, distinct from traditional movements which are set either by the acts of the occupants from the exterior towards the interior, the opposite or the façade itself. That is because they offer a clear departure from standard architectural practices by transforming space through mechanisms like rotation, scaling, and material deformation.

Fig 2. Rabel systems, engineering your architecture, german design award winner, Example of kinetic facade

Conversely, media facades employ digital technologies like LEDs and projections as mediums for visual expression and communication which highlights the building in an urban scale (p.3)

Fig 3. Rabel systems, engineering your architecture, german design award winner, Example of kinetic facade



To conclude, a kinetic façade, above all its different labels and variations, can generally be any building skin which connects actively with the acts of itself or its environment (whether that is the people, the weather etc.), creating a dynamic relationship between the two.

Fig 4. CLT Park Harumi,Tokyo, KKAA, Version of a facade showcasing how minimal and static can kinetic facades be

On the other hand, media facades, use projectors, screens and other eye-catching tools which are based in light in order to work as advertising or striking narrating landmarks on a larger urban scale.

Fig 5. Asakusa Culture Center, Tokyo, KKAA, Version of a facade showcasing how simple and calm can media facades be

These two important definitions of the two features are the states upon which the scope the Bio-Based Lab Pavilion's design scope is going to be founded. More specifically, the merger of some features of both kinds of facades is what will be destined to propel the Wood Lab of TuDelft into becoming a lighthouse of innovation.

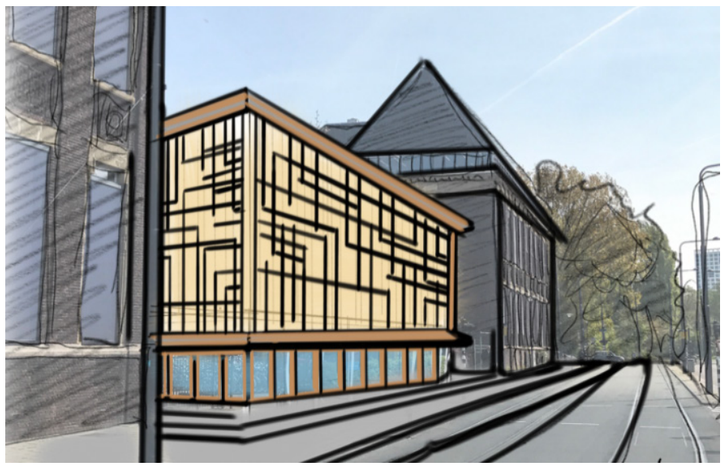
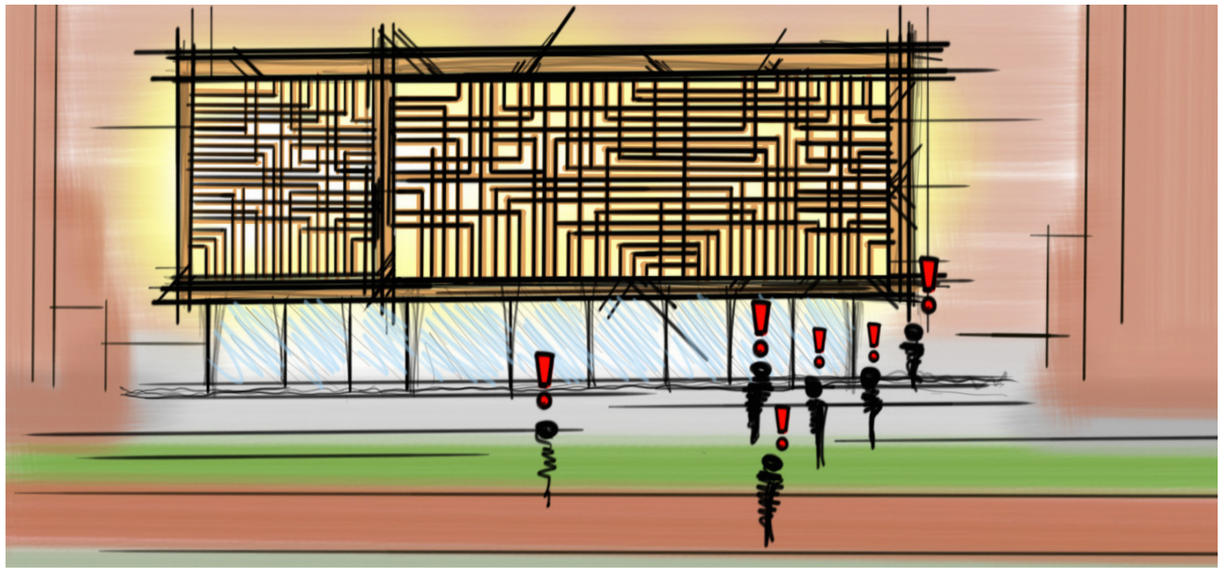


Fig 6. A sketch representing the vision towards the Bio-Based Lab's design of TuDelft

That is why, the aim of this report is to formulate a step-by-step approach for analyzing the interplay of kinetics and media in facade design. The focus is on developing abstract studies of forms which are either being in motion, in the spotlight, or completely static but interactive. The findings by this research can be integrated into the facade of the TU Delft Bio-Based Lab. This integration is crucial in achieving a facade that not only meets basic functional requirements like shading and protection but also serves as an interactive and engaging element for the public (p.3), since that is the main aim of the Bio-Based Lab's design. This facility, dedicated to wood structure studies, requires a facade that not only demonstrates innovation but also symbolizes the university's commitment to scientific advancement. The project aims to create a facade that is more than just a performance-driven structure; it should narrate the story of the activities and innovations happening within, serving as a beacon of creativity and scientific progress.



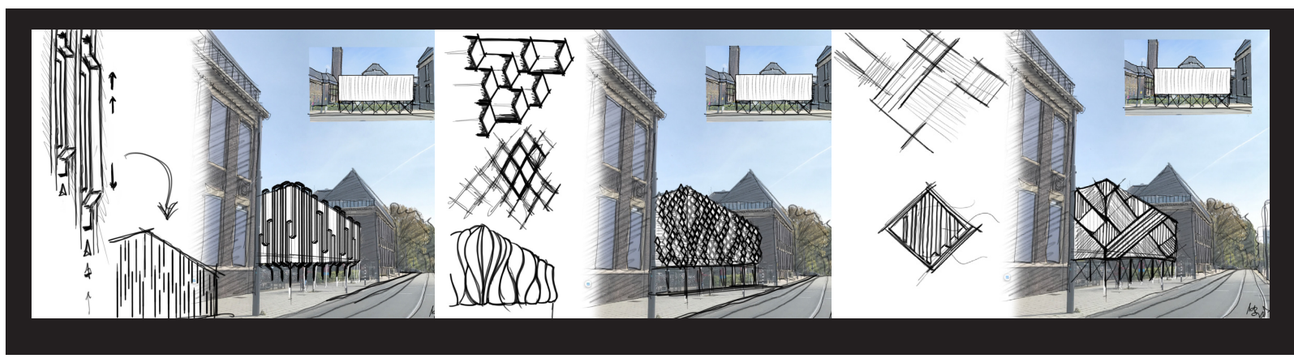


Fig 7. Illustration highlighting the sentiments of mystery and awe that the facade creates through its design pattern and lights alongwith some previous sketches of other concepts

Delving deeper in the realm of building skins, there are two important categories that should be highlighted, intelligent and media facades. In these we observe a dichotomy since intelligent are mostly kinetic facades whose intellectuality enables them to respond effectively to their surroundings. However, media facades can also be intelligent since there are times where the lights and projections are formed depending on their environment. In other words, intelligent facades, which are mostly kinetic are designed as responsive membranes adapting to environmental changes and user occupancy. This aligns with the trajectory of functionalism in architecture. On the other hand, media facades leverage technology to transform facades into urban-scale information screens or artworks, fostering zones of interactivity and engagement (p.9). A key aspect of intelligent facades is their ability to process inputs and outputs, a principle fundamental to facade design and crucial to our analysis (p.26).

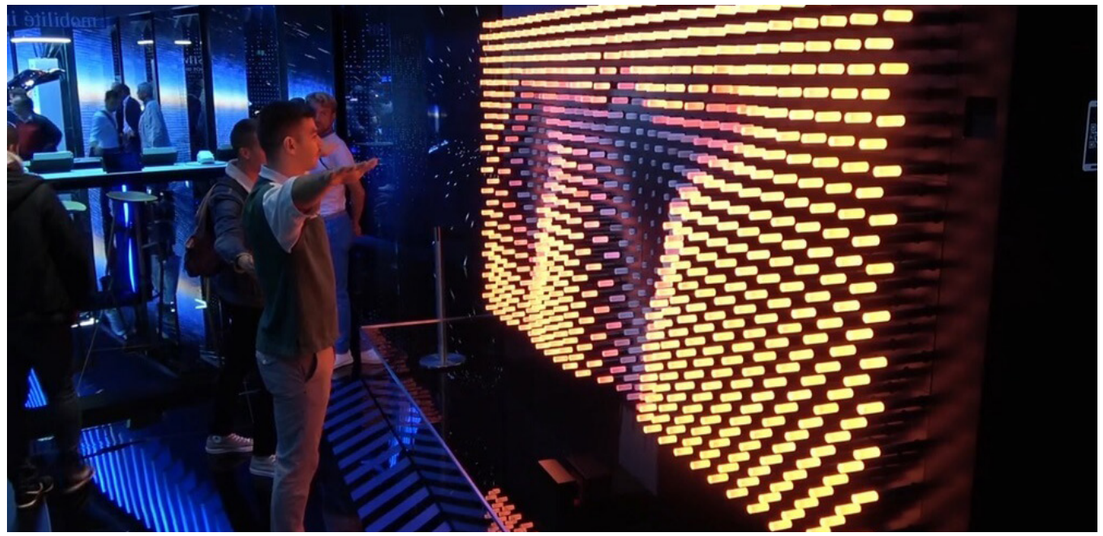


Fig 8. EQ Teaser, SOLIDSENSE, Example of facade merginf media and kinetics and interacting with the users

However, it is pertinent to note that the search for a truly adaptive and responsive intelligent facade remains ongoing. While many systems can process multiple factors and generate responses, they often fall short in their ability to learn from new data, a critical aspect in the evolution of intelligent facades. This challenge opens a debate on the extent to which buildings should even be considered intelligent entities, separate from their users (p.5, p.27).

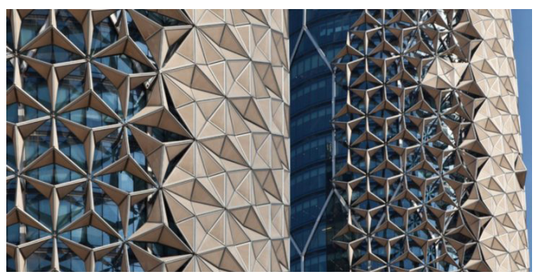


Fig 9. Al Bahr Towers, UAE, The project has little to do with sustainability and occupant satisfaction. Dazzle, Sand noises and poor mentainance

Therefore, in the design framework of the Bio-Based Lab, we have incorporated a kinetic feature that creates an interactive experience between the building and the passerby. This interaction is established through relatively static elements located at the building's end. Essentially, while these components do not move physically, they are designed to give the impression of movement or transformation when observed by pedestrians in motion. This dynamic visual effect is achieved by playing with the viewer's perspective, making static structures appear as if they are changing or moving. 10 This approach can be particularly effective in attracting people and stimulating interest because unlike passive observation, this design requires active participation. People need to move and explore different perspectives to fully experience the pavilion. This active involvement can be more engaging and memorable, as it requires physical and mental effort, leading to a deeper connection with the space, since the façade reveals different views or aspects when viewed from different angles. This creates a sense of mystery and discovery which feeds on natural human curiosity, encouraging people to move around and explore to uncover the full story or understand the building better. This illusion of movement and transformation can captivate passersby, drawing their attention and interest to the building.

Finally, the design principle of 'you need to act to find out' incorporates an element of reward. By moving and interacting with the building, visitors gain insights or views that are not immediately apparent. This sense of discovery can be very satisfying and can encourage people to engage more deeply with the building, due to the fact that the design plays with human perception and psychology by creating an environment where people feel they are uncovering something hidden or understanding a complex pattern. This is how we tap into deep-seated cognitive processes that find such activities rewarding and so on attract visitors.

Fig 10. Damiani-Holz & Ko, Modus Architects, Example of how a facade's texture can hide or reveal information depending on the viewer's perspective

PROJECT

Media Lighting Design

In addition to how the building itself will create this sense of unknown and discovery by interchanging depending on the perspective of the pedestrian, it also needs to communicate the mysteries of what may be happening inside, by using the media façade features. More specifically, the sounds happening on the interior will set the intensity of the LEDs outside. This way, by linking sound (audio) and light (visual), a multisensory experience is created since the integration of the two can be more engaging and memorable for passersby, as it appeals to multiple senses simultaneously. Furthermore, the varying LED intensities can serve as a visual representation of the intensity or nature of the activities inside. For example, a sudden brightening could indicate a burst of activity such as a chainsaw shredding a wooden beam, or a laser creating the new innovative wooden pattern inside, while a dimming might suggest a quieter, more contemplative moment. This can also create a unique ambiance around the building, enhancing the overall aesthetic of the area and contributing to a distinctive urban experience. Overall, this approach communicates the essence of what is happening inside without using words or explicit imagery, which can be more universally understood and appreciated, transcending language barriers.

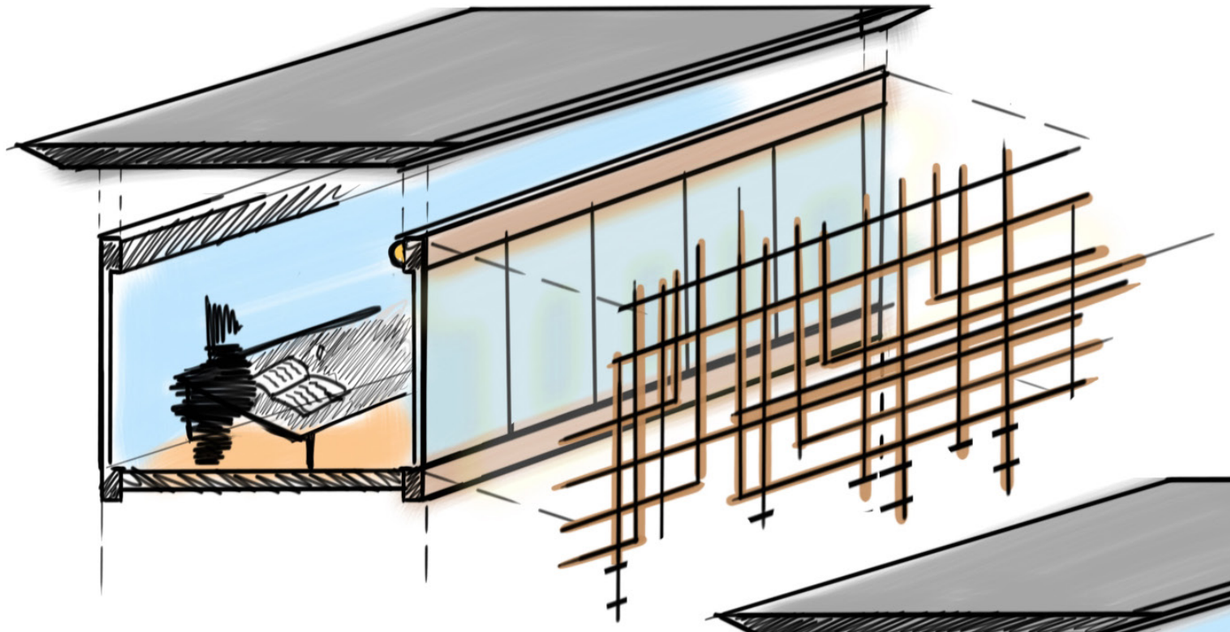
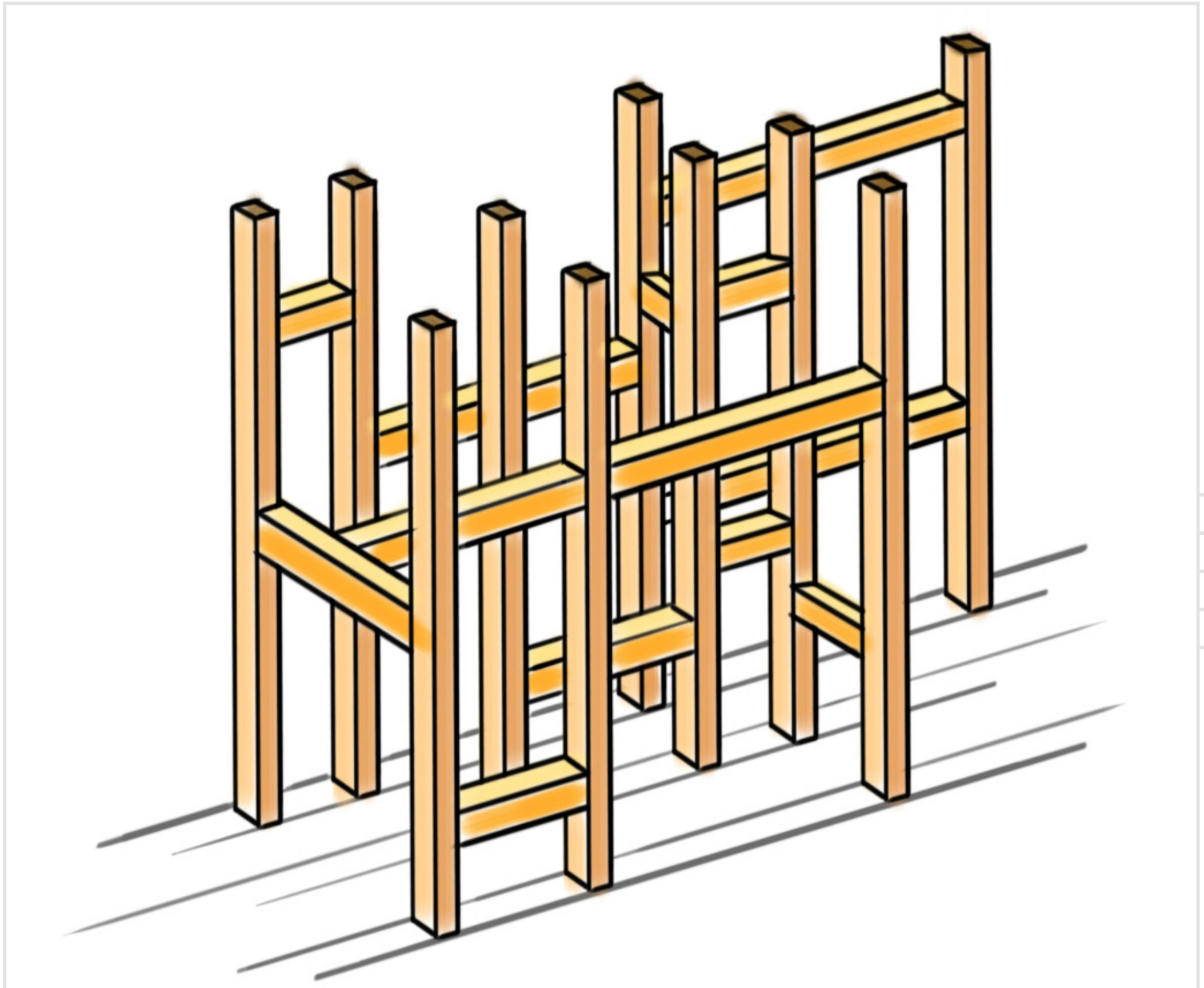


Fig 11. Illustration representing how the lights react to calm activities inside the pavilion

Fig 12. Illustration representing how the lights react to more intensive activities inside the pavilion



CHAPTER 2

Mechanics and Materiality in Kinetic Facade Design

In this chapter, we explore the intricate mechanics and diverse material choices that underpin the design of kinetic and media facades, examining both their functional and aesthetic implications. This investigation is particularly pertinent to the TU Delft Innovation Pavilion, where architecture must resonate with the university's cultural ideals and environmental ideals. The approach to materiality in architecture, as a blend of visible and invisible forces, invites continuous innovation and connection with societal values (p.35). For the TU Delft Wooden Lab's 'Lighthouse of Innovation,' the choice of wood as a primary material underscores this philosophy. As a result, having in mind these aesthetic and environmental values, as well as the design goals which where highlighted in chapter 1, the pavilion is visionized to be consisted of vertical slim slender wooden beams which blend with one another creating narrow openings. There will be 3 lines of vertical beams, placed back to back in random positions so that according to the place from which you observe the pavilion an opening would be formed to observe the inside or not.

Fig 13. Zoomed representation of the facade, pinpointing the materiliatiy and technicality of the project

The compositional potential of kinetic patterns in facades forms a central theme of this inquiry. That is because these patterns not only define the aesthetic identity of the facade but also influence its functional aspects (p.4). The concept of morphology, often associated with biology, finds relevance in architectural design, providing insights into the physical structure and appearance of kinetic systems (p.4). The challenge lies in developing a sophisticated design approach that harmoniously integrates movement, form, and functionality (p.9).

Furthermore, environmental considerations play a crucial role in the mechanics of kinetic facades. Commonly, these systems employ mechanically operated louvers or fins, with materials, profiles, and proportions varying based on design goals. Designers face a choice: embedding kinetic components within the facade to minimize aesthetic impact, or articulating them as distinct elements, enhancing the building's functional and aesthetic attributes (p.27). Often, the mechanical aspects of these systems are not a primary focus of aesthetic consideration, reflecting a traditional separation between architectural design and environmental engineering (p.6). From this point of view, in the case of our Wooden Pavilion a same process is followed where the layer of the wooden linear beams will be separate from the technical layers of protection from the exterior to the interior.

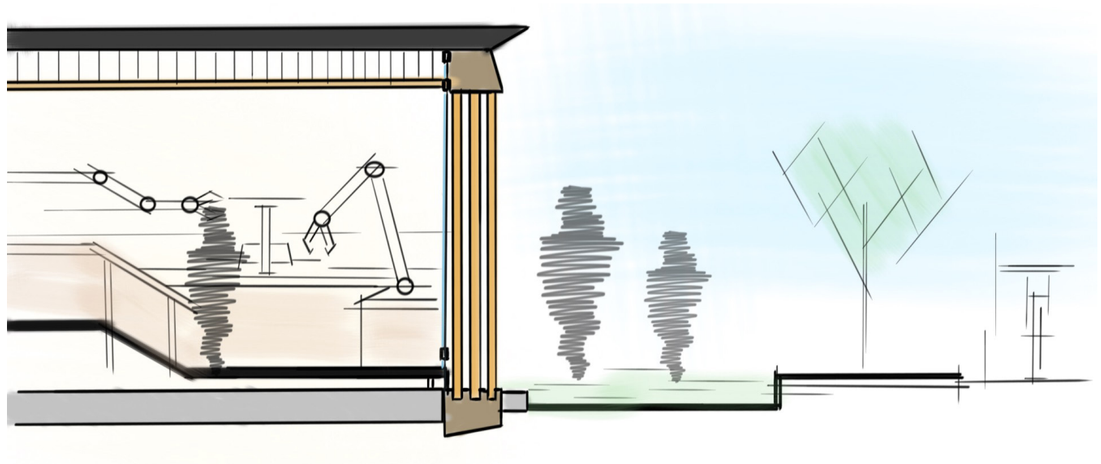


Fig 14. Sketch of how the layers of the facade could be organized with each other

Media facades, another facet of kinetic architecture, offer a different approach. They can be realized through dedicated screens or temporary projections, transforming building exteriors into dynamic displays. While some media facades are purely for advertising or artistic expression, others offer interactive experiences, although this interaction can vary in its implementation and complexity. As concerns the design of the Wooden Lab, this interactive experience which is related with the communication of the interior to the exterior will be achieved by slim linear neon lights installed inside the wooden beam's hidden spaces. These light's intensities will be set by the sounds of the facility which in some cases could be an intense chainsaw use to cut a wooden beam, or more pattern-based by the pumping of a hammer.

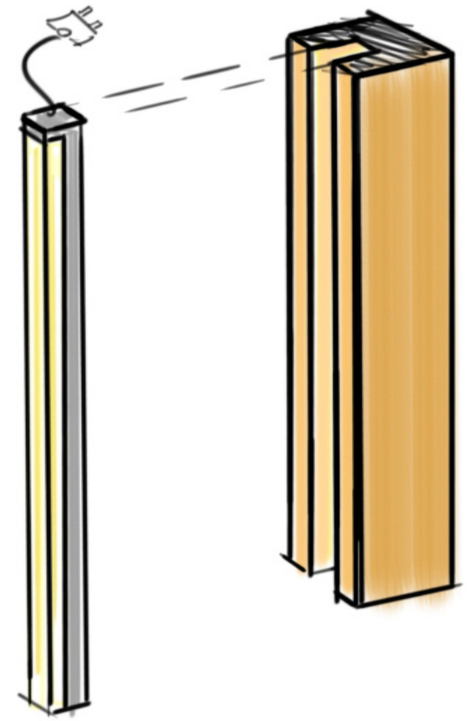


Fig 15. Instance of how the hidden lighting could work within the timber beams

CHAPTER 3

Fig 16. Jewish Museum, Berlin, Studio Liberskind, Example of how a building's facade can captivate emotions and tell a story

Historical, Theoritical and Technical Tools of Kinetics

A comprehensive study of façade technologies necessitates an in-depth exploration of their historical evolution and significance. Understanding the historical context provides essential insights into the development and application of various façade technologies, allowing for a more nuanced appreciation of their current innovations and applications. We start with the integration of kinetic facades in modern architecture, which symbolizes a harmonious blend of dynamic aesthetics and functional pragmatism, marking a pivotal shift in architectural design and interaction with the environment. Therefore, this section delves into the historical development and theoretical underpinnings of kinetic and media facades. We explore their origins, tracing the journey from early avant-garde movements like Italian Futurism and German Expressionism to contemporary adaptations, which underscore the transformative influence of these facades in shaping architectural narratives, where movement and interactivity are integral to design (p.60, p.61).

Chapter 3: Part 1

The history of kinetic art, dating back to early 20th-century avant-garde experimentation, sets the stage for understanding the evolution of movement in architecture. Naum Gabo's Realist Manifesto and his pioneering work in kinetic sculpture laid the foundation for this artistic genre that underlines the diversity of kinetic arts, classified into categories like virtual/real, spatial/non-spatial, and predictable/non-predictable, mirrors the complexity and variety found in kinetic facades. These categories include simple mechanical movements, electro-mechanical systems, and light-based effects like projections and refractions (p.62)

In architectural theory, the concept of kinetics differentiates itself from other forms of movement and time. This distinction includes several approaches: the transformation through occupation as framed by Bimands Tchumi, the physical movement of occupants, the optical effects of environmental changes, the aging and weathering of materials, and the dynamic representation of movement in forms and surfaces. In addition, kinetic facades incorporate these principles through geometric transformations - translation, rotation, scaling - and material deformations, creating a spatial dialogue between the building, its occupants, and its environment (p.7).

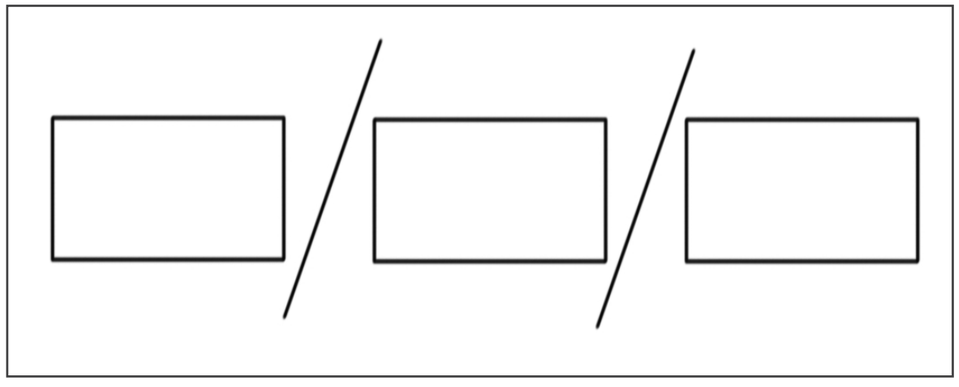


Fig 17. Graph of the kinetic approaches

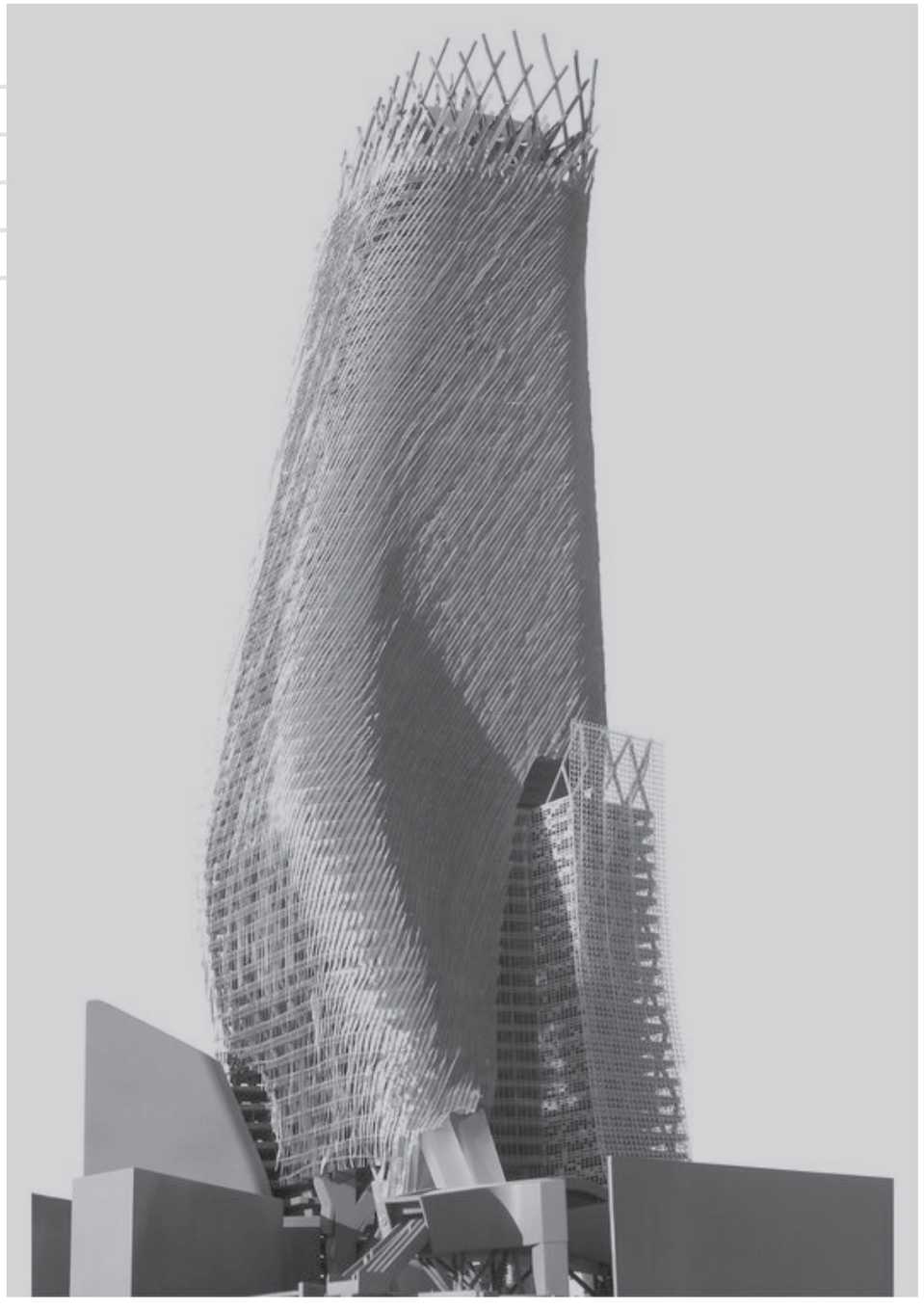


Fig 18. Phare Tower, Paris, Morphosis Architects, an Example of Avant Garde's Architecture that remade 20th century design

Chapter 3: Part 1

While grasping the methods and essence of kinetic facade design is crucial, the paramount challenge in this field also transcends into scientific and technological realms. The true test lies in the aesthetic domain, where blending technology and functional logic with a sense of poetry distinguishes ordinary buildings from architecturally inspirational ones. This aesthetic challenge, as articulated by Antonio Sagio, involves imbuing interactive architecture with an artistic essence (p.33).

The environmental performance agenda often drives facade design, continuing the functionally driven trajectory of architecture as a scientific discipline. However, this approach can render such facades socially inert, lacking engagement despite their kinetic potential, as seen in the Nordic embassies complex in Berlin (p.28). As a result, kinetic facades must balance enhancing environmental performance with social functionality (p.27).

Fig 19. Nordic Embassy, Berlin

Chapter 3: Part 3

The design of movement in kinetic facades is a sophisticated endeavor, aiming to seamlessly connect interior and exterior spaces. This connection is encapsulated in terms such as 'Envelope', 'Curtain Wall', 'Skin', and 'Facade', each carrying distinct connotations from structural roles to intelligent environmental systems (p.8), which are also many times characterized as dynamic. That term in kinetic architecture is characterized by engineering that emphasizes minimal yet impactful motion, as seen in structures where components elegantly fold in on themselves (p.29). The control systems that drive these movements are diverse, ranging from simple mechanical hinges to complex algorithmically mediated networks with learning capabilities, as outlined by Michael Fox of MIT's Kinetic Design Group (p.29). However, dynamic gestures from the building to its environment as mentioned above could also be achieved by staticity.

Dynamic architecture is an evolving domain in modern design which encompasses architectural structures with moving elements, enabling transformations in shape, appearance, or functionality. Such movement can be mechanical, as seen in rotating floors or walls, or based on responsive systems that adapt to environmental stimuli like sunlight or wind. The essence of dynamic architecture lies in the physical metamorphosis of the structure itself (p.56).

On the other hand, there is the concept of interactive architecture, which prioritizes the relationship between the building and its users or environment. Interactive architecture is characterized by its responsiveness to human presence, behavior, and environmental conditions, creating an adaptive user experience. That is why, buildings, in this framework, are viewed as a series of input-processing-output devices, as conceptualized by the Hyperbody Research Group at TU Delft (p.30). Both dynamic and interactive designs challenge architects to blend technical finesse with innovative thinking. The aim is to create prototypes that are not only robust and environmentally efficient but also subtly aesthetic in their movement. This concept is exemplified in designs like Gerrit Rietveld's Schroeder House, where operable windows transform the conventional roles of architectural elements, creating a dynamic interplay between the interior and exterior (p.43). The overarching goal is to achieve a harmony of utilitarian function and poetic composition, making each structure a living, responsive entity (p.37)

Fig 20. The Da Vinci Tower, Dubai, David Fisher, Extreme example of dynamic architecture

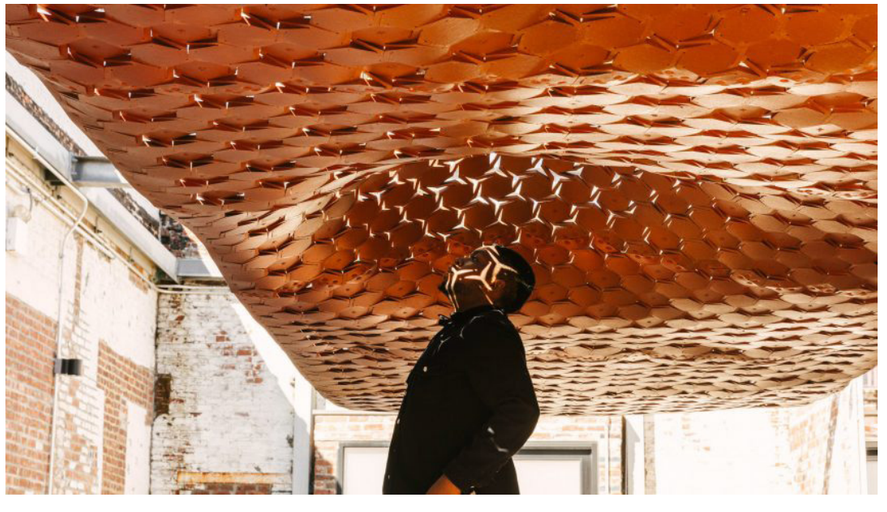


Fig 21. When visitors step into Studio INI's installation Urban Imprint, a canopy opens up above their heads, Example of interactive architecture

Chapter 3: Part 4

Another pivotal aspect of kinetic facade design is its vocabulary and the choice of tools, both of which are deeply rooted in the design's thematic essence. More specifically, kinetic facades are temporal, constantly in flux, aligning them with the arts of time rather than spatial arts. This temporal nature brings to light analogies with other temporal arts, such as music, highlighting the fluidity and rhythm inherent in kinetic design (p.58). This specific example is mentioned to highlight the fact that inspirational cues for movement in kinetic facades can be drawn from diverse sources. Another example could be that of George Rickey's analogy concerning a ship at sea, which not only provides a precise description of movement but also evokes a specific aesthetic, suggesting a poetic approach to the movement in kinetic architecture (p.69). This approach extends to understanding the irreversibility of time in motion, challenging traditional architectural symmetries and compositions (p.69).

The intricacies of kinetic design are reflected in the patterns of motion arising from the interplay of multiple components, whether those are translated, rotated, or scaled, contributes to the overall choreography of the facade. The synchronization and timing of these movements are akin to a composer's orchestration of sounds or a painter's blend of colors, with the computer serving as a tool for the kinetic designer to explore algorithmic possibilities (p.70, p.71).

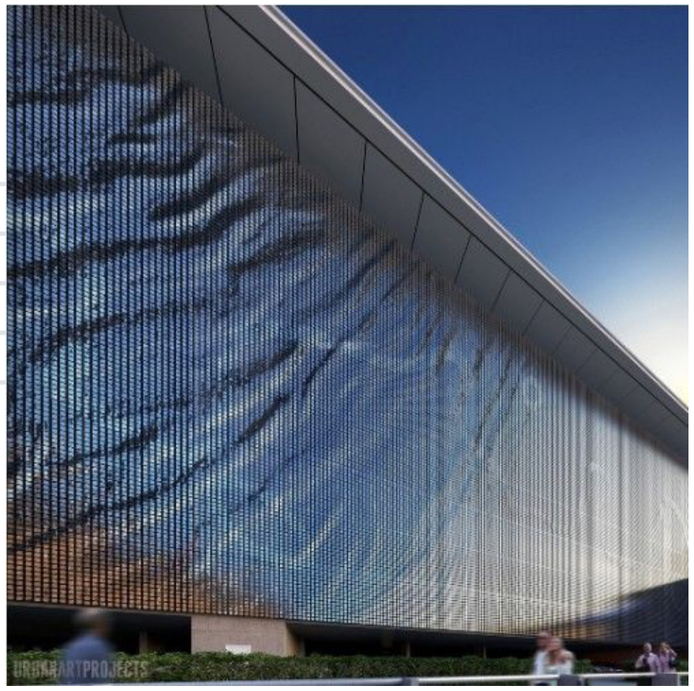


Fig 22. Brisbane Airport, Australia, UAP + Ned Kahn, Water Architecture

Fig 22.5. Pittsburgh Children's Museum, Wind Architecture

Fig 23. The Designs Inspiration, a Field of Woods

Chapter 3: Part 5

The findings of kinetic façade's history and theory gave impetus for the Bio-Based Lab's façade to hold a historical identity. Above all kinds and theoretical variations presented above. The main scope of the Pavilion in question will its ability to form architectural narratives and tell a story, via its real spatial and non-predictable gestures which are coming to life by the physical movement of the occupants. When it comes to the environmentally driven agendas that are mostly followed in the design process of a building skin, in this project the aesthetic aspect will be equal and even some times superior to health and comfort values. Although its sustainable and protecting nature, with the wooden linear dense beams shading the structure while maintaining a low carbon footprint may indicate otherwise, the main scope of the pavilion would be the awe it creates to the visitors and students of the university via its aesthetics. That could also be understood by its dynamic nature which is shaped by a specific vocabulary which is based in sounds and human motion, meaning that the LED lighting installed in the façade will change depending on the sounds inside and the static form of the façade would interchange depending on the perspective of the pedestrian.

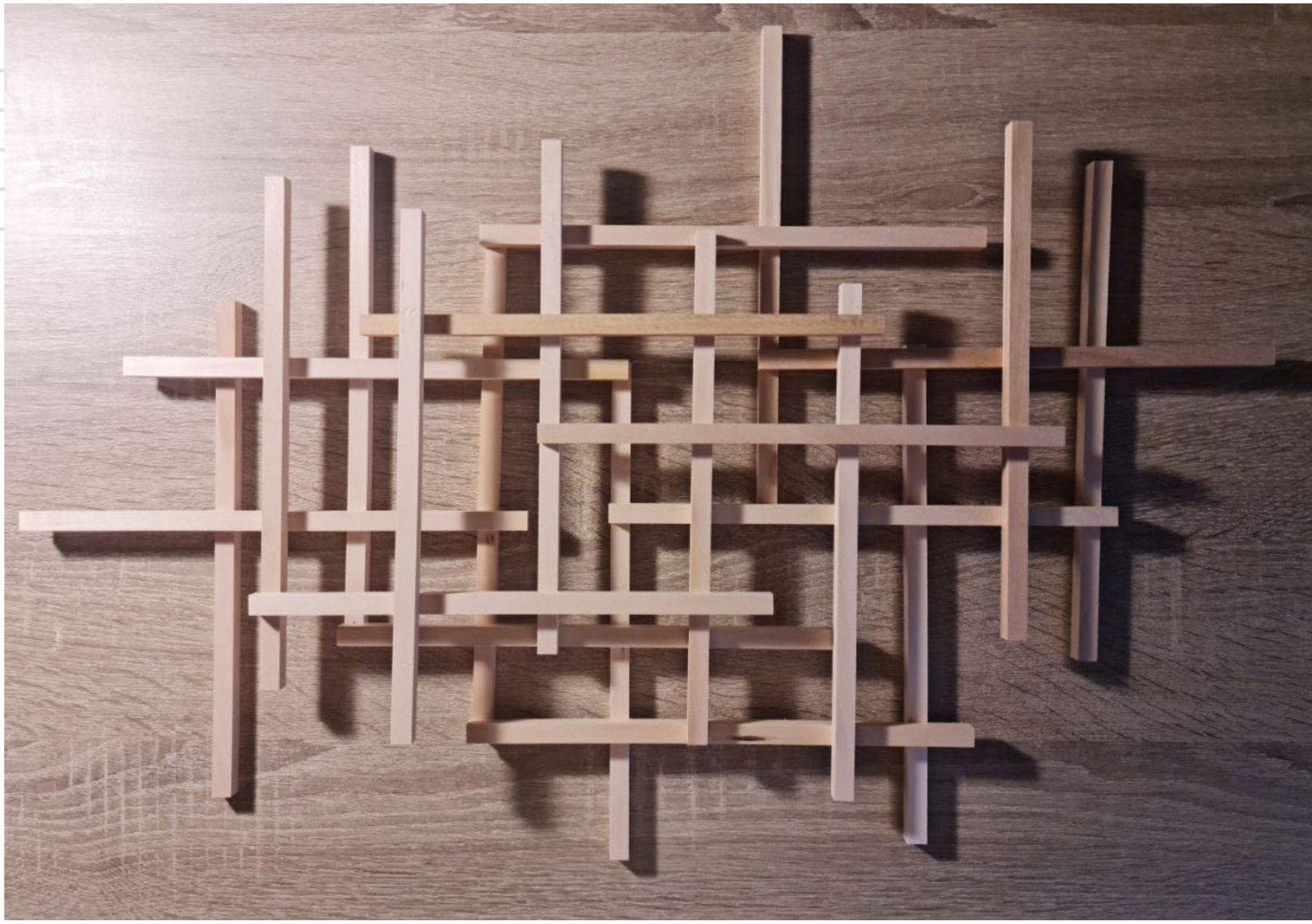


Fig 24. Froom the wooden pattern of a forest to the timber pattern of the pavilion's facade

Fig 25. Time Square, Example of how big flashy screens and lights overshadow the design behind them

CHAPTER 4

Mechanics and Materiality in Kinetic Facade Design

The design of kinetic and media facades represents a paradigm shift for architects, who have traditionally sought the optimal balance between static performance and aesthetic elegance as long as they introduce a dynamic process that actively engages with its users and responds to changing environmental and socio-cultural conditions. This design approach necessitates a deep understanding and manipulation of three interconnected elements: the input and how it is 'sampled', the logic of the control system processing this data, and the building materials' response to these controls. Unlike conventional architecture where the focus is often on the final physical form, kinetic facade design demands a holistic involvement in both the control systems and the physical components to realize its full potential (p.80).Having that in mind, in the case of the Lighthouse of Innovation that is designed for the TuDelft, the input of its interaction would be the sound from within, the logic of the control systems are sound-wave sensors that would adjust the lights accordingly and the materials used for this process would be mainly the LED slender neon lights and the wooden beams.

Chapter 4: Part 1

Something worth noting in this stage would be the fact that apart from the term 'dynamic' façade that was introduced above, there is another one really similar but yet different, 'Interactive' façade. Interactive kinetic and media facades, particularly, bring the audience to the forefront, allowing them to influence and create content, fostering communal engagement. However, the prevailing use of public displays for advertising has overshadowed their potential for interactive urban space enhancement.

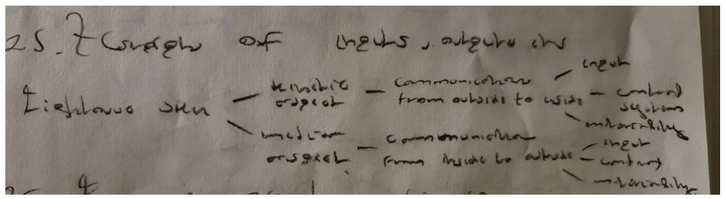


Fig 26. Graph of Facade's inputs, control systems and materiality

Despite this challenge, new-media art and Human-Computer Interaction (HCI) research are exploring interactive methods to invigorate urban public spaces. These approaches emphasize the potential of public displays to contribute value to urban environments beyond mere information dissemination (p.1, p.2). Furthermore, the integration of media technology in urban settings has predominantly followed the paths of spectacle and surveillance, often relegating citizens to passive roles. Contrarily, architectural design has the capacity to promote social and cultural values such as inclusion, identification, and participation, addressing critical societal issues and fostering social change (p.2). That is why, in the design process of the pavilion the media aspect of the façade will not be big screens or large projectors that would prevail over the story the façade will aim to express, its aesthetic or its surrounding environment.

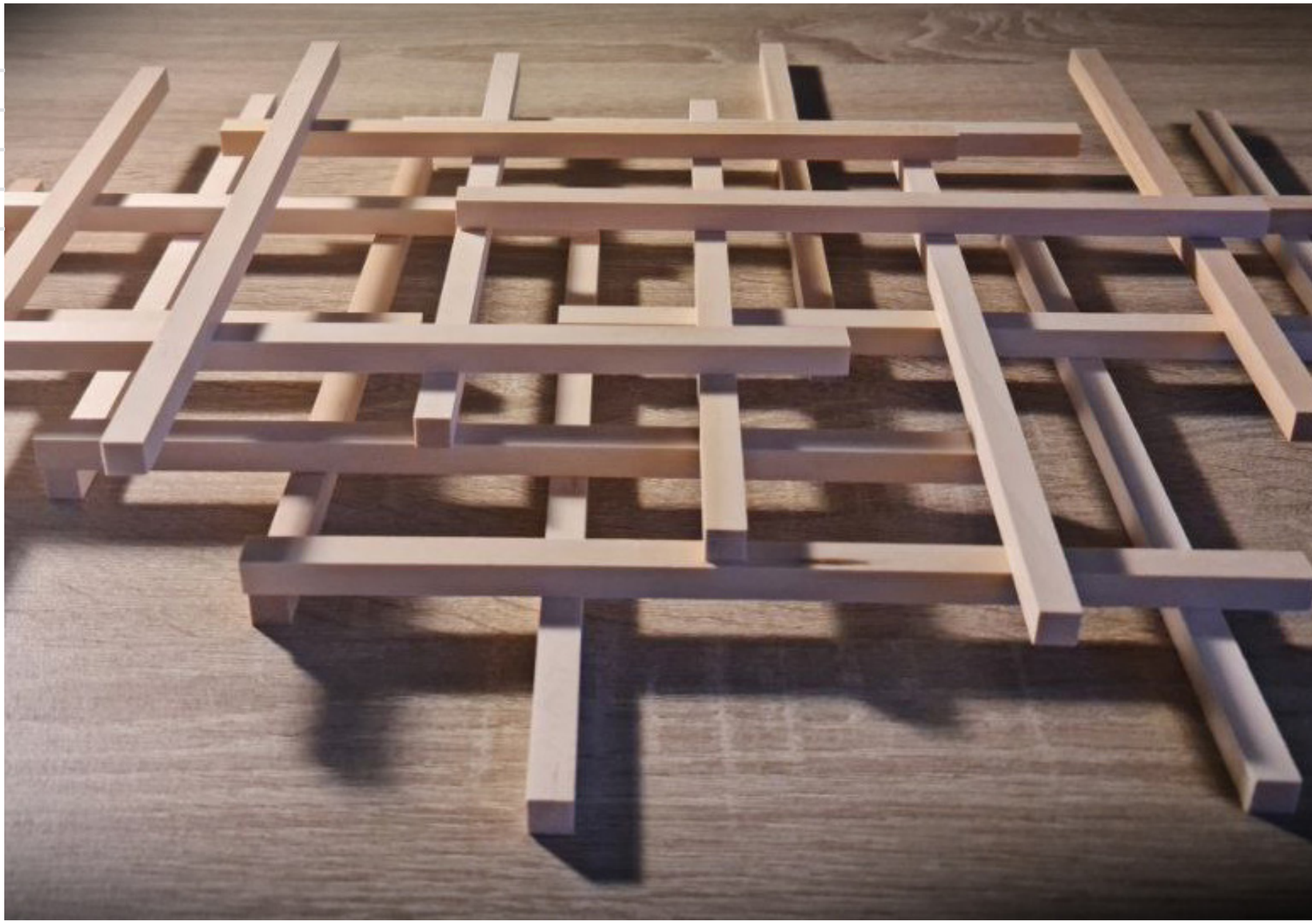


Fig 27. Kinetic and media aspects of the facade balancing with each other to promote the university's values without overdoing it

Chapter 4: Part 2

This section examines how the scale and structure of public spaces impact social dynamics, particularly in relation to kinetic facades. The behavior and movement of people in spaces like plazas and walkways are significantly influenced by the design and functionality of these facades. More specifically, in plazas, people often seek a narrative or development, engaging more deeply with the installations. This contrasts with the behavior in walkways, where interactions are typically brief and require immediate clarity (p.6).

The role of the spatial environment is crucial in determining the success of interactive technologies in large spaces. Pervasive technologies in architecture tend to focus on screen-based interactions, often neglecting the holistic integration with their surroundings. This approach should consider not only the placement of screens but also how they interact with the architectural environment (p.6).

Designers must also consider the various spatial zones within public settings: comfort spaces that offer physical and psychological ease, gap spaces that create distance, and activation spaces that arouse curiosity but limit interaction. The strategic placement and design of these spaces can significantly influence how people interact with the media facade and the broader environment (p.7). This understanding is essential for creating engaging and effective urban media facade installations.

Fig 28. Apple Central World, Bangkok, buidling whose landmark design in relation to the surrounding scale and structures impact social dynamics

Chapter 4: Part 3

This section explores the evolution of media facades from mere advertising platforms to dynamic communication tools within urban landscapes. Media facades, blending media, technology, art, and architecture, have transformed urban spaces into new forms of communication platforms, altering public perception. Initially emerging from experimental art installations, these facades have evolved into powerful tools for mass communication and advertising, creating a new urban spectacle (p.1).

The discussion pivots around three key impacts of media facades: as platforms for communication, influencers of public perception, and shapers of urban spaces. The shift from traditional advertising methods like billboards and neon signs to integrated media facades represents a significant change in how architecture communicates with society. These facades, now embedded with digital technologies, have become integral to building exteriors, contributing to the urban aesthetic and serving as new forms of ornamentation and cultural expression (p.2).

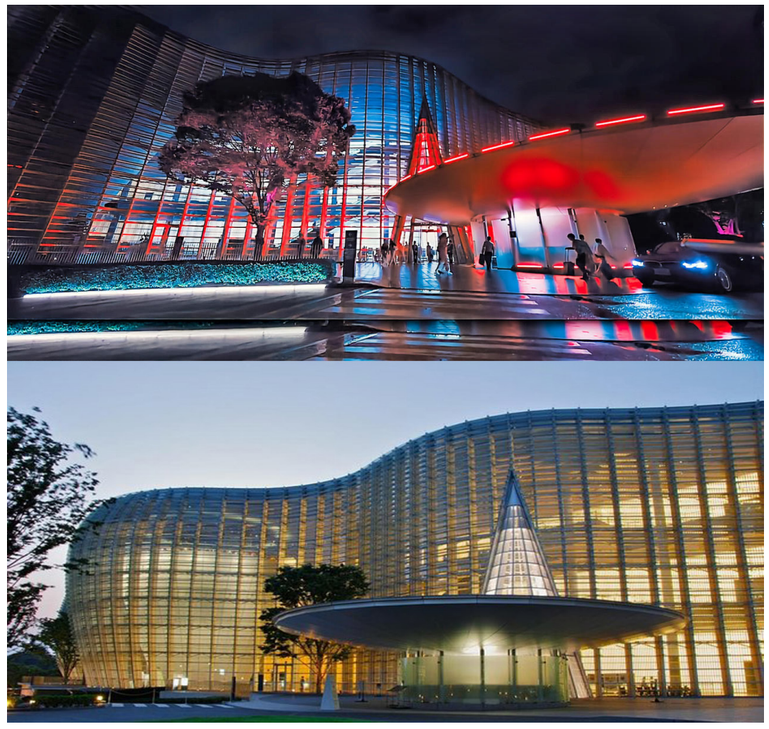


Fig 29. MegaFaces Pavilion, become the face of the Olympics 2014, Asif Khan, SEGD, Designers of Experiences

Fig 30. National Art Center, Osaca Continental from Movie John Wick, Tokyo, Example of how media aspects connect with the architecture and alter it.

The integration of media within architectural design signifies a new era of public engagement, where the building itself becomes a medium of communication. This shift from static architectural messages to dynamic, interactive displays marks a transition in the role of architecture in society (p.3, p.4). The resultant spectacle, where buildings serve as brand images and interactive entertainment platforms, redefines the relationship between society and urban architecture (p.4).

Fig 31. The Sphere, Las Vegas, Example of extreme media facade advertisment

Media facades have transitioned from mere backdrops for digital billboards to primary spectating objects, presenting both challenges and opportunities in urban design. These facades function as dynamic communication tools, reshaping urban spaces and altering public perceptions (p.5). The development of media facades encompasses various aspects: communication, ornamentation, flexibility, ephemerality, sustainability, and location, each playing a pivotal role in their design and impact (p.5, p.7, p.8).

The integration of digital media as an architectural element has led to the creation of "dynamic digital ornaments," offering flexibility and reconfigurability in building design (p.7). Unlike static advertising, media facades provide changeable and ephemeral content (p.8). The use of LEDs, while energy-efficient, poses challenges in terms of illumination effectiveness and image resolution (p.8). Media facades also raise questions about the sense of place in an increasingly connected world, where local culture and site-specificity are crucial considerations (p.8). By day and night, these facades create distinct atmospheres, becoming landmarks that reinforce local identity (p.8).

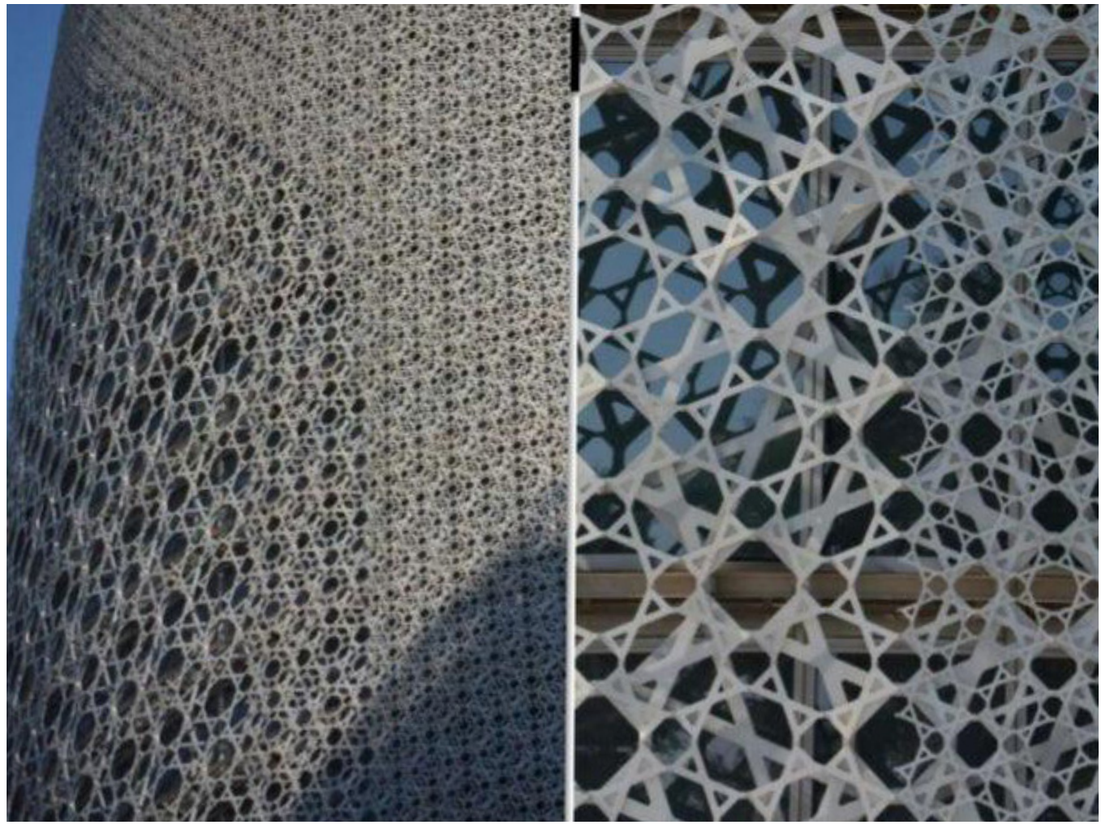


Fig 32. Mashrabiya, example perception of kinetic ornamentation in Architecture

As a result, the concept when designing the Bio-Based Lab, taking into consideration all the above information concerning the value and delicate handling of such strong performing tools of great urban scale such as the media facades, a hybrid environmental-media façade is proposed, that presents the convergence of advanced digital fabrication technologies with architectural design, fostering a blend of the digital and physical realms (p.9). The goal is to advance the design and functionality of media facades through innovative construction, control, and simulation methods, bridging the gap between art, architecture and façade design (p.1, p.3).

Fig 33. Visualization of how the Pavilion could merge smoothly the two facade aspects setting a calm, minimal and innovative design

CHAPTER 5

Case Studies and Insights in Kinetic Facade Design

Children's Museum of Pittsburgh: This project showcases a facade designed to engage children, integrating principles of basic physics and environmental awareness. The facade, made of acrylic resin flaps, creates a dynamic, visually appealing structure without the need for complex control systems (p.94).

The design of the Wooden Pavilion's façade is conceptualized to serve as an educational tool about woodworking. The façade features linear wooden beams arranged in a manner that demonstrates various types of wood joints. As these beams intersect — with vertical ones connecting to horizontal ones — they collectively exhibit a range of joining techniques. This design is intended to be instructive for students passing by; it visually presents the diverse possibilities of wood connections. By merely observing the façade, a student can gain initial insights into woodworking, potentially sparking their interest to learn more and engage hands-on with woodcraft. This architectural element is not just a structural component, but a living educational display, inviting exploration and study of the art of woodworking. (p.114).

Fig 35. Rough Design of How the Wooden Facade's Joints Could Work.

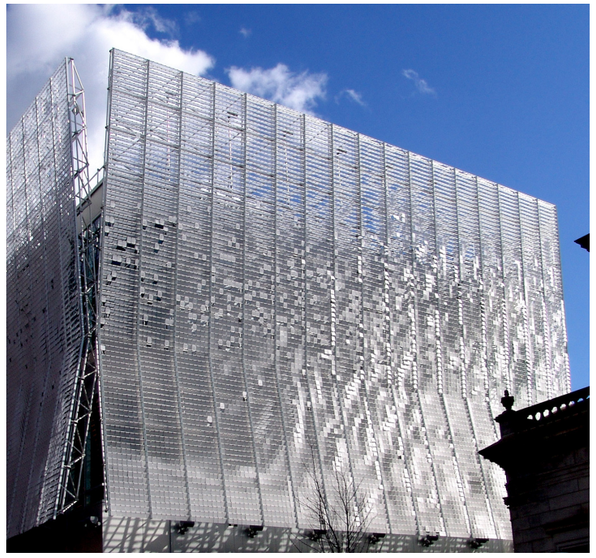
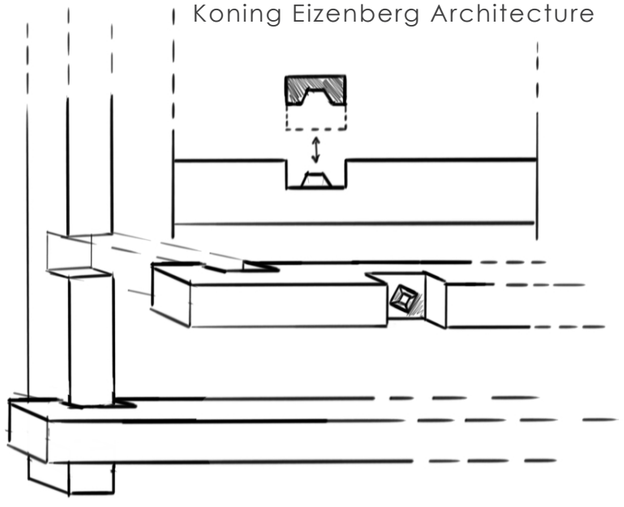


Fig 34. Children's Museum, Koning Eizenberg Architecture



The same way the design DNA of the bridge is the same as of its surrounding environment, so will the design of the Wooden Pavilion will be derived from the nature of the TuDelft Campus. That means, that flashy and open colors, complex forms and extreme lighting will overthrown by minimalist design and natural shapes.

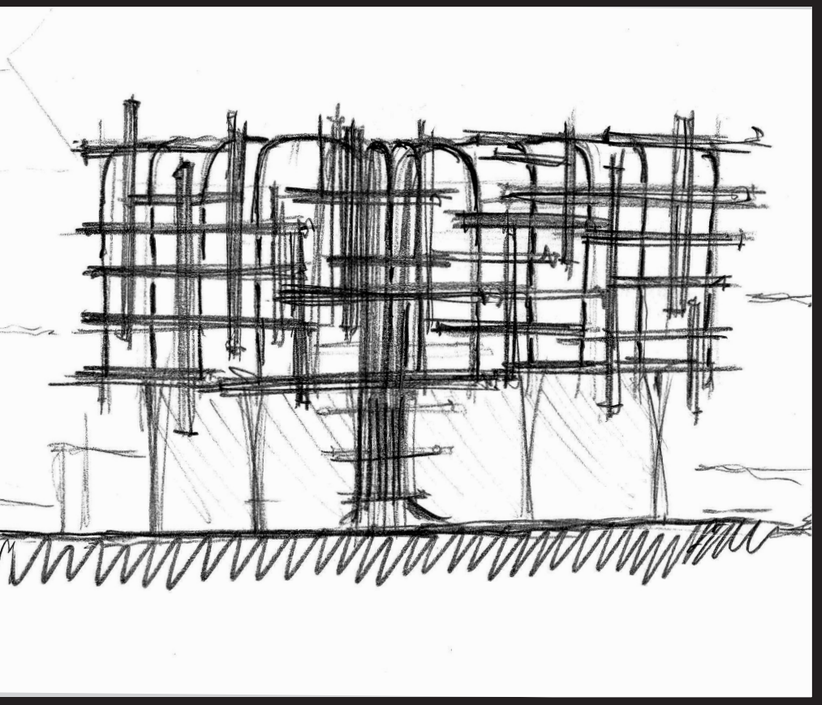
Fig 36. Café-restaurant OPEN, Amsterdam, Architekten Cie

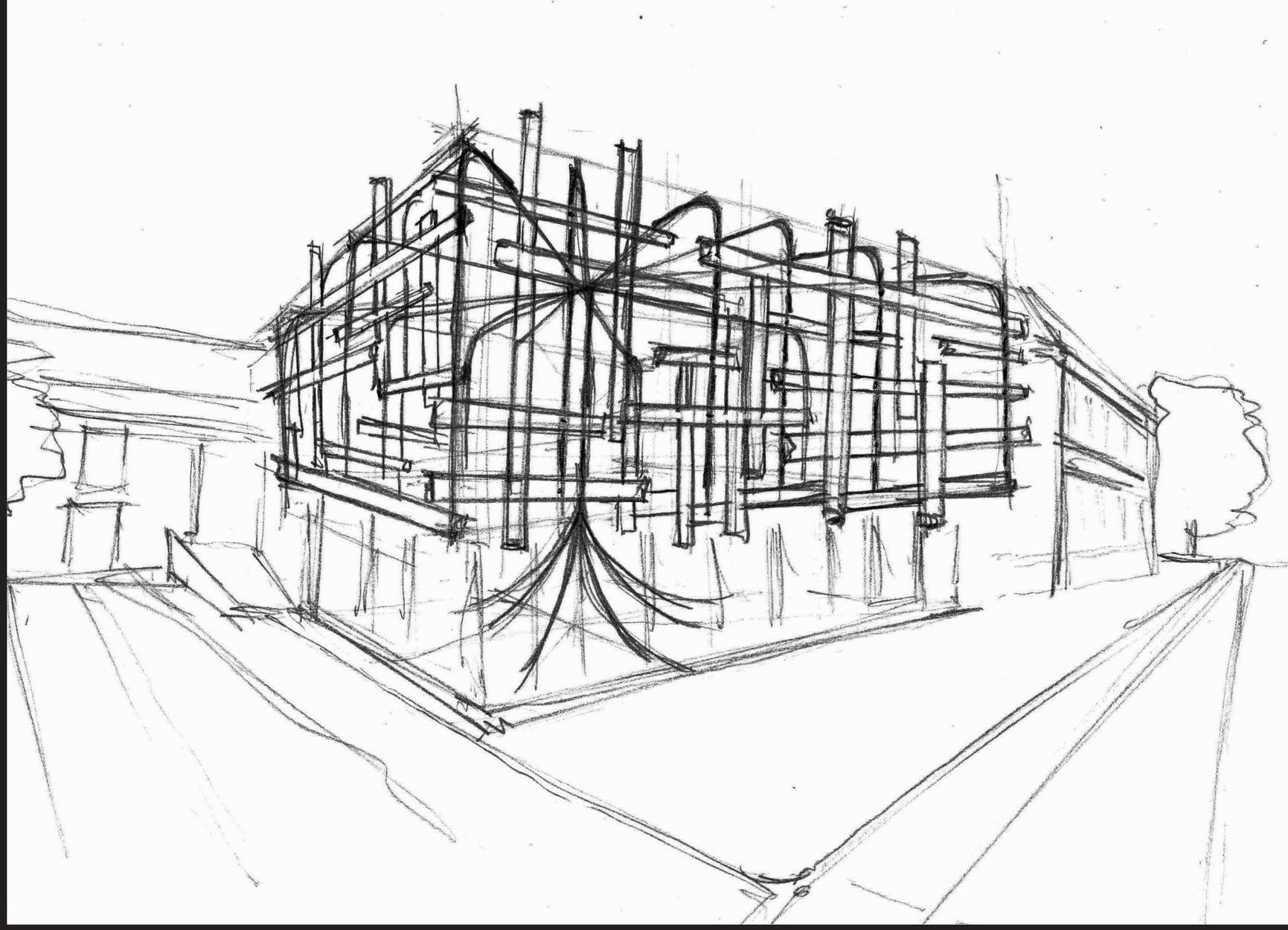
Council House 3: Known as Australia's most sustainable building at the time of its completion, this project is a testament to the effective combination of radical technologies and passive design. Its design principles, rooted in biomimicry, focus on natural ventilation and solar control to maintain a comfortable interior (p.138).

Fig 37. Counsil House 2, Melbourn

CONCLUSION

This design inspires the merger of functional with aesthetic design in the case of our façade. The way it mixes different materiality such as steel and wood, and maintains a comfort interior with an aesthetically pleasing and sustainable exterior will be thoroughly studied for the design process of the bio-based lab.





All in all, the focus is on the use of digital and static components in the design of the Pavilion to make it responsive. These innovative materials enable the facade to adapt to environmental conditions, whether that's the sound from within or the perspective of the pedestrians passing by, and serve as a communicative display. The discussion revolves around the concept of permeability in architectural skins, exploring how they can moderate the relationship between the interior and exterior of a building as well as what input, output, vocabulary and materiality needs to be considered when designing them. Therefore, after making a thorough research on the historical, theoretical, psychological and urban spectrums that concern the kinetic and media facades. The idea is to achieve a visual communication effect similar to conventional media screens but through 'soft' active and passive materials embedded in wooden beam structures, thereby redefining the traditional one-way communication role of building facades (p.1, p.2, p.9).

INSPIRATIONAL OVERVIEW

SECTION

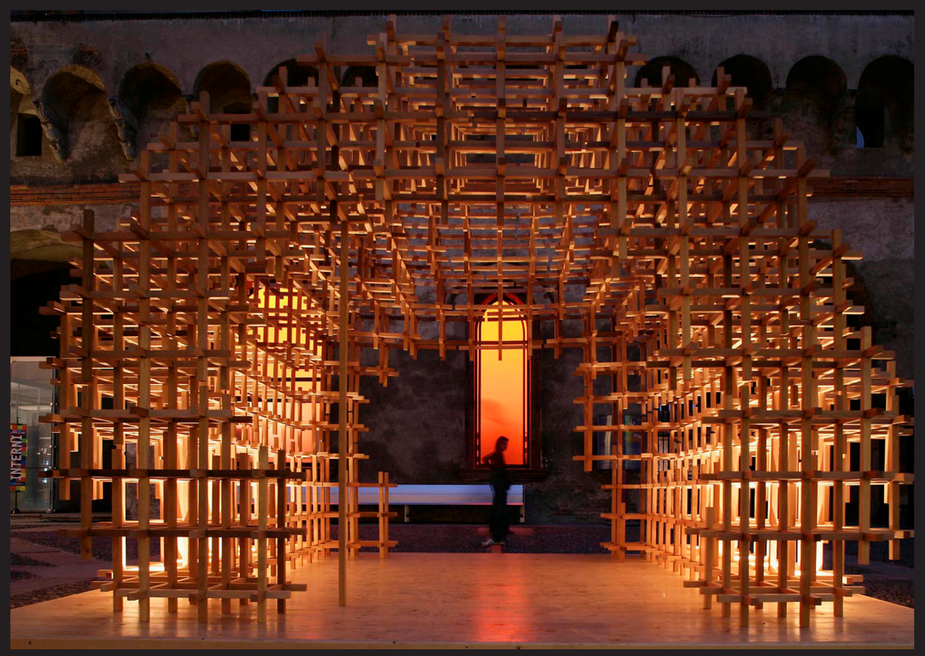
Taketa Museum and House of Wooden Lattice

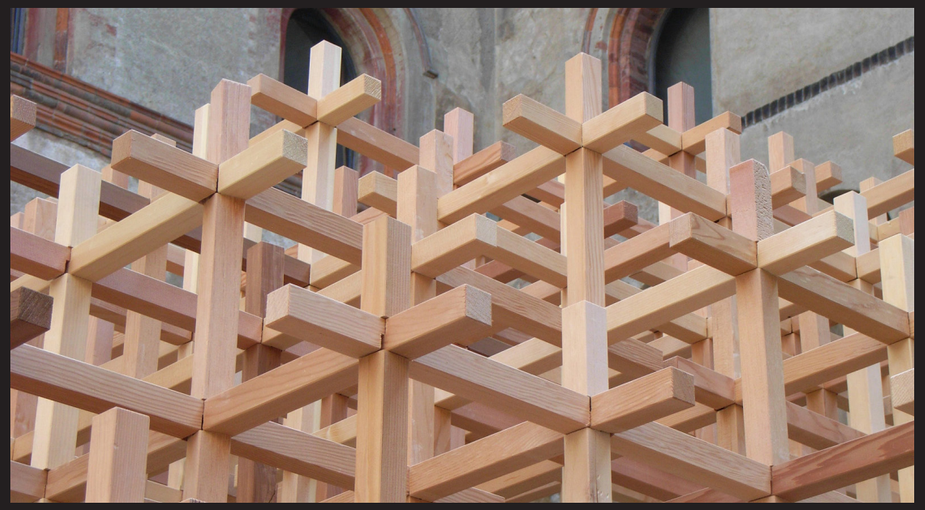
On the right, the house of Wooden Lattice is presented from which comes the inspiration for a timber 3D-Based designed facade where the beams that are envisioned to be in the outer skin of the bio-based lab can be installed in both axis, not just one. On the left, we see the Taketa History and Culture Museum. The bamboo pattern throughout the pavilion's skin is the perfect example of the scoped transperancy based on the perspective of the passer-by, the bio-based wooden lab is aiming to achieve. when looking closiely in the two photos of the left, we see that on the top one something is starting to appear of what is happening inside, while on the bottom one from the specific perspective, this is far from the case.

INSPIRATIONAL OVERVIEW

SECTION

Cidori Pavilion, Kodama Pavilion and Grand Seiko Boutique





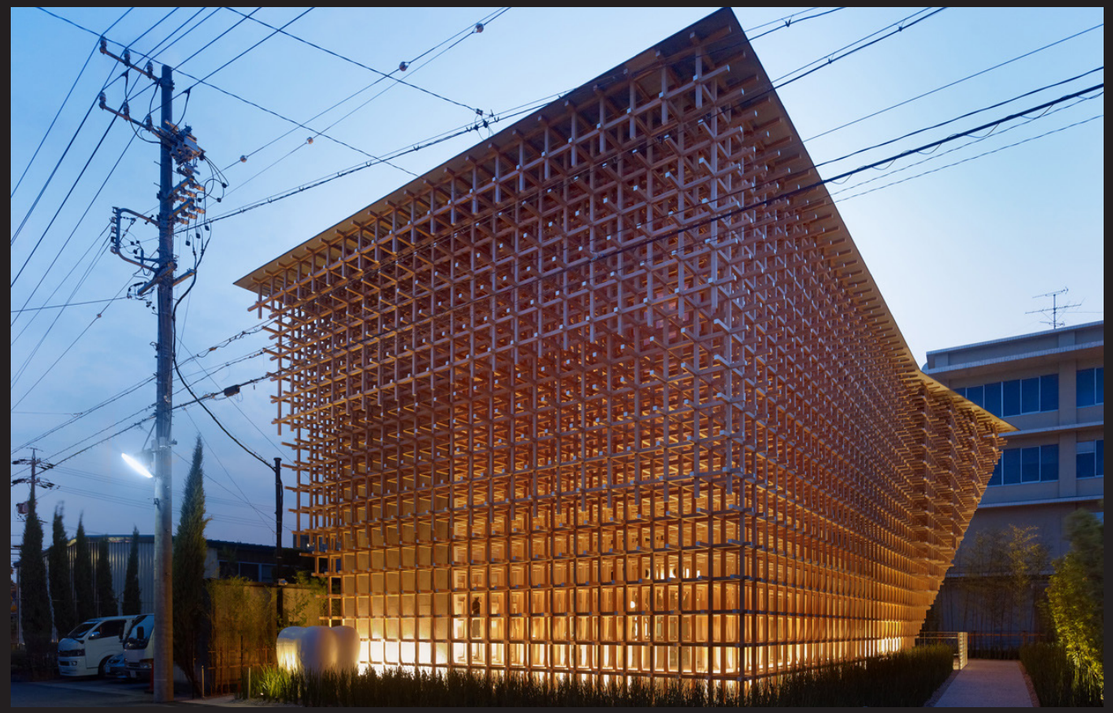
On the upper right we see Grand Seiko Boutique Vendome in Paris. For distinguished experience on "Japanese watch brand", bamboo sumushiko and tatami were selected as main materials. The transparency but at the same time space limitation is what inspires the facade of the Bio-Based lab to work as a display platform. The other two pavilions named as Cidori and Kodama are analyzed for their joints.

INSPIRATIONAL OVERVIEW

SECTION

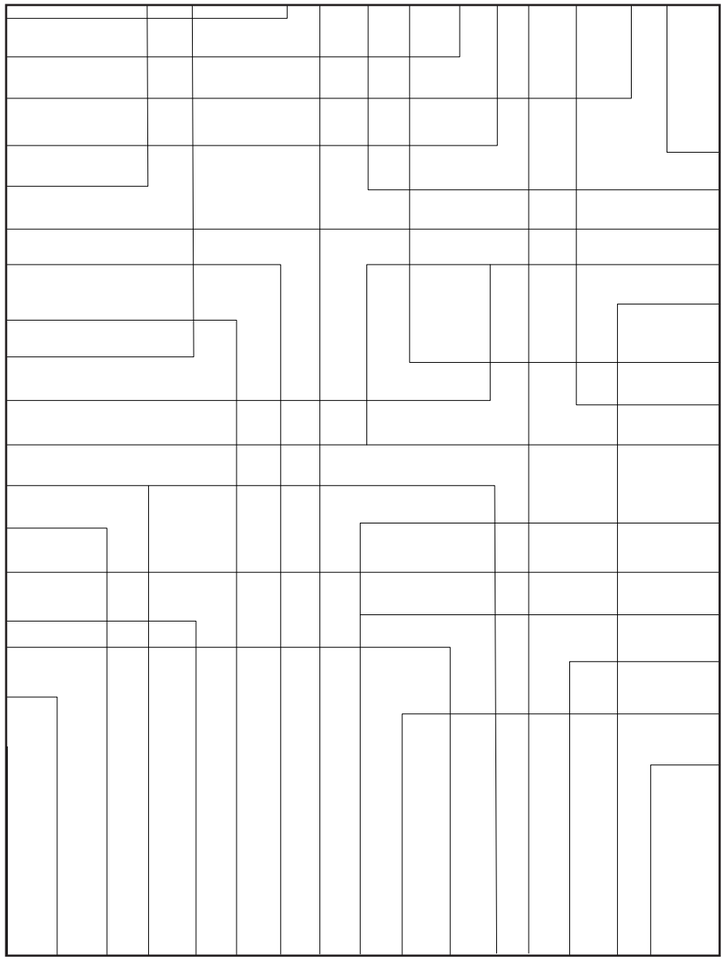
Coeda House and
GC Prostho Museum Research Center

What gave birth to the 2D-patterned timber facade of the tudelft lab shown previously was inspired by the Coeda House, which although in the specific case, the installments of timber beams create an object like mass which also holds the roof and is not an exterior uilding feature, indicates ways of how timber beams could be stack on top of each othr efficiently in order to create 2d patterns. On the left, we se the CG Prostho museum which used a top-tier japanese joint technique in order to create a 3D - massive building skin with media features installed to create the essence of awe and mystery by using light and shadows. This is a combination really important for the design process of our pavilion.

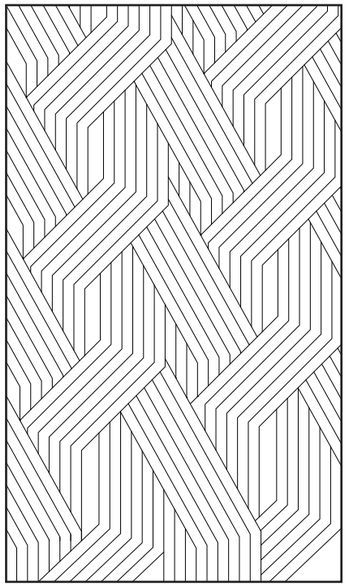


PATTERNS

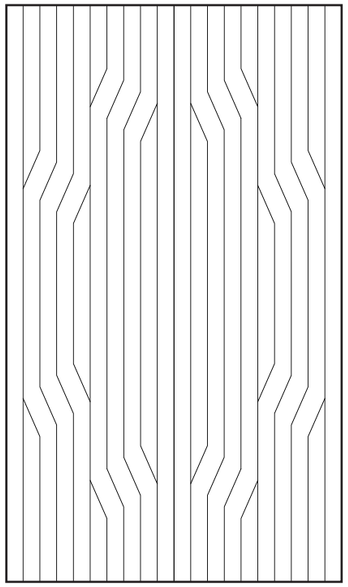
Created patterns for facade morphology
on the left: the chose pattern
on the right: the rest of the ideas



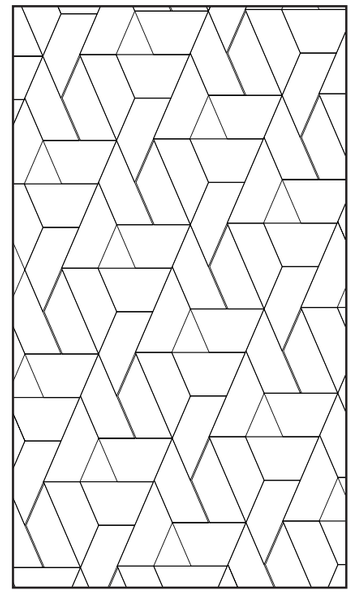
This the chosen pattern for the timber bio-based lab's facade which is a representation of a group of line's vertical and horizontal strengths highlighting the two dimensional axis. Within this blending an eminent feature is the geometries which are generated by the intersection points of each line with its vertical part, creating unique shapes and impactful locations in the texture attracting attention and forcing the viewer to alter the perspective.



The pattern presents a three-dimensional illusion using two-dimensional lines, creating a rhythmic interplay of zigzagging forms. This optical play suggests movement and depth, engaging the viewer's perception and inviting them to decipher the spatial relationships within the design.



This pattern exhibits a linear fluidity, creating a sense of organic movement through the undulating lines within a structured grid. The design plays with visual perception, suggesting waves or natural forms, while maintaining a disciplined, repetitive structure that could be applied to architectural surfaces for a subtle, yet impactful, visual texture.



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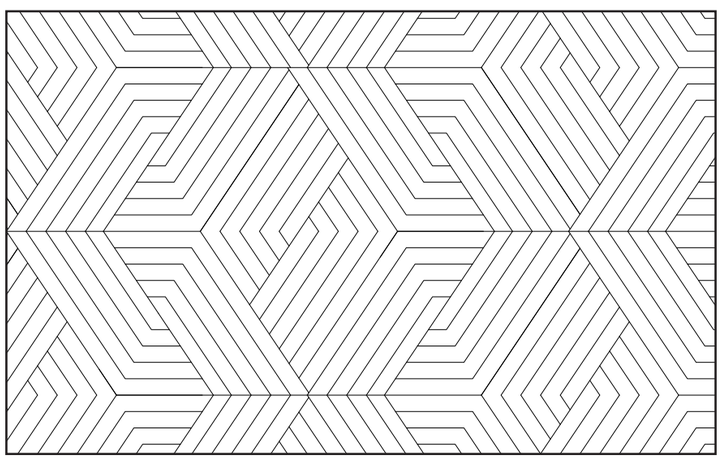


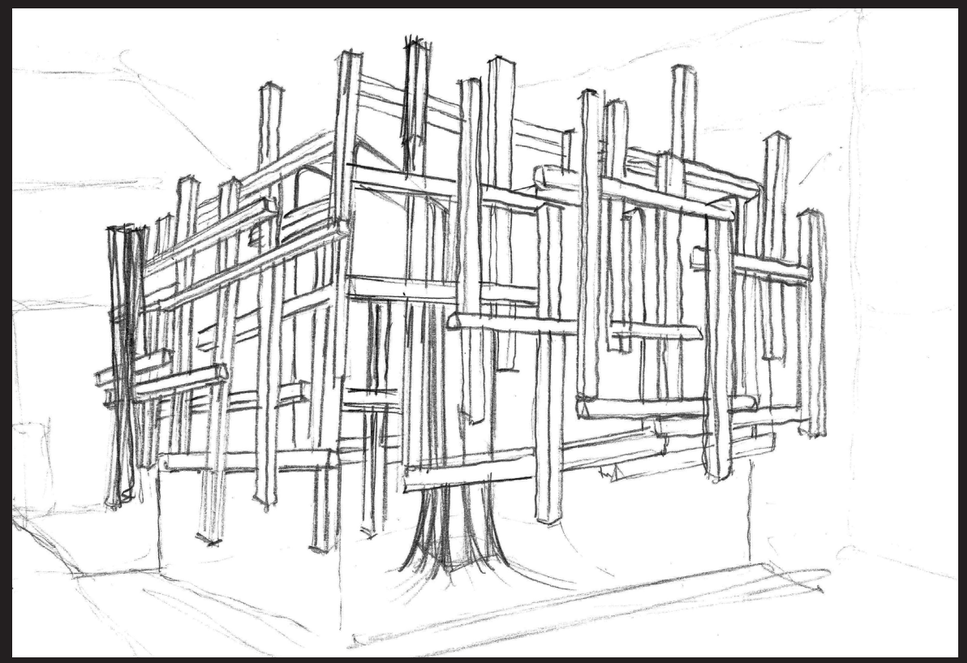
This pattern is a geometric composition that creates a three-dimensional cubic illusion on a two-dimensional plane. It uses angular shapes and varying line thicknesses to form a tessellated maze-like design, which plays with perspective and depth, suggesting solidity and spatial complexity.

RESULT

The technical design of the facade conceptually merges two distinct elements to create an engaging architectural statement. Firstly, it incorporates static, edgy aesthetics with kinetic skins, which craft a sense of motion as perceived from different viewpoints by passers-by. This design element aims to intrigue and draw the attention of onlookers, effectively generating a sense of mystery and encouraging engagement with the building's interior dynamics.

Secondly, the design utilizes strategic lighting to accentuate the pavilion within a broader urban context. The lighting is envisioned to vary in intensity, correlating with the activities inside the pavilion. This adaptive lighting design serves as a communicative tool, symbolically broadcasting the internal vibrancy of the pavilion to the external world.

From an architectural standpoint, the concept represents a fusion of two primary materials: steel and wood. This combination reflects a harmonious blend of high-tech development with low-tech materials, embodying both modernity and naturalism. The core idea is centered around a 'still organic spine' that metaphorically roots into the ground and ascends towards the center, unfurling at the end in a manner reminiscent of tree leaves. This spine, constructed of steel, acts as the supporting structure from which timber beams, akin to branches, emanate. This architectural narrative not only exemplifies structural ingenuity but also resonates with the theme of growth and organic development, symbolically linking the building to its educational and innovative purposes.



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