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## **Stories of structures, spaces and bodies: towards a tectonics of well-being**

Tvedebrink, Tenna Doktor Olsen; Jelic, Andrea; Robinson, Sarah

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**Title:**

*Stories of Structures, Spaces and Bodies: Towards a Tectonics of Well-being*

**Author information:**

Tenna Doktor Olsen Tvedebrink

*Department of Architecture, Design and Media Technology, AAU, Denmark*

[tdol@create.aau.dk](mailto:tdol@create.aau.dk) (corresponding author)

<https://orcid.org/0000-0002-6183-3888>

Andrea Jelić

*Department of Architecture & Department of Civil Engineering, KU Leuven, Belgium*

<https://orcid.org/0000-0001-7372-522X>

Sarah Robinson

*Department of Architecture, Design and Media Technology, AAU, Denmark*

**Abstract:**

Architect Jørn Utzon is known for his devotion to human well-being and his ability to integrate architectural and structural ideas. Yet, discussions in scholarly circles often emphasise his *tectonic genius* related to sublime formgiving and structural-material experiments. Less attention is given to how his sense of empathy and concern for the well-being of users influenced his design process. To address this absence, we explored how training students in a user empathic design process can be integrated in an architectural and engineering design approach.

First, we outline a theoretical framework grounded in the 1) scholarship on tectonic thinking by Jonathan Hale and Marco Frascari and 2) cognitive-neuroscientific understanding of how human beings interact with their surroundings in an embodied and emotional manner. Architectural experience is thus co-produced in an on-going meeting between structures, spaces, and human bodies. Secondly, we present a case study of an experiment with storyboarding as a technique to visualize the intangible aspects of designing for well-being and emotional experience. Placing the 'body' and 'experience' at the center of the design process calls for greater sensitivity to diversities within user groups. We argue for an adjusted tectonic design toolbox focused around *translating* experiences, emotions, and behaviors as a means of joining user-oriented, architectural, and engineering principles in the early design phases. This paper intends to spark a debate about '*tectonics of well-being*' and to discuss whether storyboarding as a narrative design tool can help join structural-material genius with socio-cultural realms of human experience in tectonic design.

**Keywords:**

- 1) Tectonic Design
- 2) Human Well-being
- 3) User Diversity
- 4) User Empathic Design
- 5) Storytelling
- 6) Storyboarding

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## **TEXT**

### **Stories of Structures, Spaces, and Bodies: Towards a Tectonics of Well-being**

#### **1. Introduction**

The global climate emergency demands that architects and engineers urgently reconsider *how*, *what*, and *why* they build in order to create sustainable, health promoting, and inclusive built environments. Achieving these goals requires considering the impact of different design strategies not only on the climate and the environment, but also on people's well-being, lifestyles, and cultural practices. In other words, it requires both a *human-experiential* and a *joined architectural-engineering approach to design*. Yet, the rapidly growing environmentally friendly and sustainable building solutions tend to focus more on the structural-material factors of construction, with little attention to the socio-cultural factors of a joined design approach. This neglect prevails despite the long-standing theories and increasing evidence that the natural environment, building design, and human well-being are closely related to each other [1–6]. Danish architect Jørn Utzon is one of the prominent advocates for such a humane and joined architectural-engineering approach to design. He is widely regarded as a socially concerned architect, devoted to human well-being and the experiential character and corporeal impact of architecture on the human body [7–10]. In one of his key contributions: “The importance of architects”<sup>1</sup>, Utzon argues that architectural design is not only a process based on careful structural and material understanding, but is a process that relies on a profound ability to understand and *empathize* with shifting user perspectives, varied socio-cultural relationships, and changes a building faces throughout its lifespan [11, 12]. By experimenting with colors, light, sensuous and structural properties of materials as well as exploring structural systems and construction details, Utzon was acutely aware of how buildings will be used and changed through use over time. He combined careful attention to human well-being with structural-material considerations as a critical means to achieve higher architectural quality [7, 13]. Yet, Utzon is often applauded for his *tectonic genius* manifest in his sublime form-giving skills and structural-material experiments and the success of the tectonic designs is assessed as a careful relationship between material, structure, construction, meaning, and form [10, 14]. Less attention is given to how Utzon's focus on human well-being influenced his (tectonic) *design process* and (tectonic) *design approach*.

For an experienced architect like Utzon, who had the fortunate opportunity to travel to many different nations, explore ancient building techniques, and observe the everyday life of foreign cultures—handling such complex user analysis likely became part of his tacit “designerly expertise” [15]. For instance, going through various imaginary user scenarios, everyday rhythms and flows of movement simultaneously while sketching the plan layout or sections. With his numerous travels, Utzon was able to accumulate a large pool of *embodied emotional experiences* on which to rely on when developing his tectonic designs. His considerations of human well-being, emotional experiences, and behaviors were based on theoretical speculations and his own wealth of accumulated experiences and presumptions of what it means to inhabit a space. But what about inexperienced students and young practitioners with less personal experience, how might they be educated in an integrated approach?

In light of recent advances in evidence-based design and growing insights from cognitive- and neuroscience related to human well-being in the built environment, the scholarly understanding of the diversity of user experiences has expanded significantly. Designing with well-being in mind requires that (future) architects- and engineers' move beyond one's own personal bodily standards, to *empathize* with different demographic backgrounds and to recognize the impacts caused by disorders, impairments, or illness. Consequently, this

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<sup>1</sup> According to Andersen [7], the four key testaments written by Jørn Utzon are: 1) ‘Arkitekturens Væsen’ (The Nature of Architecture) from 1948, 2) Tendenser i Nutidens Arkitektur (Trends in Today's Architecture) from 1947, 3) ‘Bolig?’ (Housing?) from 1952, and 4) ‘Platforms and Plateaus: Ideas of a Danish Architect’ from 1962.

absence of attention to a humane and user empathic perspective in a joined architectural-engineering design approach opens an important debate about the future framing of tectonic thinking and tectonic design.

The relevance of this debate is further supported by the radical change in today's professional building practice, with the shifting of the old organizational structure, where engineers entered the design phases *after* the architects. In Norway and Denmark, this is evident with a series of large engineering companies like Rambøll, Sweco, Cowi, and Nordconsult acquiring architectural companies to meet the strong demands for more holistic-sustainable services from builders/contractors [16]. As a result, professional practice increasingly requires graduates to engage in interdisciplinary work that *joins* architecture and engineering. And for graduates who can bring the engineering-based knowledge and technical understanding into play as part of a strong tectonic concept and creative approach in the early design phases. Therefore, the aim of this paper is to spark a debate about future tectonic design and discuss how to train a user empathic design process with a joined architectural and engineering design approach. In other words, *how to train architectural-engineering students the knowledge, skills and competencies in 'tectonics of well-being'?*

Motivated by the absence of attention to human well-being in tectonic design, from 2018-2021 we explored training MSc02 students in a user empathic design process with a joined architectural and engineering design approach. Our hypothesis was that we needed: 1) an adjusted tectonic *theoretical framework* that can help students understand how human well-being is fundamentally affected by the built environment in an embodied and emotional manner; as well as 2) an adjusted (tectonic) *design toolbox* that can strengthen student's ability to translate and visualize diverse human experiences, emotions and behaviors as means of joining user-oriented, architectural and structural engineering principles in the early design phases.

Methodologically, this paper draws on: 1) a short theoretical tectonic framework, and 2) a single educational case study to scrutinize the above questions. In the first part of the paper, we outline a theoretical framework for '*tectonics of well-being*' that moves beyond an understanding of tectonic genius as a mere *static-structural and material object* into a definition of tectonic genius as a *dynamic-embodied and emotional experience*. This theoretical framework builds upon Utzon's humane design approach and key-elements in the theoretical tectonic thinking developed by Hale [17] and Frascari [18]. We use their reading of the recent insights within cognitive neuroscience to expand the understanding of how human beings experience and interact with their (tectonic) architectural surroundings in a fundamentally embodied and emotional manner. The tectonic design is understood to be actively embodied and co-produced in an on-going, ever-evolving emotional experience between material structures, spaces, and human bodies [3, 4, 19, 20]. This understanding brings architectural-tectonic expression beyond visual-aesthetic, structural-material genius into socio-cultural realms of *storytelling*. In the second part of the paper, we present a case study from architecture-engineering education outlining how we in the "Architecture, Health, and Well-being" (AHW) master's level course have been experimenting with narrative design approaches like storytelling and design tools like storyboarding to capture and visualize the intangible aspects of design for user experiences and emotions. The real-life context and field of investigation takes its point of departure in the everyday teaching environment of the AHW course and the (visual) work of 78 students over 4 years (from 2018-2021) (see table 01 for an outline, and figures 01-03 as specific examples of student work). The practitioner insights are based on an explorative analysis of the storyboards submitted as part of the students' design hand-ins, in combination with our personal teaching experiences and impressions captured by us as teachers affiliated with the course.

This research strategy uses the AHW course as a dynamic testing ground (between theoretical thinking and experience of practice) for our new ideas and speculations, as well as for early considerations and reflection on the potentials and possibilities this specific narrative approach and design tool offers. In that sense, the case study methodology becomes a catalyst for our own learning which helps inform our future decision-making, both as researchers and as educators [21, 22]. The case study provides insights from a visual examination of how students worked with storyboarding in the AHW course, as well as discussion of student-learning outcomes on the theoretical backdrop of the tectonic thinking and the insights from cognitive-neuroscience presented in the first part of the paper. Rather than suggesting that the conceptual methods outlined here should be widely applied, we are more interested in sparking the debate about the '*tectonics of well-being*', and how it can be integrated in an architectural- and structural engineering context.

## **2. Theoretical framework**

### **2.1 Joining architectural- and structural design with human well-being**

In this section, we briefly outline a theoretical framework for '*tectonics of well-being*' as both a *human experiential* and a *joined architectural-engineering approach to design*. In the scholarship on tectonics, we identify two themes of particular interest: 1) the positioning of human well-being as the basis of tectonic design, and 2) the role of human embodiment and emotional experiences when designing.

As previously mentioned, Utzon is widely recognized as a socially concerned architect devoted to human well-being. Utzon [11] elaborates on the perspective on human well-being with the argument, that it demands a

“*healthy sense of life*” and a great understanding of the countless forms of human expression, movement, experience, and current life conditions or life styles to architecturally facilitate and frame well-being and everyday living [13]. The purpose and use of a building is more than a shelter or protection against climate conditions, and human living is more than basic needs and safety. In his text “Platforms and Plateaus: Ideas of a Danish Architect”, Utzon [12] uses examples from Mexican, Moroccan, Indian, Chinese and Japanese buildings to illustrate their relationship and sensitivity to natural surroundings, human movement, and bodily scale in the interplay between different building aspects, such as ceiling heights, platforms, and roof shapes. These ‘architectural tricks’ orchestrate a series of variations in human bodily movement and experience [12]. His key point is to use these ‘architectural tricks’ to achieve a human emotional effect in the interaction and meeting between building form, interior materiality, and the human body. This is manifested in the experience of walking, sitting, and lying/resting comfortably, enjoying the sun or shadow, feeling water against the body, feeling the warmth of the ground under your feet and paying attention to all the other intangible sensory inputs. And, as described by Holst [8] human well-being is promoted when the person is allowed to feel contemplative and calm. With his profound interest in understanding different ways of living, Utzon also emphasized the importance of symbolic content, ceremonies, and rituals, and how a building might express a certain functional purpose, specific lifestyle, or form of life, while rejecting the primary use of statistical norms and rules based on the so-called “most usual” [7]. Consequently, in his writings Utzon argues that a sense of human well-being is the foundation of architectural thinking and doing, as well as an important means to achieve a more humane architecture [7, 8, 11]. According to Utzon, the creation of buildings and their real-life use are interconnected, so architects must therefore focus on the *acts* and *feelings* of human beings—rather than the mere beauty of objects. He practiced what could be referred to as an empathic analysis of various user experiences and embodied-emotional relations while incorporating the expected function and experience of the building to inform his design ideas, from early design sketches to the development of structural systems.

With the notion “*the sense of architecture*” Utzon and Faber [13] describe the design of architecture as a double interpretation process based on: 1) an *accumulated experience* of existing buildings, and 2) an *imagined experience* of future buildings [7]. In our opinion, a narrative approach captures the mutual relationship between understanding the human experience of existing spaces (the ‘as is’) and predicting the future experience of potential users (the ‘to be’). Utzon and Faber [13] also highlight the ability to *empathize* with the natural and human surroundings; to train the ability to register sensory inputs and feelings when moving around and to train the eye and mind to grasp space, form, light, shadow, and color as means to understand and analyze the impact and affect created with the spatial experience [13]. They further underline that all elements and details of a building matter for the human spatial experience; various forms, structures and materials can help accentuate and articulate each other’s sensory qualities, or blur and obliterate their character. Andersen [7] describes how Utzon was fond of using ‘cutaway’ section-models for examining the visual-spatial relationships between form and structure in his building designs. The goal was to be able to view the spatial qualities from both the inside and outside simultaneously, as well as to study the connections between interior, exterior, and surrounding landscape at eye-level. This approach brings awareness to the human scale, the envisioned occupation, perception, and inhabitation of the future users, and further supports a narrative approach to design. Yet, according to Tyrrell [14], Utzon distrusted an overly theoretical and academic approach to architecture. Instead, he insisted on the importance of deliberately collecting a series of *personal* embodied experiences. For Utzon, the contextual and human awareness further meant that the actual construction of a building design was not a conclusion or self-referential, finished piece of work. Instead, he saw the building construction as a transition phase between his task as an architect trying to predict the future use and the following slow transformation activated by the inhabitation and everyday acts performed by the real users [7].

When debating Utzon’s tectonic perspective and attention to human well-being, it is important to mention the recent turn in tectonic thinking, that focuses more on sustainability. For example, the ecological perspective (coined as ‘ecology of tectonics’) introduced by Beim and Stylsvig Madsen [23], focuses on the environmental and climatic impacts of structural systems, construction and materials in building design. An interesting part of this ecological thinking applied to tectonic philosophy is the growing ethical attention to the eco-systems of buildings and the related systems of *social organization*. According to Stylsvig Madsen [24], “*An ecological understanding of the world links the well-being of the individual to the conditions of its surrounding environment*” and asking how such an understanding can help inform architectural practice in the future. Also, Bech-Danielsen [25] adds to this social sustainable perspective and calls for more attention to human well-being, stressing the need to move beyond the elitist modernist approach assuming that everybody has the same abilities and capabilities. Finally, Hale [17] as part of his text ‘Cognitive Tectonics: From the Prehuman to the Posthuman’ addresses the cultural framework of everyday life and asks how the impact of human occupation might influence the overall tectonic thinking. In this quest, Hale [17] draws on the recent developments in neuroscience and the concepts of embodiment and cognition to introduce what we might refer to as a ‘tectonics of occupation’. He points to the need for the built environment to be engaging and carry visible traces of both construction and occupation. This point is based on the argument that spaces invite engagement with both the

bodies and minds of building users [17]. Furthermore, this specific discussion about visible traces built on top of, among others, the writings by Frascari [18, 26, 27] on how to physically ‘*construct*’ and mentally ‘*construe*’ architecture.

As argued for in Tvedebrink [28], with the interdependent notions ‘construct’ and ‘construe’, Frascari [26, 27, 29, 30] established a discourse in tectonic thinking which: 1) brings tectonic design beyond structural-material genius into socio-cultural realms of storytelling, and 2) emphasizes the underlying architect/designer *intention* and overall architectural *narrative* around social, cultural and emotional affordances. Frascari [18, 27] highlights the narrative approach and a double meaning in the architectural doing and visionary thinking. Yet, before he passed away, Frascari [18, 30], like Hale [17], developed an interest in the cognitive and neurosciences. A key point in these writings is, that the experience of architecture is fundamentally based on human cognition and how we understand space, time, and matter [18]. Furthermore, that in his opinion, the task of architectural design is to ‘control’ places and spaces, through the careful use of walls, ceilings, structures, textures, lights/shadows, noises, scents, and odors. Thereby pointing to the ethical role of architects (or design-engineers) to carefully orchestrate and compose the built environment to help future users not only to navigate, orientate, and live comfortably—but to thrive, inhabit, and *feel well* [18]. According to Frascari [18], the principles of why cognitive neuroscience are relevant to architecture are not new. He emphasized that strategies and principles to lure people’s expectations and trigger emotional responses have long been known within domains of commercial business stores and themed leisure parks [18]. For instance, the deliberate use of (interior) architecture to provoke and elicit feelings, or even to persuade people. Which suggests that an emotional connection exists between human well-being and the design of built environment [18]. According to Frascari [18] the architectural storytelling challenge is to avoid designing distressful architecture or architecture that invites discomfort and unnecessary mental or emotional conflict. In connection with this line of argumentation, he presents the notion of ‘*thinking well*’.

With the notion of ‘thinking well’, Frascari [18] addresses the embodied processes that evoke human feelings and affect different emotional states of being through various bodily sensory inputs informed by insights provided from cognitive and neurosciences which reveal more and more about human biology and psychology. A key finding is that the built environment is part of an ever-ongoing embodied process continually shaping our emotions and actions [31]. In this sense, the experience of architecture is *co-produced* between human beings and their surrounding environment. Furthermore, making sense of the surrounding environment is also a question of multi-sensorial embodied engagements and the *moods* (emotions and feelings) evoked in us. Therefore, the built environment (within a context of contemporary society and technology), must be understood against the background of how the human-world relations make actions and practices possible (what is sometimes referred to as ‘affordances’<sup>2</sup>). Also, about the ways in which we relate to them aesthetically and emotionally (what is sometimes referred to as ‘atmospheres’<sup>3</sup>). Another important point is that the human mind can *simulate* different feelings and emotional body states based on a recollection of memory [31]. Which means that one can ‘relive’ a given experience and emotional state or even anticipate an emotional event *as if* it had taken place with only fragments from memory [31, 32]. Hence, any experience or feeling of a given built space stems from recollected and re-arranged fragments of our own lifespan, previous experiences, and past emotional states. Human experience and emotions are thus very tight connected to imagination and memory.

Furthermore, this knowledge suggests that cognitive processes such as creativity, imagination, and our ability (as architects and engineers) to *empathize* with other persons and to *imagine* possible futures or non-existent events are in fact just another form of (re)combining memory content [33, 34]. On the one hand, this close connection between memory, empathy, and imagination naturally makes the risks of false recognition and confabulations quite high. On the other hand, it is this specific connection between memory, empathy, and imagination that possibly confirms the value of the theoretical speculations on (mental) *construing* and *storytelling* put forth by Frascari [30] and reinforces the importance of the acute awareness to human well-being that Utzon championed. And today, we have more evidence on the workings of human experiences and emotions than ever before – and these insights push the contemporary tectonic theoretical framework. With the above insights, it is clear that we need to move beyond an understanding of tectonic genius as mere *static-structural and material object*, into a redefinition of tectonic genius as *dynamic-embodied and emotional experience*.

This redefinition demands a greater sensitivity to user perspectives and understanding *diversities* within user bodies and emotional states. Because we need to acknowledge the profound impact that individual human sensory systems and cognition have on the emotional experience of the built environment—no general standards can be used to understand how children, elderly, impaired, or sick people (just to mention a few) experience and

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<sup>2</sup> Affordances is a notion introduced by Gibson [45], which on the basis of ecological psychology defines how the form and character of an object help reveal its’ possibilities of use.

<sup>3</sup> Atmosphere is a notion introduced by Böhme [46] which on the basis of philosophy defines how the form and character of a space can cause an emotional effect.

feel when interacting with the built environment. So, when Hale [17] refers to what might be called a ‘tectonics of occupation’, we advocate moving beyond the merely functionalist thinking into an embodied-inhabitation thinking; instead suggesting a ‘*tectonics of well-being*’. This notion better captures the aspects of human experiences, embodiment, emotions, and user empathy, while embracing the dynamic, co-productive relationship between built environment and diverse human beings. It is not enough to talk about occupation and function—or how to ‘nudge’ diverse user groups or inhabitants into more positive behaviors by making their surrounding environments more comfortable. We wish to acknowledge not only how human beings ‘occupy’ and ‘behave’ in spatial settings, but to place human experience, embodiment, emotions, and user empathy at the core of tectonic design.

### 3. Case presentation

#### 3.1 Storytelling as a method of construal

A broad use of the term ‘storytelling’ has found many different applications within various domains and academic disciplines. The domains of fiction, animated film, and cartoons are obvious means of storytelling, yet it is also used in the disciplines of sociology and social research [35] and more recently within domains of medicine and care (doctor and nurse educations). Growing attention to the ‘narrative approach’ and the value of narrative knowledge is underway. For instance, so-called ‘narrative medicine’ is based on a patient-centered perspective; training the empathy of doctors and nurses to help them better understand how different people *feel* about and *experience* their own health and well-being. This kind of narrative approach includes students reading fiction and poetry, as well as engaging in creative scenario writings [36]. Storytelling in architectural thinking has primarily focused on narrative research approaches; concentrating on capturing personal experiences of users or architects, representing spatial atmospheres [37, 38] and developing so-called personas as design fictive characters to support design solutions [39]. Sussman & Hollander [40] speculate on the importance of personal attachment to another person, an object, an experience, a place, as well as the unusual human capacity to *create* and *share* stories. What in our case might be interesting about the notion of storytelling—or narrative approach—is the *act of story-making* and the human ability to mentally imagine (future) scenarios and emotional situations based on the ability to empathize and immerse ourselves into other people’s stories. Hence, the ability to use the knowledge of past/existing situations (the ‘as is’) to help predict and envision the future (the ‘to be’). Supported by the visual strengths of the *storyboarding technique*, it helps bring the story-making process beyond pure imagination and mere oral and/or written (text based) outputs into the important creative processes of sketching.

As the human brain weaves stories together [41], the storytelling approach and storyboard technique can help students *weave knowledge together*. The pedagogies of storyboarding work as both a form of visual communication (to peers) and as a process of realization (about users). While the primary intention is to train user empathy, the storyboarding technique also enables one to visualize early ideas, strengthen awareness of atmospheres and affordances, as well as to communicate early design choices and conceptual decisions with the user investigations to other group members and across project teams. The specific assignment of developing an ‘everyday scenario’ and illustrating it as a storyboard, helps develop the ability to weave fragments of real persons stories into the bits and pieces of information and knowledge gained from literature reviews and studies of state-of-the-art research. This helps students to 1) *envision/imagine* and 2) *visualize/communicate* what happens where, when, how, and with whom. In addition, the pedagogical purpose and didactic value of the storytelling approach and storyboarding technique offers the creative advantage of the elements from filmmaking and cartoons: the ability to work visually with different framings, shots, composition, sequencing, mixing perspectives/angles, movements, light conditions, layering, editing, and narrating. As well as the ability to combine inside thoughts with outside events; jump in time, zoom-in on specific details, events or life situations and to zoom-out on large scenes or meta-levels. And very importantly, it trains the ability to bring forward changing feelings, emotional states of being, and thoughts. The narrative approach possibly holds a clear path to help *interpret, translate, and conceptualize* how engineering design aspects such as structural systems, construction, and material choices can support the well-being of various user groups. We are thus interested in exploring if and how this approach can be used as a means for joining user-oriented, architectural and engineering principles.

#### 3.2 ‘Architecture, Health, and Well-being’ (AHW) course

The AHW course started in 2018 and was repeated in 2019, 2020, and 2021 with only minor adjustments to the course content and overall structure of lectures and assignments. The underlying idea was to incorporate basic

knowledge on the relevance of cognitive and neurosciences in the Architecture & Design Education<sup>4</sup>, as part of a more humane approach to the joined architectural and engineering design process. As well as training students to work with a more diverse and research-informed user empathic perspective when developing sustainable tectonic design solutions in their MSc02 semester projects.

In the AHW course an overall storytelling approach is used, divided into five sub-phases: 1) Defining user group and design challenge, 2) Reviewing research-based literature and best-practice, 3) Using narrative research to capture real user perspectives, 4) Develop persona, 5) Develop ‘as is/to be’ scenarios with storyboarding technique (see also table 01). All five sub-phases inform the early design process and help the students develop their early (sustainable) tectonic design strategies as a parallel preparation for the semester project. Whereas, a more in-depth theoretical understanding of tectonics and sustainability, as well as readings of literature by Jonathan Hale and Marco Frascari - or studying the practice of Jørn Utzon - belongs to the project module. More insights on the content and learning outcome of sub-phase 1-4 can be found in Tvedebrink & Jelić [42] and Tvedebrink & Jelić [43]<sup>5</sup>. In 2018 and 2019, 67 students were asked to develop an A0 poster, among others, presenting an everyday scenario and a storyboard illustrating what key activities the specific user-group/persona would perform as a typical everyday-scenario in a health center (as a design task). All students were free to determine what kind of storyboard and scenario they would develop. In 2020 and 2021, the educational situation was changed due to COVID-19 restrictions. The adaptation to the strictly online and digital format complicated the use of an A0 poster format, whereas students instead were asked to develop an A3 portfolio. Furthermore, reflecting on the past years learning outcome, students were this time told to develop two scenarios with the storyboards. The first scenario should represent the ‘as is’ situation. Illustrating the everyday situation of their specific user group, as it would happen today in existing settings. Following that, the second scenario should visualize the ‘to be’ situation. Thereby illustrating the future everyday situation of their specific user group, as they envision/imagine it so take place within their building design.

Before the students start working on the storyboards, they have been asked to go into the field and do short, focused ethnographic studies like interviews and observations with 1-3 real persons representing their specific user-group. It can be either a ‘staff’-perspective (nurse, doctor, therapist, yoga instructor) or a ‘patient’-perspective (child, young, adult, elderly, veteran, refugee, police-officer suffering from different traumas or cognitive disorders/impairments like PTSD, Dementia). In the contact with the real people, representing their user-group, we encourage them to focus on collecting the personal stories (capturing the ‘as is’). For instance, paying attention to the ‘fragments’ and ‘cues’ of information that later on can grow into a fictive ‘persona’ and an imaginary coherent story/narrative. With the scenarios and storyboards, we ask our students to merge the results of their findings from scientific literature with their individual design ideas (the ‘to be’). As an essential part of this ‘weaving together’ of own empirical studies with the findings from state-of-the-art research, we, as with the above example of Jørn Utzon, encourage students to understand what kind of everyday life different user groups live in the building and around the building, and how that everyday life might change from user perspective to user perspective. While also trying to understand how user needs and desires can change throughout time; depending on age, life situation and even just time of the year (due to different cultural traditions and socio-cultural rituals). Hence, the anticipated *use* and function (the ‘to be’) of the building is a key design driver in the early sketching process and development of the final design brief.

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<sup>4</sup> The Architecture and Design Education is a BSc and MSc Level university education offered in Aalborg University, merges classic architectural design thinking with engineering skills across domains of structural design and environmental design.

<sup>5</sup> In Tvedebrink & Jelić [42], we focused on the learning outcome and teaching experiences gained from using ‘persona’ as a design tool. Whereas, in Tvedebrink & Jelić [43], we focused on teaching literature reviews/using research findings to inform the design choices made in the early design phases.



Table 01. Facts about the case.

The table illustrate the outcome of our visual examination of how students worked with storyboarding in the AHW course, as well as inform about the set-up and underlying structure behind the case study.

Case Study Structure	2018	2019	2020	2021
<b>Participants:</b>				
Number of students	35	31	41	25
Number of submissions available*	18	6	28	25
<b>Mode:</b>				
A0 Poster	x	x		
A3 Portfolio			x	x
<b>Process and tasks:</b>				
Literature review (research state-of-the-art)	x	x	x	x
Best-practice (design profession)			x	x
User perspective (interview)	x	x	x	x
Persona (fictive character)	x	x	x	x
<b>Storyboard – ‘as is’ (illustrations)</b>	<b>14</b>	<b>3</b>	<b>9</b>	<b>25</b>
<b>Storyboard – ‘to be’ (illustrations)</b>	<b>8</b>	<b>5</b>	<b>26</b>	<b>25</b>
Design Brief	x	x	x	x
Design Strategies and Functional Diagram			x	x
<b>User Experience and activities:</b>				
Social interactions and relationships	17	6	26	24
Feelings and emotions	16	3	14	22
Embodiment and user sensations	10	5	13	15
User activities/everyday tasks and rituals	14	6	24	24
<b>Architectural principles:</b>				
Time flows and rhythms	13	4	12	5
Interior atmospheres	12	4	19	24
Furnishings and affordances	9	5	20	18
Landscape, vegetation and plant life	11	5	25	24
Accessibility and wayfinding	11	2	7	6
Building scale and room sizes	11	3	16	21
<b>Engineering principles:</b>				
Wall/Ceiling/Floor surface	14	6	19	21
Structures (structural system and/or construction)	2	0	11	14
Assembly joints and/or surface details	6	4	13	17
Window/Door Detail	10	5	19	23
Material Characteristics and/or colors	8	3	12	16
Acoustics and sound quality	6	1	5	10
Daylight and light quality	8	2	10	18
Temperature and air quality/smells	5	1	2	8

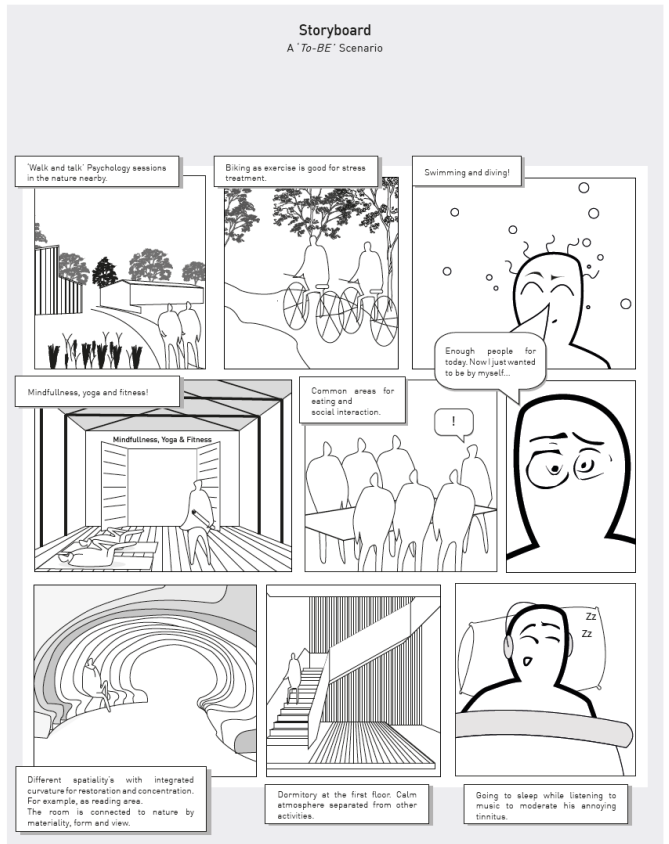
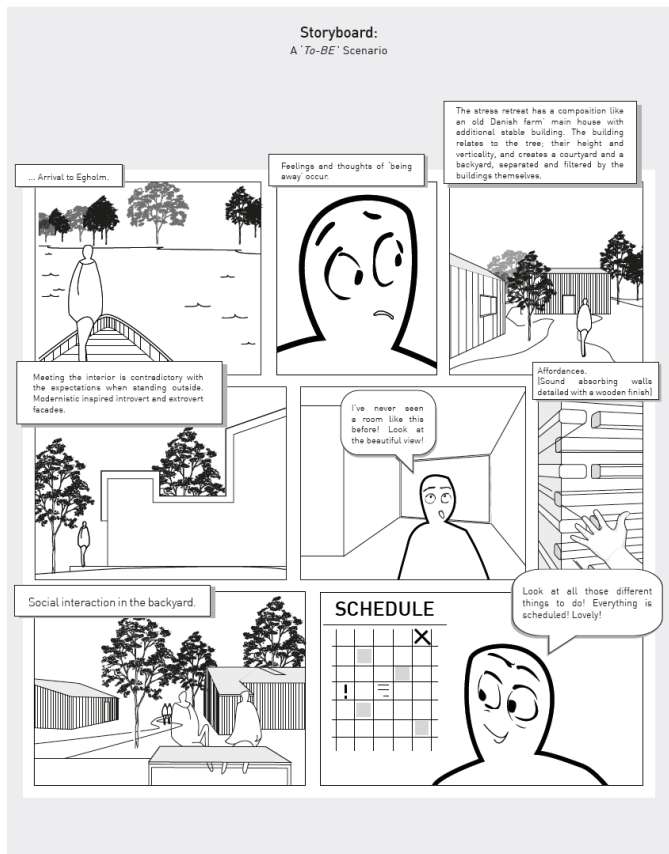
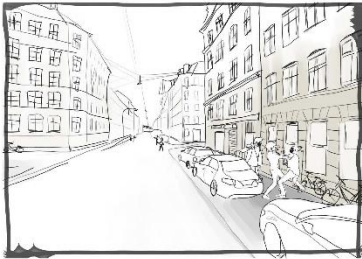


Figure 01. 'To Be' storyboards developed by MSc02 student, Aske Eg Thorn in 2020.

# STORYBOARD | AS-IS

## DEVELOPING PTSD

gray days in the shadow of the assault



1) Rantzausgade 27, Nørrebro, Copenhagen, Denmark, 22 March 2016, Tuesday, 7:08 a.m. Anders gets assaulted with a knife by two masked men.

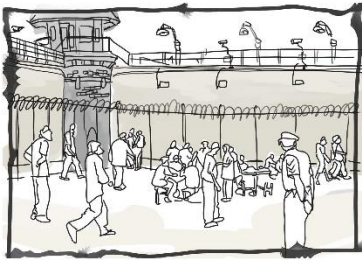


2) After finishing treatment at Rigshospitalet's Traumatocenter, Anders is taken to Station Bøllehave, where he was questioned about the episode.

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3) The police suspect one of the men to be the 23-year-old who is a Pakistani citizen but resides in Denmark and was possibly involved in an alleged identical assault last summer. According to the police, he is a member of the gang Loyal to Familia.



4) In case of the previous assault the chairman of the Prison Association, Kim Skotervej, was in no doubt that it was highly planned and ordered from inside the walls of the prison. A group of inmates whistled out the window, just as the officer left the prison. They thus sent a signal to the waiting car, he says.

5) Now Anders does not know how to be emotionally distant from work anymore. His spare time is no distinct much from work hours. He is constantly on guard and his residence neighbourhood does not bring safety feelings to him anymore.



6) He notices that he is afraid of his surroundings, constantly in need of more space around him. What, if so, someone will stab him in the back? Or jump on him from behind the corner? He gets trauma flashbacks from only thinking about it!



7) He got some small first aid psychological help, but as the time passes he realizes that it was not enough to cope with the situation and he needs to take a break from the environment that betrayed him. He needs to go somewhere else to reset his restless mind.

8) With encouragement of his wife he finds a facility that might help him with exactly what he needs...

# STORYBOARD | TO-BE

## RECOVERY IN THE FACILITY

the takes on colors again.



1) Anders arrives to the Retreat at Tur, dedicated for prison staff members who developed PTSD as a result of work-related trauma. First thing he sees is bright, warm and welcoming lobby with soft modern furniture, that opens up to calming views to the nature and water outside. He is not afraid to check in.

2) He gets a private room with his own bathroom all for himself. What a relief to have a personal space, where he does not need to deal with other people.



3) When he enters his room he can immediately scan the whole space. Good. No mysteries or dangers waiting for him. He notices that all walls and furniture are rounded - curvature creates no sharp or biting corners. It feels nice, flowing and hugging in a way. He likes it.

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4) Anders starts "feeling like at home" even the rooms that feel like psychological therapy with his specialist are very cozy. He did not expect that from a residential facility.

5) After spending resettle time alone in his room and with his therapist in a private setting, he starts to slowly open up to other experiences. He participates in excursions around Tur's area, leaving his "safe bubble", which gradually helps him to engage in an active life again.



6) He knows there is also a fitness gym back in the Retreat. Any form of exercising, not to mention breaking some sweat, seems to be helping him with stress management.

7) Anders knows that he is not alone in the Retreat. Various common experiences of different levels of privacy and social coherence, so he already had a chance to talk with other patients in the a limiting and calm setting. They all went through similar situations, so he finally feels understood what's great circle of support!



8) He in particular likes the small kitchen area, where he does not necessarily have to cook, but instead enjoys some snacks, tea and casual conversations with other people. Social interaction is a part of his healing process!

9) He heard that they will soon reintroduce VDMA-assisted treatment, that is also why the room is so well prepared for long sessions and feels so welcoming and accommodating.



10) When he feels like he had enough of "activating" and socializing. There is a Healing Garden and other outside areas to go, create some fresh air and do some very needed relaxation and grounding in nature. Inside of the center there is a social space - retreat space to spend time alone. If needed, out a yoga & mindful fitness studio. Maybe he will give it a shot to calm down his mind?

Figure 02. 'As Is/ To Be' storyboards developed by MSc02 student, Patrycja Klara Ziemenowicz in 2021.

## STORYBOARD - AS IS

1 The doctors have declared that I'm terminally ill. Soon I am going to be switched into a **new ward**. I am worried how that is going to be.

2 The nurse is moving me to the new place. It is a bit scary. It is so **dark and empty**. It feels like being pushed closer to death.

3 Oh, this room seems exactly **similar** as the one before. Hmm...Why did they even want me to move ward?

4 Here I am. Laying in my new room. Why is the wall yellow? Somehow I get **irritated of it**. It's hot inside and the **window** is placed too high, so I can't open it. It feels like prison.

5 I have to get ready before I see my family. It took me a few seconds to recognize myself. This is not me. I look so ugly. I don't want to show this face to anyone, who am I? **My identity is gone**.

6 Time is up, my family is calling me. The first thing my child asked: Mom? **You look so sad**. Is everything fine? - That made me even more sad.

7 The call just ended and I feel so **lonely** here, disconnected with my family. They really want to be with me, but the room does not facilitate for that and they have to keep up with school.

8 Suddenly a nurse came with dinner. We had a talk about life, family and death. It felt better to talk with somebody and being close with a person. **I got less sad**. But the nurse had to go quickly again, and then the loneliness came back to me.

9 It is 3 o'clock and I woke up by hearing a lot of **noise** from the other room. I can hear people crying. Something is going on. Maybe somebody died? I can not sleep again. My heart beats really quick and it is hard to calm myself down.

10 My plan was to stay at the hospital until my last day on this earth for my children's sake. But the hospital environment and being alone away from my family makes me miserable. Maybe, it is better just to **go home** even though it can create tragic memories for my kids. I really don't like this place. I don't have anyone to talk with either. I am going to call my husband, so he can pick me up.

## STORYBOARD - TO BE

1 My husband is driving me to the hospice. I am going to spend my last days here. Oh, the hospice **looks so familiar**.

2 A nurse is taking me toward my room. I feel so **calm** and less afraid of this place.

3 I like this place. My husband has taken some pictures and my favorite porcelain with us. I was worried about the hospice, how it will be, but suddenly everything **feel homely**, it look just like my home in Thorshavn. I feel **safe and free** here.

4 I want to take a bath before seeing my children. The nurse took me to this room. It was so relaxing and after a long time a finally felt beautiful again. It was just me, **looking up to the skies and thinking of my days on this earth**.

5 I do not look the same way as I did before. But after the wellness I feel prettier than before. **Clean and ready** to meet my family.

6 Me and Emma got out to the terrace. I felt alive again. **The sound of the ocean, the fresh air and the singing birds**.

7 We got out to the **common area**. The children were playing, while I took part of the **art therapy** with other patients. Finally I could paint again. It felt so good!

8 I had a good day. I feel so **happy** here and **not alone** as in the hospital. My family is going to stay here in the guest room. I can finally tell **goodnight stories** to my children before sleep.

9 The **sun is going down**. It is so beautiful. Never I have adored small things as I do now. I like this place. It is so **calming and relaxing**. Everybody is so kind and helpful. I was worried if I took the right decisions staying in a hospice rather than home. Well, everything here **reminds me of home** so that's perfect. I am in a **safe place** and I feel free to do whatever I want.

Figure 03. 'As Is/To Be' storyboards developed by MSc02 student, Inoyah Devathanan in 2021.



### 3.3 Visualizing form, structure and material

The students start sketching out the storyboard, developing different frames and setting the scene – puzzling the narrative and plot together. It is a rough putting together of knowledge and insights found within the scientific literature studies and user interviews, with little concern for the visual style or specific choice of graphics. Instead, trying to make sense of the information they have found. This rough sketching phase quickly triggers a re-visiting of key findings, a search for more knowledge and further insights. Slowly, they start developing ideas and making changes. They start editing the frames and the sequencing, paying more attention to the specific perspectives, angles, and bodily postures outlined. They start playing around with how they can add more nuanced layers to the overall narrative through amplified atmospheric and emotional clues. Here, the scenario writing becomes relevant, as the content of the drawings can be further articulated through small narrator sentences, dialogue, or simple wordings. It is this continuous oscillation between whole and parts; real and imagined; construction and construing that is so difficult to capture and translate in the (tectonic) design process.

For instance, as in figure 01-02, students start paying attention to the interior detailing not just in the sense of overall spatial atmosphere, but to how structural systems and construction details can help articulate a tranquil atmosphere and invite certain social behaviors, such as a window seat or a comforting niche that creates privacy, or alternatively, the soft curvatures of a corner. The point is that in the storyboards the students show greater sensitivity to human scale, and start thinking about room size or experiential zones, integrating comfort criteria like light, temperature, and air change with a more critical-reflective perspective, while also balancing the need for privacy of the individual and the desire for a sense of community. This sensitivity to human scale and privacy is reflected in the attention to material choices; their surface appearance expressed both through their (structural) form as well as through their tactility, color, and acoustic quality. In this way, they begin to consider climatic, structural, spatial, social, cultural, and spiritual dimensions in a joined combination, while also touching on the synthesis between structure and form; geometry and structural elements as a means to start affording human protection.

Storyboards also provide the ability to work in section. As previously mentioned, and as emphasized by Tyrrell [14], Utzon was fond of using ‘cutaway’ section-models for envisioning the occupation and inhabitation of the future users. Working in section was essential: it helped reveal how the joining of architectural, structural, and material principles form the spatial atmosphere and affect the human experience on both sensory and emotional levels. Nevertheless, creating such physical section-models is a rather time-consuming process, often demanding a clear idea about the overall shape, structure, and form. In comparison with the practice of Utzon, the specific technique of storyboarding helps the students to grow the many complex technical and occupational demands of the project together, into a coherent whole from the perspective of the atmospheric feeling and experience/movement/actions they envision. As seen from table 01, many students show awareness towards the importance of daylight/light quality for human well-being. And we see how the change in light conditions as a result of the movement of the sun reveals time of day and give a sense of daily and yearly rhythms. This further pushes some students to play around with thinking inside-out, outside-in, and pay more attention to the connection between landscape and the building. Working with the exterior not only as a climate screen, but also as an important transition space connecting outdoor and indoor (as seen in figure 02). Students carefully consider different user habits, patterns of use and movements of different people, for instance during meal situations or various therapy sessions, where the users shift positions depending on the climatic conditions and season (rain, snow, or sun) and time of day (morning, noon, or night). Another series of the storyboards pays special attention to understanding how everyday rituals are possibly different from rituals related to special occasions and extraordinary events. Here we see how a series of students first use color to help convey a specific mood, but they also start paying more attention to the subtle details that make the differences clearer (as seen in figure 03). Students become aware of how the choice of structure and material can help articulate the impact of time and season or the sound of rain. More importantly, students become aware that the use of space is a dynamic process in continuous movement. With the various frames of people sitting, standing or reclining in different positions, situations and bodily postures the students start illustrating the anticipated usage of space, simultaneously as they subtly start revealing ideas about the shape and underlying structure (as seen in figure 01). The attention to changing bodily postures, detailed body language, and awareness to human silhouettes becomes important for understanding what social interactions and behaviors take place. This is further reflected in the careful positioning of interior elements like furniture, windows, plants, the light conditions become highly relevant, and even the contours of the wall, floor, and ceiling reflect the human scale and bodily relations (as seen in figure 01-03). An ever-changing and continuous re-arrangement of space—the use of space as a dynamic process in continuous movement.

In many of the student works, it is clear that the students have developed a more refined understanding of how the surrounding built environment influence and affect human behaviors and human well-being. What we see in table 01 and in most of the storyboards is that the human acts, behaviors, and emotional experiences are put in the foreground and at the center of the frames. Interior furnishings and essential probes used during everyday activities are put in the middle ground around the persona. Whereas the spatial characteristics and

material characteristics are often more working as an atmospheric background or ambient landscape behind the persona and the furnishings. It is in the careful composition and ordering of these three layers that the complexity of the sustainable tectonic design task is revealed for the students. Perhaps we can even claim that setting the scene and scenery for the storyboard helps the students frame their architectural tectonic narrative and pay greater attention to how spatial detailing affects human well-being. Yet, it might suggest a clearer focus on the *acts, behaviors*, and emotional experiences of the people rather than the aesthetic form and structural design of the objects (built environment).

Therefore, it is important to emphasize, that the individual frames in the storyboard are not precise representations of the future tectonic design proposals. Instead, each storyboard and frame *indicate* the student's careful considerations on the future use and movement, as well as outlines early considerations on social interaction and interrelationship. It *reveals* clues to an overall structural principle, through the spatial character and material expression depicted (through material properties like the shaping and treatment of the material surface, the load capacities, durability/patina suggested by positioning according to climate conditions). The architectural design co-narrates our everyday lives through deliberate design decisions on where to put structural elements like walls, windows, doors, openings, ceiling (heights), stairs, columns, beams. Not only through their physical form and specific shaping, but also with their material character and expressive qualities and what these elements afford, when arranged and ordered into a whole spatial composition. So, it is within this careful placing of the conceptual building parts and spatial elements in the different storyboard frames that we see a subtle weaving of complex ideas and parts together, and the contours of a tectonic design idea. The full synthesis, coherent narrative or seamless tectonic whole is not yet achieved, but the coherent narrative is slowly under development with the early joining of user-oriented, architectural and engineering principles in the storyboard. It thus shows potential as a valuable tool in the early design phases.

The storyboarding technique helps illustrate how the synthesis between form, structural system, and material choices are the means by which a distinct atmosphere and human acts and experiences can be afforded. That the careful humane sensitivity is revealed with the form-giving and materiality, as well as how a building can subtly express various atmospheres and what feelings or behavior it invites for. Thereby, revealing the tectonic design intention through physical matter. This perspective of construing and the realms of storytelling are *also* important ethical aims of tectonic design, because they are crucial for what we experience, feel, and remember in our everyday life. So perhaps, what these findings further suggest is that the tectonic expression is revealed in the process of turning the parts into the whole. More importantly, that when the design proposal leaves the hand of the architect it is constructed as an *ensemble*—the intention of the architect or engineer turned into form. As the real users afterwards start occupying and inhabiting the building, it slowly turns into an *assemblage* instead—a web of many different ways of living and numerous emotional and experiential layers.

## 4. Discussion

### 4.1 Revealing the acts and emotional effects of architecture

Learning how to solve problems is one of the key skills that our students must develop. This means they must employ various design methods and techniques during their project work and design process. And despite the ongoing educational attempts to discuss the general patterns of an integrated design process, students' individual design process is seldom well documented, articulated, or agreed upon. There are of course many variations in everyday practice, but in general, it is difficult for the individual student to share the approach and process of developing a certain design idea with group members and peers. Our intention behind the AHW course was to try out a pedagogical intervention that reflect more accurately how the human mind works, and how humans experience the built environment.

We were interested in exploring how students might benefit from using the storytelling approach and storyboarding technique to grow and develop their tectonic design *thinking*, as well as support a more humane design approach and user empathic design process. In the end, the narrative that students end up crafting the storyboards to illustrate a collection of everyday events; a prediction or envisioning of what could happen in the future (the TO BE). Consequently, this technique becomes a valuable design tool not only to capture, represent and communicate user experiences and well-being externally—but also to explore, analyze, and reflect on human emotional experiences and well-being internally. Which means that on the one hand, the storyboard serves as a visual tool to provide valuable insights for the spectator/reader into the student's idea development and decision process. While on the other, helping to bring forth and reveal parts of the early design process and conceptual thinking; the analytical process of translation, interpretation, and combining of research- and empirical findings with architectural-tectonic intentions that would otherwise remain hidden in the mind of the student and be difficult to share or explain. On the other hand, the act of crafting the storyboard might also allow time to ponder the impact of built environment on future users; and allow time to find out more about future user needs and demand; time to repeat/redo spatial impressions, play around with material characteristics, test and investigate surface compositions, imagine how to evoke certain emotional experiences – thereby, depicting

and assembling (or mentally ‘construing’) the design narrative. In most cases, the storyboarding technique seemed to help our students to start imagining scenarios, events and situations (the TO BE) instead of simply visualizing in the mind and then put the knowledge in front of themselves in the paper. In comparison to the practice by Utzon, the storytelling approach requires students to engage with diverse user groups; it brings attention not only to client needs, but also to question unknown challenges and demands. The students immerse themselves in the everyday life of their user group and start empathizing better with their specific life situations. In this sense, the process of developing the written scenario and visual storyboard is more than a sampling of the different cues, bits, and pieces they have found. It is a physical construction (through drawing) and mental construing (through imagination and reflection) of a ‘coherent narrative’; slowly unfolding the meaning of the building design through an oscillation between functional concerns and emotional aspirations. Moving from the present ‘as is’ into the future ‘to be’.

The process of developing the storyboard not only communicates their ideas to peers, but also helps to document and keep track of how they interpret and translate empirical findings and research into their own design proposals, as well as mixing inspirational ideas based on best practice. When students start discussing and comparing their work with each other, the storyboards in particular help the students to communicate and to develop awareness of the complexity of addressing multiple-diverse user perspectives simultaneously and how public building designs must address various user perspectives—and often even divergent user needs and demands together. This further supports eliminating so-called “tight-fit functionalism” [44], and instead considers how to allow for some degree of individual moderation and adaptability over time. The storyboard allows students to put into words and images the emotions, feelings, and thoughts they have about specific situations, atmospheres, and social interrelations; a part of the design process that can be very difficult to capture and explain in more traditional architectural drawings/blueprints like the plan, section, and elevation made on tracing paper or on the computer. What, in our opinion, is valuable about this case study is how the storytelling approach and in particular, the storyboarding technique allows the students to explore the complex multi-layered experiential conditions that a humane tectonic design holds. Finally, the drawing technique, compared to the more traditional plan layout or section, works as a tool recording more clearly their ideas about user acts, behaviors and their anticipated emotional experiences. The storyboard technique thus allows the students to start weaving their own thoughts and ideas together with research-based knowledge, best practice and empirical findings. Yet the unique strength of this method is to allow images and words to be placed side by side to illustrate buildings, landscapes, ensembles of spaces. And perhaps most importantly, to bend time and to twist spaces and places—to travel across and jump in time, to switch narrator voices, and illustrate how people feel and think, to highlight and bring awareness to unnoticed elements and explore materiality, atmospheres and affordances, and to help grasp the tectonic qualities of their design strategies that pinpoint and select conceptual ideas and overall design strategies in the early design phase.

A skilled and experienced practicing architect like Utzon might be able to handle this complex continuous inseparable loop of interpretation and translation of user experiences and emotions in a few seconds; drawing, pausing for second thoughts, reflecting, drawing again, thus conceiving the *coherent narrative* and *tectonic idea* in the mind, before the pen is put to paper. Yet, what we find is significant about the storytelling approach and storyboarding technique is that together they help the student realize and reflect on the role of the built environment not only as a well-orchestrated and well-composed architectural *ensemble* with a tectonic coherent narrative, but also as an ever-changing, dynamic *assemblage* – where the tectonic narrative allows for a patchwork or web of independent life worlds and personal stories filtered together. These educational insights are important clues for how to improve architectural -engineering education and an important long-term remedy to rethink professional practice. This approach can provide an important steppingstone for future professional practice and is important not only for how we practice architecture—but for how we *think* architecture and tectonics; and is crucial for promoting the growth of a more holistic and ethical mindset.

## 5. Conclusion

Motivated by Utzon’s ability to join architectural and structural ideas with a strong devotion to human well-being, this paper aims to spark a debate about ‘*tectonics of well-being*’, with the long-term goal to lay the groundwork for a discussion in an architectural and structural engineering context about how to achieve more sustainable built environments in which people thrive and feel well, in parallel with maintaining high tectonic architectural qualities.

Our theoretical insights and educational case study findings underline the need to enrich the understanding of the tectonic design: the overall (tectonic) *design approach* and (tectonic) *design process*, as well as which (tectonic) *design techniques* that trains students to integrate user-oriented, architectural, and structural engineering principles. Placing the ‘body’ and ‘experience’ at the very basis of tectonic design requires a much greater sensitivity to user perspectives and diversities within user groups, together with the more formal, aesthetic-spatial, and structural-material engineering considerations. This calls for not only an adjusted tectonic

framework and attuned vocabulary for discussing human well-being but, more importantly, an adjusted (tectonic) *design toolbox*, focused on translating diverse human experiences, emotions, and behaviors when designing. And finally, the approach we have outlined offers a valid educational method for training future architects in the skill that Utzon himself advocated in his 1948 statement: “*In the development of a project the client (i.e. the future user of the building with his special life style) is just as important a building material as concrete, brick, stone, timber and steel.*” [7].

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