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Architecture: Cause or Cure for Eco-Anxiety?

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Abstract. Construction is the main cause for global raw material extraction, and a key source of greenhouse gas emissions. Through the increasing consumption of resources, it is driving us beyond the planetary boundaries. We argue that in this light, the connection of the environmental impacts of new buildings and the symptoms of eco-anxiety among their designers, builders, users, and funders needs investigation and discussion.Art, culture, and rituals have been proposed as means to process and cope with difficult eco-emotions, including anxiety. Architecture is an important part of culture, oftentimes defined as, or including aspects of art, and can have symbolic meanings. Hence, it may also hold potential for dealing with difficult feelings, through e.g., memorial places. More importantly, however, regenerative, and emphatic architecture could support a shift of values away from an environmentally harmful construction culture towards building within planetary boundaries. This requires defining architecture from a new perspective, acknowledging its role in causing friction between values and acting thus as a driver for the ensuing predominantly negative emotions such as environmental anxiety. Design choices or architecture do not, however, need to be antithetical to environmental awareness, on the contrary. In this article, we present and discuss the dual role of architecture in relation to eco-anxiety. On one hand, architecture drives the consumption of resources, which causes significant environmental damage, and may hence spur difficult eco-emotions. On the other hand, architecture could be used for mitigating resource consumption as well as for offering re-evaluation of our construction culture, which is destructive for the wellbeing of our planet. Architecture could also create spaces where people are able to engage constructively with eco-emotions. Overall, we argue that architecture needs stronger value discourse. Conscious decisions, awareness-raising and skill-building can enable designers and teachers of design-related studies to better take eco-anxiety and other eco-emotions into account.

Keywords. Architecture, construction, eco-anxiety, eco-emotions, climate change, culture

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1. Introduction

1.1. The environmental weight of architecture

Architecture is closely related to the environmental impact of the construction sector. Around a third of all greenhouse gas (GHG) emissions are associated with the built environment [1]. Construction utilises half of annually extracted raw materials, which has an indirect contribution to biodiversity loss: around 90 percent of it is associated with the extraction of raw materials [1]. To prevent a dangerous climate emergency, the International Panel on Climate Change (IPCC) has called for a reduction of 80–90% of building-related GHG emissions by 2050 [2]. These emissions are mostly related to the use of energy and materials. However, the consumption of building materials is currently growing faster than the global population [1], which is contrary to the reduction needs of the IPCC. Furthermore, the built environment is not efficiently operated. Currently, around one-third of the buildings in Europe are underutilised, and 16 percent are empty [3].

Therefore, it is understandable why architects have also expressed environmental concerns. Movements such as the Architects Climate Action Network and the Architects Declare initiative are examples. Calls to avoid new buildings have also been expressed [4], including a moratorium on new construction by Charlotte Malterre-Barthes [5]. These movements are initiated by architects themselves and are promoting environmental action among them.

As the understanding of the environmental burdens of construction has grown, iconic buildings of modern times have been subject to criticism regarding their environmental burdens. For example, Professor Kiel Moe has thoroughly studied both the Empire State Building and the Seagram Building and recorded the excessive consumption of resources and the consequent environmental and social burdens [6, 7]. Alvar Aalto's Finlandia Hall in Helsinki has received criticism regarding the need to replace its white marble façade panels too frequently, as they have proven ill-performing in Nordic weather conditions [8]. Additionally, the famous Bauhaus school of architecture in Dessau, Germany (by Walter Gropius) and the iconic La Cité de Refuge in Paris (by Le Corbusier) are notorious examples of extremely inefficient use of energy and operating costs [9, 10].

So far, many of the practical steps taken towards lowering emissions are related to the reduction of energy demand of buildings, which is the cause of *operational emissions*. In 2019, however, the World Green Building Council turned attention to building materials by starting a global campaign "Bringing Embodied Carbon Upfront" [11]. These *embodied emissions* are caused by the production, transport, and assembly of building products, as well as their replacements, disassembly, and final disposal. Importantly, however, the current emphasis on embodied emissions is turning more attention to building materials, shapes, and adjustability, which are visible and tactile in our built environments. This new emphasis on *tectonics* may ease our understanding of the environmental friendliness of buildings.

These issues have consequences for the role of architecture in evoking various eco-emotions, which we will discuss next.

1.2. Eco-emotions and encountering them through art and culture

Environmental problems cause many kinds of emotions, which can be called eco-emotions or environmental emotions. The most prominently discussed eco-emotion has been eco-anxiety, which is a wide-ranging phenomenon. Current and future ecological threats can cause many threat-related emotions and sometimes significant distress [12], [13].

Eco-anxiety, or eco-distress, can be difficult to bear. People can wrestle with strong anxiety states about the future. They can question meaning in life because they feel that the future is seriously threatened, and they may also have depressive symptoms [14, 15]. If these feelings and mental states are closely related to climate change, the terms climate anxiety, climate distress, and climate depression are relevant [16-18].

Fundamentally, however, anxiety as an emotion is related to the perception of potential threats [19, 20]. Eco-anxiety can thus be "practical anxiety" and related to the perception of very real but wide-ranging environmental threats. As a result, eco-anxiety cannot be categorised simply as something problematic: it may have both adaptive and maladaptive forms [21, 22].

Numerous people worldwide feel anxiety, worry, and sadness in relation to environmental issues [23, 24]. For example, in a large international survey in 2021, 66% of young people between 16 and 25 years reported anxiety and sadness because of climate change [25]. In the Finnish national youth barometer of 2021, as much as 76% of the youth reported ecological grief [26]. Young people have also reported anger towards decision-makers because of the lack of progressive environmental politics, and feelings of helplessness and powerlessness [25]. People of various ages have reported guilt due to environmental impacts and/or inaction, and guilt or shame can influence feelings of eco-anxiety [24]. Eco-emotions exist both on individual and collective levels, and they should not be reduced to either level only [27].

The relationship between eco-anxiety and other eco-emotions is intimate and complex. What is commonly called eco-anxiety may include, e.g., sadness, moral outrage, guilt, powerlessness, and despair. All these are relevant for the topic of architecture and eco-anxiety, or more broadly, eco-emotions. Buildings and other features of the built environment are an integral part of people's lifeworlds, and they resonate in many ways with people's emotions about the state of the world. Depending on the context, there may be either more direct or more ambient relationships between eco-anxiety and architecture.

Emotions live in people's bodyminds, in the intimate connections between their bodies and minds [28]. This is why embodied, and holistic experiences can be profoundly important in relation to emotions. Spaces and places can move emotions, especially if people are moving in them. For engaging constructively with eco-emotions in education and communication, various arts and environments have often been utilised. For example, people have been led to reflect on eco-emotions in city parks, with the idea that greenery and relations with the more-than-human world can support them; and dance has been used to explore eco-emotions [24]. Architecture can thus be a factor in the complex interplay between environments and events in cases when eco-emotions are intentionally engaged with. Various performances and rituals have engaged with eco-anxiety and other eco-emotions, sometimes in connection to memorial places [29].

Eco-anxiety and other eco-emotions are clearly phenomena which are relevant also for architects and architecture because design is made to serve people's needs and environmentally sustainable design is mainstreaming. It seems evident that people's eco-

anxiety can be impacted into better or worse by architecture and design, but this topic has been very little if at all studied. Furthermore, architects and students of related fields also have their own eco-emotions, which may include eco-anxiety. Attention to the relationship between eco-anxiety and architecture is thus important for many reasons, and in this article, we provide starting points for further interdisciplinary analysis. One of the major dynamics which affects the topic is the large environmental impact of construction.

1.3. The symbolic potential of architecture in societal value shifts

Architecture – quite literally – makes our lifeworld what it is. The capacity of architecture to carry meanings has been recognised since the dawn of contemporary societies. Architecture has traditionally carried different types of societal and cultural symbolic meanings. This is visible in how religious buildings, for example, have been designed at different times to represent spiritual ideals or in how the houses of the ruling classes show power not only in symbolic form but also through their sheer size and proportions. These can also be references to the power structures of society by making the ruling class and wealth visible. Grandiose or neoclassical styles have also been employed to represent traditionalism or totalitarian politics [30]. Architecture designed for leisure and pleasure purposes often portrays these functions and so do hospitals and other places designed for the sole purpose of healing. On the other hand, architecture embodying consumerist culture such as shopping centres portrays the market economy's values with their inward-turned facilitation and precipitation of processes of consumption.

Architecture makes human values visible through its means of taking up space and forms, its use of materials, and its relation to other elements of its surroundings. This type of symbolic value has been readily used as a means of emphasising power structures and different functions of society but besides intended meanings, unintended ones are ascribed to architecture as well. This is partly because the inscribed meanings and values cannot be fully controlled but also because they tend to change over time. Symbolic meanings in architecture rely on the interpretation skills of the people using the buildings and spaces around them. The more fine-tuned or subtle the means of expression are, the more is required to assess the intended meanings.

The so-called cognitive or scientific approaches in aesthetic theory emphasise the role of knowledge in the assessment of one's environment and its perceptual qualities. Scientific knowledge has been identified as being of importance when making informed judgments of aesthetic quality [31]. *'Aesthetic disillusionment'* is a term that in aesthetic theory has been used to describe what happens when we learn about the object of our appreciation something new which negatively impacts our experience [32, 33]. This relates also to shifts in the scientific paradigm, as in sustainability transformations: something that was previously considered to be normal becomes suspicious in terms of ecology or planetary boundaries. As an example, the widespread use of concrete has been proven to be unsustainable [34] and this shift in knowledge is causing deep reconsideration not only of the omnipresent paradigm of architectural design thinking but also of the existing building stock.

In the contemporary context, the ongoing value shifts are also reflected in architecture. Emerging symbolic shifts represent a turn towards posthuman and regenerative architecture, biocentrism, and minimalist approaches (in opposition to

rampant consumerism). These are, however, still marginal and do not fully respond to the growing awareness of environmental damage. This awareness can penetrate our perception, leading to mixed reactions to beauty when recognising that it is a (by-)product of destructive human activity [35]. Hence, our age is defined by an increased sensibility to the signs of environmental damage.

Architecture as a product of human intentional activity makes human values experienceable. The "original" intentions of the designer(s) are not necessarily the ones to direct further interpretations, but they often provide some guidelines for interpretation. Architecture is in this sense always not only inter- but transgenerational to a significant degree [36, 37]. Some meanings carry as intended to future generations but in principle, each generation forms their assessment based on the value constellations that characterise their era. To avoid falling into a trap of relativism in the interpretation and recognition of values, scientific and sustainability-related knowledge offers sufficiently reliable ground to assess the evaluation processes: in this way, we can normatively state that some architectural forms support human and planetary wellbeing better than others, even though they may have been previously assessed as being of lower experiential quality.

Despite the obvious risks involved in the interpretation of symbolic meanings and the values they carry, architecture has significant power and potential to alleviate the anxiety-producing facets of contemporary societies. This is partly because the same building can signal different things to different people. The symbolic value of architecture is always contextual, making architecture vulnerable to changes in interpretations and emotions it evokes in people. Which direction the symbolic values tilt in one's interpretation and view of the building depends on many variables. One direction to amplify positive, anxiety-alleviating interpretations is to educate people and, in this way, increase a certain form of architecture literacy and sensibility to the changes in values. The ongoing re-evaluation of the fossil-fuel dependent industrial era is an example of this, as it causes commotion in the assessment and use of many previously preferred materials and processes.

1.4. Aim and scope of this article

As described above, eco-anxiety is already a common phenomenon, especially among the youth. Due to the heavy environmental problems of construction and the symbolic potential of architecture, there can be many possible connections between eco-anxiety and architecture. Despite this close relation, academic research on the connection of architecture and eco-anxiety is, to our understanding, so far almost non-existent.

We argue that this topic deserves closer exploration. The scientific discourse on the ambivalent and dualistic role of architecture as a source of environmental damage, but also as a means for mitigating it, has already begun. However, architecture as a form of cultural production may carry symbolic value that could either increase or decrease feelings of eco-anxiety – or produce related ambivalent effects. All these aspects would presumably apply to both architects and the public who are exposed to different forms of architecture.

Our objective in this article, therefore, is to identify connections between architecture, environmental damage, and eco-anxiety. In a broader scope, this relates to

the overall wellbeing in the built environment on two levels: First, we expect that there may be a connection through the architectural stimuli in our built environments that either intensifies or decreases eco-anxiety. Secondly, we hypothesise that architecture can be read as a physical record of caused or avoided environmental damage. Thirdly, we seek to trace typologies in architectural responses to environmental crises. Figure 1 depicts our main research question.

In this article, we will not discuss in depth the complex role of people's own estimations and evaluations of architecture. We limit our discussion to a) theoretically discerned possibilities of the relations between architecture and eco-anxiety, and b) intentional use of architecture to alleviate difficult forms of eco-anxiety.

In the following, we are testing these hypotheses and suggesting further research needs and directions. We have structured this article into four main sections. In the introduction, we have identified where architecture, eco-anxiety, and environmental damage meet. The second section describes the materials and methods of this article. In the third section, we will present our results and reflectively discuss them further in the fourth section.
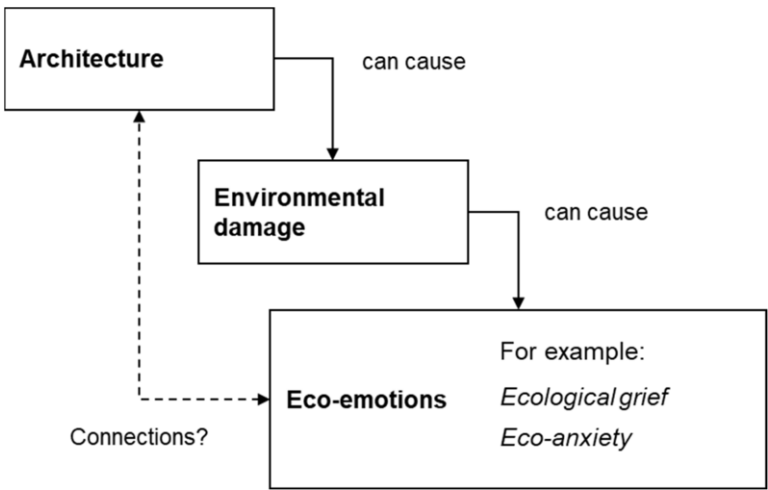

Figure 1. Are there connections between architecture and eco-emotions?

2. Materials and methods

2.1. Materials and methods of this study

Our approach to this article is based on a combination of interdisciplinary research methods. We approach the topic through conceptual analysis from the viewpoints of architectural theory, environmental and climate sciences, philosophy, and eco-emotion research. Many of these fields are themselves interdisciplinary and draw from psychology, sociology, and many other sciences. We fully recognise that other methods (e.g., from the social sciences) would be needed to study the topic further. In this article, we have focused on architectural theory and environmental philosophy, especially aesthetics.

2.2. Literature review

We conducted literature reviews from academic and professional media. The goal has been to identify:
- What is already known about the relation of architecture, environmental damage, and eco-anxiety?
- Is there indication that architects, or public are expressing views related to these topics that are yet to be recognised in cross-disciplinary studies of wellbeing in the context of the built environment?

In addition to the review of current academic and professional literature, we have reflected the above-mentioned topics to earlier writings in architectural theory and history.

2.3. Examples from the built environment

For studying the above-mentioned aspects, we sought examples from the built environment for further review. Our focus has been on well-known and published building projects, in which architecture can have linkages to eco-anxiety. With the help of these buildings as examples, we aimed to answer:

- What kinds of architectural approaches have been used in the mitigation of adverse environmental impacts of construction?
- What kinds of approaches have been used in memorial places for dealing with (difficult) feelings?
- How are these approaches connected to eco-emotions?

For this review, we have selected projects that have been published recently, or that are known examples in the modern history of architecture. The criterion for this selection is based on the visibility of these projects in international professional media (e.g., ArchDaily, Dezeen). The selected examples are listed in Table 1.

Table 1. List of exemplary projects used for this article.

Example	Type	Location	Built	Designer
Place Léon Aucoc	Urban square	Bordeaux, France	1996	Lacaton & Vassal
UBA Federal Environment Agency	Office	Dessau, Germany	2007	Sauerbruch Hutton
F87	Residential	Berlin, Germany	2011	Werner Sobek
Modern seaweed house	Residential	Læsø, Denmark	2013	Tegnestue Vandkunsten
Passenger Pigeon Memorial	Memorial	Cincinnati, USA	2014	Cincinnati Zoo
No Footprint House	Residential	Ojochal, Costa Rica	2018	A-01
Tecla clay house	Experimental, detached	Massa Lombarda, Italy	2021	Mario Cuccinella
KA13	Office	Oslo, Norway	2021	Mad Arkitekter

Resource Rows	Residential, apartment block	Copenhagen, Denmark	2022	Lendager Group
Alusta	Pavilion	Helsinki, Finland	2022	Elina Koivisto & Maiju Suomi
Living Places	Residential	Copenhagen, Denmark	2023	Effekt Architects
Underground Cathedral	Memorial, exhibition	Portland, UK	(Not built)	Eden Project
Action Hub	Pavilion	Gothenburg, Sweden	(Not built)	Amitis Fouladi

3. Results

3.1. Literature review

3.1.1. What is already known about the relation of architecture, environmental damage, and eco-anxiety?

There are only a few texts explicitly discussing eco-anxiety (or other eco-emotions) and architecture. However, closely relevant studies can be found, for example, in research about memorials, and some studies already discuss memorials and ecological grief. Below, we briefly discuss examples of relevant research.

The most explicit studies of eco-anxiety and architecture are various kinds of student theses, which can be difficult to access. In her master's thesis in Architecture, titled "From Anxiety to Action: Exploring How Participatory Architecture Can Aid Youth with Climate Anxiety", Amitis Fouladi focuses on a case study of youth shaping a public space to aid in engaging constructively with climate anxiety [38]. This is an intriguing effort as it includes potential impacts on eco-emotions on various levels and in various stages. Eco-emotions expressed by the youth were recognized in the process, which is helpful for these individuals, and these emotions influenced the co-design process of a space aimed to evoke both environmental awareness and facilitate constructive engagement with eco-emotions. Regrettably, the result was not constructed, at least not immediately after the process, and Fouladi discusses the potential disappointments that this may have caused to the participants. This is an important point in relation to co-design projects: they may end up increasing feelings of powerlessness if the process does not come to fruition. However, one may argue that it is still valuable to listen to the voices of various people and at least attempt to advance these kinds of projects. Similar topics are approached in the thesis of Adele Valtersson [39]. She explores the possibilities of architecture itself to evoke various climate emotions, both comfortable and uncomfortable. This is a very creative agenda.

Adams [29] has explored the possibilities of memorials and public rituals to engage with ecological grief, ecological guilt, and ecological shame; she does not explicitly name eco-anxiety but mentions anxiety, and the emotions she focuses on are very intimately connected with eco-anxiety [24, 40]. Adams believes that communal engagement is essential for constructive coping with eco-emotions. In relation to architecture, she uses The Lost Bird Project, an exhibition art project by artist Todd McGrain that commemorates birds lost to extinction caused by humans, as an example of environmental memorial. Adams argues that various difficult eco-emotions should be

engaged with creatively in public spaces, but the focus is more on events than architecture. The same applies to other studies of memorial events for environmental loss, such as the international Remembrance Day for Lost Species activities [41, 42].

More broadly, Mihai and Thaler [43] analyse ethical guidelines for "environmental commemoration", discussing ecological grief and various kinds of memorials (private monument, a national museum, and a memorial complex in a city-owned zoo). They argue that ecological grief (which may co-exist with eco-anxiety) should be publicly acknowledged as a legitimate reaction to environmental loss. This is important both in relation to raising moral awareness about the destruction of more-than-human life and in relation to recognizing publicly those who grieve, thus acting against disenfranchised ecological grief [44]. Mihai and Thaler propose a set of guiding principles for environmental commemoration: multispecies justice, responsibility, pluralism, dynamism, and anti-closure. Their article thus provides important background for the possible roles of architecture in relation to eco-anxiety and ecological grief, even while they do not engage extensively with research about architecture.

3.1.2. Recognition of the connection between environmental damage and architecture

The term "eco-anxiety" was only occasionally brought up in the professional sources that we looked at. However, there are several texts, interviews, blogs, and projects in which the causes and symptoms of unsustainable architecture and construction have been discussed.

We found several examples of projects and design companies that already address the problematic relationship between design and environmental damage. Award-winning Pakistani architect Yasmeen Lari has suggested an entire redefinition of the profession of architecture, aiming to better address social and environmental crises [45]. White Architects (Sweden) and Studio Mikhail Riches (UK) have declared their intention to shift towards designing only carbon-neutral buildings [46, 47]. Norwegian architectural firm Snøhetta has set even more ambitious goals, aiming to design all their projects to be carbon-negative within 20 years [48]. In the respective interviews and announcements, concerns for the state of the environment are verbalized. As Alexie Sommer and Ella Doran put it, designers should "stop making pointless stuff that looks nice and fuels relentless consumption" [49].

Similar voices have also been heard from non-architects. In 2019, New York City Mayor Bill de Blasio announced planned legislation to "ban the glass and steel skyscrapers that have contributed so much to global warming" [50]. In London, Mayor Sadiq Khan announced similar considerations [51].

In our literature review, we did not find any published sources that would contain opposing views, i.e., arguing that the mitigation of environmental harms should not be considered in architecture and construction.

3.2. Examples from the built environment

3.2.1. Architectural approaches in the mitigation of adverse environmental impacts of construction

The "Trajectory of Ecological Design" by Mang & Reed is an often-used model that describes the evolution of design approaches [52]. It spans from conventional to green, sustainable, restorative, and finally to regenerative design. Despite the merits of the model, it is not nuanced enough for describing architectural approaches. This is due to

the diversity of both architectural projects and their environmental impacts. As design is conducted collaboratively and by many individual decision-makers, each project inevitably includes aspects that perform better or worse—or land at distinct stages of the trajectory of Mang & Reed. Furthermore, there is no single environmental performance indicator that could adequately capture the ever-expanding field of environmental assessment. As a result, no building can be definitively labelled as "ecological," "green," or "sustainable," as these definitions are too ambivalent to clearly describe all their benefits and drawbacks. For example, a project that may perform well in terms of climate impacts may have adverse effects on biodiversity or eco-toxicity. Hence, parallel definitions appear necessary.

Regarding a "conventional" approach to environmental conditions or constraints, we can find examples from 20th-century modernism. The famous Bauhaus Dessau school by Walter Gropius (1927) introduced modern curtain wall facades but required significant amounts of coal for heating the building. Le Corbusier's La Cité de Refuge (1933) in Paris is another unsuccessful attempt to resist the laws of thermodynamics with heating and cooling systems integrated into a glazed façade. A similar approach of solving energy discomfort by using more energy is apparent in Ludwig Mies van der Rohe's Seagram Building in New York (1958), considered a leading example of the modernist heritage of the Bauhaus school.

Despite these failed attempts, *technological optimism* is a strong trend in modern architecture. For example, the Federal Environment Agency in Dessau by Sauerbruch & Hutton (2005) or the F87 Plus Energy House in Berlin (Werner Sobek Architects, 2011) exemplify high-tech architecture and the results of analytical design. Both represent an *active approach* to achieving sustainability goals, building on the capacity of building service systems. Passive approaches, on the other hand, include solutions that are less dependent on building service systems and rely more on the architecture and tectonics of the buildings. For example, the No Footprint House in Costa Rica (A-01 Architects, 2018) integrates natural ventilation with openable louvres and solar shading into its modern architecture. The Modern Seaweed House in Denmark (Tegnestue Vandkunsten, 2013) goes even further in a *passive and low-tech approach*. Its materials are mostly organic and vernacular (seaweed and wood), relying only marginally on technical systems. An interesting example between high-tech and low-tech approaches is the Tecla Clay Pavilion in Massa Lombardy, Italy (Mario Cuccinella, 2021). It combines low-tech material (clay) with high-tech building technology (3D printing) into the shape of a humble, meditative dome.

Circular construction, or reducing material consumption through reuse and recycling, is currently a strongly growing approach. The KA13 office in Oslo (Mad Arkitekter, 2021) or Copenhagen's Resource Rows residential complex (Lendager Group, 2022) are well-known examples of this approach. Their materials include high degrees of reused components or recycled materials. The avoidance of new building products and reuse of old components correlate with significant environmental savings [53].

Optimizing the carbon flows of a building is another emerging architectural approach. The Living Places housing project (Effekt Architects, 2023) has succeeded in achieving a very *low carbon footprint* while building *carbon storages* with organic materials.

Place Léon Aucoc in Bordeaux (Lacaton & Vassal, 1996) stands in stark contrast to all other projects described above. Commissioned to refurbish a square, their (unexpected) intervention was to refrain from construction and recommend more

frequent cleaning and taking care of trees instead. Solving the design brief without building, or building as little as possible, has become an often-referred example of *minimizing resource consumption*. The same trend is apparent in the KA13 and Resource Rows projects.

These examples are but a limited selection for the purpose of describing different approaches to environmental impacts through architecture. We do not suggest, however, that hubris in architecture would only apply to modernism of the 20th century, or that there would not have been early examples of regenerative design.

3.2.2. Approaches used in memorial places for dealing with (difficult) feelings

Memorial places are intended for commemorating someone or something. These commemorations can be for losses (e.g., victims of war, or an accident), or for gains (e.g., for victories, or achievements). In our review, we selected examples that are related to either difficult feelings, or environmental losses.

The Underground Cathedral by the Eden Project is a powerful and provocative design for a memorial and exhibition in Portland, UK. It would utilise ancient stone carving techniques to commemorate species that have gone extinct, mostly due to human activities. This line of commemoration is also present in the Passenger Pigeon Memorial at Cincinnati Zoo, which is dedicated to the memory of a single bird species hunted to extinction little more than 100 years ago.

The Alusta pavilion in Helsinki (Koivisto & Suomi, 2022) and the design for an Action Hub in Gothenburg (Fouladi, 2022) are examples that invite activities related to commemoration or eco-emotions. The Alusta pavilion is an example of tectonics that can serve both humans and non-humans by offering shelter or function to both. The Action Hub is designed for reflecting on emotions related to the unsustainability of modern society but can also serve as a source for empowering well-being, resilience, or action.

All these examples of memorial places can be considered to offer elements of coping or healing: Confronting difficult eco-emotions in a safe environment may either increase tolerance or spur action.

3.2.3. Typologies for the relation of architecture and environmental crises

As the connection between eco-emotions and architecture is very little studied, we were looking for typologies that could be used to describe the relationship between architecture and environmental crises. Based on our review, we identified three main typologies for the architectural intentions to meet environmental crises. There can certainly be other typologies, or the projects could be categorised differently, but these three seem appropriate for describing the relationship:

1) Techniques: Solving environmental issues with functional and technical designs, materials, and systems
2) Emotions: Offering places for dealing with emotions
3) Values: Making statements for reflection of values

We chose 'techniques' as the first typology, as most case studies include a collection of different functional and technical solutions designed for the mitigation of adverse environmental impacts. These solutions include a broad variety of high-tech or low-tech approaches, or active and passive solutions. They also focus on different environmental impacts or desired outcomes (e.g., climate, energy, or the circular economy). Such

solutions are also very broadly represented in the academic literature of sustainable architecture and construction.

The two latter typologies could be recognised but were clearly fewer in number. Projects that sought to offer places for dealing with emotions were building on the positive aspects of communication, collaboration, and social engagement. Projects that can offer reflection of values included fewer aspects of social engagement but approached ecological crises as commentaries, monuments, or memorials.

In Table 2, we present an interpretation of these different intentions in the reviewed projects. One project can include features of several typologies.

Table 2. Typologies for the relation of architecture and environmental crises.

| Project examples		Techniques	Emotions	Values
Place Léon Aucoc	Square	✓		
UBA Federal Environment Agency	Office	✓		
F87	Residential	✓		
Modern seaweed house	Residential	✓		✓
Passenger Pigeon Memorial	Memorial		✓	✓
No Footprint House	Residential	✓		
Tecla clay house	Experimental	✓		✓
KA13	Office	✓		✓
Resource Rows	Residential	✓		✓
Alusta	Pavilion	✓		✓
Living Places	Residential	✓		
Underground Cathedral of the Eden Project	Memorial, exhibition		✓	✓
Action Hub	Pavilion		✓	✓

4. Discussion

4.1. The relation of architecture and eco-emotions

The connection between environmentally problematic building techniques and eco-emotions is, in our view, related to the *ecological literacy* of buildings and cities [54, pp. 125-140]. As construction materials are usually easy to 'read' from the surfaces of buildings, the increasing environmental literacy of new buildings can raise concerns about associated environmental harms. Similarly, old, reused building products or refurbished buildings can convey positive signals. Hence, ecological literacy in architecture can be related to positive or negative eco-emotions (Figure 2).

If this sort of literacy of the built environment evolves in our societies, it can support a shift in values, spur aesthetic disillusionment, or spark new ideals.

Next, we will discuss the *dark and bright sides* of architecture, or how it can either cause or alleviate eco-anxiety. It is evident that there are numerous factors related to people's own estimations and evaluations of architecture which can have a strong impact on the eco-emotional effects of buildings, but we must leave this dimension to future research, and we hope that our discussion can help to construct such research.
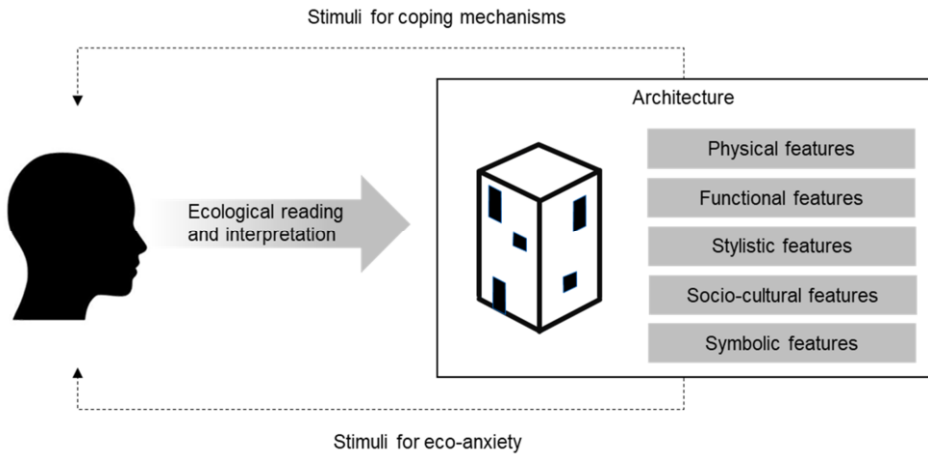
Figure 2. *Ecological reading and interpretation of architecture.*

4.2. The dark side: Architecture as a generator of eco-anxiety

Environmentally conscious people have reported feelings of eco-anxiety because of contemporary construction methods and scale (e.g., Toiviainen, 2007 [55]). These impacts on eco-emotions clearly deserve further study. The negative impacts may be more direct or more related to the symbolic potential of architecture. Physical environmental damage and psychological damage can be intertwined.

The direct damage wrought by environmentally damaging architecture is probably most prominently observed at the time of construction. People still remember what the place was without the building(s), and the material costs are perhaps most visible then. However, people with ecological literacy can observe and be impacted by this damage also later.

In addition, there can be less visible and temporally long-standing damages wrought by buildings, and it is possible to apply Rob Nixon's framework of *slow violence* [56] to examine these. The concept refers to violence which 'is neither spectacular nor instantaneous, but rather incremental and accretive, its calamitous repercussions playing out across a range of temporal scales.' Architecture can take part in producing this kind of violence to people and ecosystems, and part of this can be the negative impact on eco-anxiety that some architecture produces. The built environment is a long-lasting asset. If it is designed in a manner that demands lots of energy, or that is not resilient for future needs, a negative path-dependency is possible. Unravelling over decades, such path-dependency forms into another form of slow violence.

Today, much of the public criticism of architecture is aimed at the visual or haptic appearance of buildings or parks, their location, or their (dys)functionality. Tomorrow, as the understanding of the critical role of the built environment as an accelerator of environmental damage becomes better understood, would the criticism then be aimed at these features? Already now, there is criticism against the meaning and representativeness of statues and monuments of dictatorships of the past, and against the monumental buildings or parks that were built with the income from slavery (as examples

from the US and Belgium have shown), or from the gains of a linear, fossil economy (as in the case of the Seagram Building).

As has become clear, the dark side of architecture is a redefinition of brutalism, pomp built with the high price of environmental and social externalities. To explore this avenue, let us return to the essays about the pleasure and violence of architecture by Bernard Tschumi [57]. He states that architecture can be violent in either a *formal* or *programmatic* way. He defines the former as a conflict between objects (distortions, fragmentations, disjunctions, etc.) and the latter as purposes that are intentionally evil or destructive (prisons, slaughterhouses, concentration camps, etc.).

We suggest that architecture can also be *environmentally violent*, as exemplified in this article, and that this can be either 'fast' or 'slow' violence. This violence can, in our view, form a direct linkage between architecture and eco-anxiety. We should even ask if mainstream modern architecture is becoming (in Tschumi's words) *perverse*? Namely, its lust for materials and energy has required – until recently and especially in developed countries – a violent transgression of the already broken safe boundaries of our planetary carrying capacity

4.3. The bright side: Architecture for alleviating eco-anxiety

Fortunately, architecture and design also have great potential for alleviating eco-anxiety and providing opportunities to engage with many kinds of eco-emotions, both uplifting and sad.

Especially in previous decades, many environmentalists advocated for optimism and action as antidotes for eco-anxiety and other difficult eco-emotions. However, as the ecological crisis has worsened, the need to be able to live with difficult emotions has become more evident (e.g., Verlie 2023 [58]). Action is still a major factor, but it cannot be the only method for coping.

This is highly relevant for the relationship between architecture and eco-anxiety. Advancing sustainability in construction methods and materials can both lessen adverse environmental impacts of construction and alleviate eco-anxiety potentially felt by designers themselves and by people who evaluate (or read) architecture through an ecological frame of reference. However, Weijers and Agar remind us that 'overzealous appeals to the abilities of climate tech may end up making us much less happy' [59]. As many environmental thinkers have argued for a long time, technology is only part of the solution, and profound change is needed in human desires and values. Overly strong techno-optimism can backfire.

Architecture can also be seen as an enabler to more sustainable lifestyles, and this also has impacts on eco-emotions. Amid the current ecological and (philosophically) existential crisis, a lifestyle trend of voluntary simplicity is (again) trending. Although minimalism as a lifestyle can be an expression of anti-consumerism [60], it is tightly related to our built environments as a form of architecture. The latter, however, does not necessarily require strict stylistic formalism, which is not a necessary definition for a simple lifestyle. The interdependency of minimalist architecture and simple life can, however, be found in the need for a calm yet functional space that can support a life without excess possessions or excess consumption of materials and energy for a good and meaningful life.

Furthermore, architecture can make room for social approaches to dealing with eco-anxiety. In Fouladi's Action Hub project (2022), the youth wanted to create a building which would promote both ecological awareness and enable constructive engagement

with various eco-emotions, for example via supportive discussions. The symbolic function of architecture is also related to this, but in a complex manner. Architecture has the potential to function as a sign of hope, but often it functions as an ambivalent sign of both ecological progress and costs.
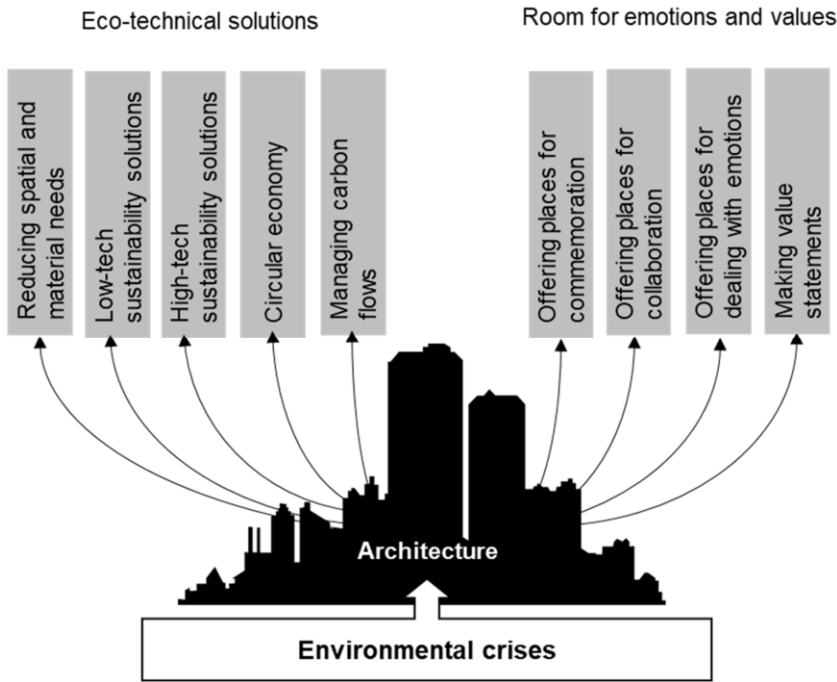
Finally, the alleviation of eco-anxiety relates to the importance of memorial places, which are oftentimes architectural. A parallel example could be the Holocaust Memorial in Berlin by Peter Eisenman (2005). Although built for a different purpose, it is an example of public architectural memorials in which collectively difficult feelings can be met. The memorial also allows for a multisensory, bodily experience, as the views, light, acoustics, and even temperature change as one walks through the passages of the stones that make up the public artwork. Immersive spaces offer holistic possibilities for engaging with eco-emotions. However, both ecological impacts and inter-human justice issues need attention when designing these kinds of buildings and spaces [41, 43].

An important observation from our review of projects is that projects that utilise architecture's potential for dealing with eco-emotions or for reflection of values seem to be rare. As emotions and values are deeply related to our actions, we raise the importance of considering these dimensions more in architecture and design.

4.4. Strengths, limitations, and topics for further research

The article has several strengths, including its novelty in addressing the topic and its interdisciplinary approach. However, these strengths also lead to certain limitations. While the article provides brief discussions on many topics, there is still much more work needed to fully integrate and apply the various disciplines together. Some important areas for further research include:
- Philosophy of technology and typologies of environmentally oriented architecture.
- Empirical research on eco-emotions among a) architects, b) students of related fields, and c) various individuals impacted by buildings.
- The role of the observer in relation to eco-emotions: exploring how the same building can be interpreted differently in terms of eco-emotions. This requires utilizing methods from various social and psychological sciences to understand the multitude of factors influencing people's perceptions and experiences.
- Exploring the interplay between spaces and events in engaging with various eco-emotions.
- Expanding the range of examples from the built environment, particularly in landscape architecture and city planning.

Figure 3 shows a diagram with two groupings. On the left, under "Eco-technical solutions": Reducing spatial and material needs, Low-tech sustainability solutions, High-tech sustainability solutions, Circular economy, Managing carbon flows. On the right, under "Room for emotions and values": Offering places for commemoration, Offering places for collaboration, Offering places for dealing with emotions, Making value statements. All arrows point from a building silhouette labeled "Architecture," which rises from a box labeled "Environmental crises."

Figure 3. *Different architectural responses to environmental crises.*

5. Conclusions

According to architect and theorist Christian Norberg-Schulz, "since remote times architecture has helped man in making his existence meaningful" [61]. Contemporary cultures are more diverse, and single buildings seldom have the concentrated meaning that ancient megastructures had. However, the potential of architecture to manifest values and influence people's meanings in life still exists, albeit in a more diffuse manner. Many buildings today reflect materialistic, hedonistic, and anthropocentric values, but designers are increasingly exploring possibilities for buildings that signal and manifest environmental values and the meaningfulness of intimate relations between humans and non-humans. This aspect is fundamental to environmental education and communication through architecture. Even environmentally problematic buildings may serve as warning examples, akin to ancient Japanese "tsunami-stones" that warn future generations about the reach of destructive waves.

Moreover, it is crucial to recognize the ambivalence often present in ecological architecture, which can itself be a tool and form of environmental education [62]. Awareness of this ambivalence and its constructive utilization could be considered an advanced level of ecological literacy.

Architecture, or the built environment more broadly, can remind people of the climate crisis due to its carbon and resource-intensive nature. This can be termed the signalling function of architecture, which for some individuals may induce climate

distress or eco-anxiety. However, carbon-intensive, and ecologically problematic buildings can creatively be used in environmental education and communication, serving as reminders of past mistakes and lessons to be learned. This potential for a "dark pedagogy" highlights the ambiguities of human relationships with the more-than-human world.

Designing less environmentally harmful buildings can alleviate eco-anxiety for designers and the wider public if there is clear communication about the end products. Participation in the design process can further alleviate eco-anxiety for those involved, potentially leading to better outcomes influenced by the knowledge and experience of eco-anxious individuals. Buildings, places, and spaces that provide opportunities for constructive engagement with eco-emotions are crucially needed. Examples such as memorial places for engaging with ecological grief and anxiety, and democratic spaces for discussing environmental issues and emotions, are relatively rare, indicating that the full potential of architecture for mitigating adverse environmental impacts has yet to be realized.

Overall, it is imperative to seek constructive ways to live with ecological crisis and eco-emotions. The relationship between architecture and eco-anxiety is complex and best understood as a process: eco-anxiety can influence architecture, and vice versa. Architecture plays a role when people strive to cope, adapt, and transform in the face of an escalating socio-ecological crisis [58, 63]. Conscious decisions, awareness-raising, and skill-building can empower designers and educators in design-related fields to better address eco-anxiety and other eco-emotions.

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