

Apparent Destruction Architectural Design for the Sustainability of Building Skins

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Abstract: Technical durability and aesthetical longevity of building skins are among the fundamental demands of sustainable architecture in terms of building fabric's physical changes due to deterioration. This concept paper presents a design concept intended to fill the existing gap related to the limited durability of buildings and non-existing design methods for its effective extension. The study concentrates on the anticipation and assimilation of disintegration processes occurring in time into the architectural design methodology to promote the design techniques focused on the visual expression of the coexistence of nature and the artificial in the function of time. This study investigates the building's enclosure as an active boundary through which the building's interaction with the natural environment occurs, as well as a regulator of the building's energy performance and a factor conditioning their durability. The consideration of formal and esthetical deconstruction in architectural design is followed by the analyses of some relevant examples of completed buildings and cultural determinants underlying this issue. The proposed Apparent Destruction Architectural Design (ADAD) concept addresses the time-dependency of the building skins' physical properties manifested by the deterioration, destruction and re-figuration of the building's fabric. This design concept offers a solution to the disturbing problem of architecture's impermanence enhances the issue of sustainability of the building's fabric in time, becomes a means to search for the unconventional comprehension and vision of architecture, as well as to reframe the architectural design toward its compliance with sustainability postulates through the aesthetic concept.

Keywords: architectural design; apparent destruction; entropy; technical durability; aesthetical longevity



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1. Introduction

The issue of buildings' longevity remains one of the fundamental requirements of sustainable architecture due to the constant transformations as a function of time. These changes are related to the characteristics of the destruction process that are recognised as unrecommended for technical reasons, as well as for aesthetical intentions. The obvious response is to slow down these changes by undertaking preservation efforts that cause elevated financial costs, which include, among others, additional expenses due to increased energy consumption. The buildings' rising energy absorbency throughout their life cycle, therefore, becomes a factor contrary to the sustainability paradigm. The occupants' acceptance of visible signs of weathering or effects of the systematic deterioration of material substance, as well as a positive perception of a building's destruction-related aesthetics, can be indicated as essential factors in overcoming these negative consequences.

Buildings, or "composite structures" enabling different human activities and having "both an internal space and an external form" ([1], p. 6), render a built environment component essential. The question of forming a building's envelope refers partially to the technical pillar that, along with social, economic and biophysical postulates constituting the principles of sustainability [2], assures the construction of durable and functional structures of high environmental performance and quality.

The self-modification of the initial phase of architectonic objects, disclosed after the completion of a spatial concept of the aesthetics being specifically defined as well as purposely developed by architects, remains unavoidable. The kind of this correction, the intensiveness or the ultimate results, are difficult to anticipate since they depend on the multifaceted factors that influence this process independently or synergistically. This development has a destructive character mainly in terms of its materiality and formality, as well as functionality or semanticity.

This article examines the durability-oriented design methods to shape the building skin that goes beyond the direct application of the developed building techniques to focus on the eco-aesthetic measures within the design process. The study investigates the building enclosure as the active boundary through which the building's interaction with the environment occurs, as well as a "component in the integration" ([3], p. 1) of human-made structures with natural ecosystems, and which does so in terms of the anticipation and assimilation of disintegration processes occurring over time. It considers an architectural design methodology that promotes the coexistence of architecture and nature. The article analyses the character, scale and range of the relationship between the deterioration of the technical conditions of buildings associated with their limited durability within their life cycle and the aesthetical effects of this phenomenon.

This paper presents a conceptual framework aimed at implementing the Apparent Destruction Architectural Design (ADAD) concept into the design methodology, supplementing the strategy for effective resources management that fulfils the environmental sustainability issue. Specifically, its technical pillar [2] is accomplished with lean design and construction, as is done as well with the introduction of recycled materials and durable structures. The main objectives of the study are as follows: (1) formulate an apparent destruction architectural design framework in view of the building enclosure's sustainability; (2) determine the range of possible formal and technical interventions within the building skin to employ the design scheme and then examine the character of their contribution to sustainability; (3) recognise the apparent destruction as a means to reframe the architectural design toward its compliance with sustainability postulates.

All those postulates are intended to respond to the apparent necessity to launch a serious discussion about further methods to increase the sustainability of buildings by way of unconventional solutions. The presented concept is designed to fill the existing gap related to the limited durability of buildings and non-existing methods of its effective extension. Written published materials have not indicated this way of dealing with the analysed issue so far.

The structure of this article is as follows: the first part addresses the building skins and emphasizes their substantial role in the buildings designed in accordance with sustainability postulates and in view of their function as a separator between the exterior and interior of buildings, as well as a regulator of their energy performance. This section also deals with the issue of the durability of buildings conditioned by building envelopes. The next chapter considers formal and aesthetical deconstruction in architectural design, analysing some relevant examples of completed buildings. It also discusses the cultural determinants underlying this issue. Crucial is the section dealing with the introduced term "apparent destruction design", which explains the meaning and essence of the idea by analysing it in larger, energy-related and biophilic contexts. The application modes of this concept in executed buildings, presented in the next fragment of the paper, give the idea of the results of the implementation of the destruction concept. The Discussion chapter attempts to justify the investigation of the realm of the interrelationship between the human-made and natural environments that is the inspiration of the presented idea.

2. Building Skin and Sustainability Postulates

As Lee noted, the "building envelope occupies a special position within the strategies of sustainable design" ([4], p. 120). These strategies respond to the functional, technical and energy-related questions in a cohesive manner and assure the "symbiotic relationship

with natural environment" ([5], p. 260). The building skin, also referred to as the building envelope, shell, fabric or enclosure, establishes a physical boundary between the interior of a building and the outdoors. The structure and technically advanced components of this "environmental separator" generally situated between the inside and outside of a building ([6], p. 2) are expected primarily to respond to external circumstances, providing users with psycho-physical comfort.

For the purposes of this study, the term building skin is applied to analyse the apparent destruction of a building's external surface in the context of its environmental sustainability. The term building skin designates the active position of this building component and its ability to "selectively admit and reject" ([7], p. 247) the natural environment's influence in time, as well as to overcome its position as a boundary to physical and psychological control of the environment [8]. This interrelationship results in visible signs of progressive physical deterioration of building materials and products over time. The building skin, providing the "transition between inside and outside" ([9], p. 9), becomes a responsive building component in view of the following sustainable postulates: (1) low level of energy consumption; (2) effective management of resources with emphasis on the materials' durability; (3) enhancement of indoor environment quality parameters; (4) articulation of interconnectedness and interdependency of human-made and natural environments to provide the building's functional and aesthetical cohesion. This serves to modulate the occupants' multisensorial emotional and cognitive experience of a building and intensify the topophilia [10], understood as individually developed and emotionally based reception of the space.

2.1. Energy Efficiency

Building skin responds to the sustainability requirements in a way to contribute to the object's high environmental performance, mainly through the control over effective energy consumption within the object's life cycle, as mentioned earlier, meaning both operational and embodied energy.

The supplementing design techniques to accomplish the energy-efficiency-related demand through the building skins outline, in large measure, comprise the following: (1) spatial disposition respecting functional demands as well as building orientation and exposure to meteorological conditions; (2) modularity of enclosure construction; (3) simplicity of surface treatment of the enclosure's finishing layer and limited processing (e.g., mechanical working, plastic forming, abrasive machining); (4) application of reclaimed, recycled or recyclable building materials and products; (5) assembly technique allowing for the sporadically executed partial demounting of the damaged parts and their replacement.

These above-mentioned procedures, having a direct or indirect impact on the appearance of the enclosure, are decisive in this regard and should override aesthetical concerns in a genuinely sustainable design. However, this seems to be a challenge to the ingrained methods of aesthetical perceptions. This paper proposes a new approach to the issue of energy-related features of building skins that brings them closer to the natural aspects of the environment.

2.2. Effective Resources Management

In searching for notions relevant to the analysis of the connection between architecture and the sustainability paradigm, Lee highlights concepts addressing the relationship between the sensory perception that enables the qualitative evaluation of an object and the quantifiable measures applied to its assessment [4]. These notions denote the "role of architectonics in informing the relationship between the expression of material culture and the environment" ([4], p. 10).

Given that sustainable architecture is to address and stimulate the users' senses [11] and considering the external wall as a compound functionally and technically developed to enclose and dress the built structure, retaining superiority over the construction in terms

of form and the content of architecture [12], the study focuses on the questions of building skin materiality, identified as an essential factor of aesthetical distinctiveness. In addressing the pro-environmental postulates, the building skin design is to simultaneously provide the occupants with the high values of formal qualities that affect users' perception on the cognitive, behavioural, and emotional levels. Limited to the buildings' enclosure, the study area denotes perception as the "subjective assessment of individuals" [11], influencing the users' qualitative evaluation of the building's performance.

To achieve this, the effective management of resources is necessary, namely the suitable choice of building technology related to the skin and emphasising its low embodied energy as well as durable materials and their fixing techniques.

2.3. Durability of Building Fabric

Durability is the most frequently mentioned and considered part of the sustainability paradigm [13,14]. However, the difference between durability and longevity should be elaborated on, given that they have a similar meaning. Some sources define durability as "the quality of being able to last a long time without becoming damaged" [15], "the power of uninterrupted or long continuance in any condition; the power of resisting agents or influences which tend to cause changes, decay, or dissolution" [16]. Another definition relates to the characteristics of a concept, meaning its ability "to exist for a long time without significant deterioration in quality or value" [17]. Longevity is defined as the "long duration of individual life" or "long continuance" [18]. It seems evident that the term durability rather than longevity applies most closely to the problems related to architecture and construction, as well as to the analysis in this paper. However, the term longevity will be used in relation to aesthetical issues.

Another concept used in relation to sustainability and close in meaning is resilience, understood as the "ability of a system to absorb disturbances and still retain its basic function and structure" ([19], p. 1). This concept, allowing small re-arrangements irrelevant to the object's identity and integrity, is aimed to "build capacity to work with change" ([19], p. 14). The durability of any component, regarded as the quality of maintaining the object's satisfactory performance, is correlated with the environmental and operation-related factors that cause deteriorating or degrading effects upon the object's properties and its functioning. Durability is the "product of a large number of factors" [20], including the type and quality of materials chosen or the degree of exposure to which a building is subjected. As noted by Legget, it is justified to analyse this term separately within each major building components category, including the group "exterior finishes" [20].

Technical durability in the case of buildings, addressed through design and construction, remains the factor enabling the amortisation of environmental and economic costs [21] and assessments of the ability of a building and its parts to "perform required functions in its service environment over a period of time without unforeseen cost for maintenance or repair" ([6], p. 2). Durability informs the extent to which a material maintains its original requirements over time [22]. It refers to the state of the conceived material object, defining its ability to fulfil the assigned functional requirements within the anticipated lifespan "without breaking down irreparably" ([4], p. 12), whereas sustainability is understood as a process that means continuity reached through the presence of necessary structures and relations. The term durability, considered sustainability's complementary component [4], addresses the appropriate building methods that are to maximise the value of the object in terms of its utility duration. This approach to the question of the object's usefulness implicates the evaluation of the introduced building materials, as well as the applied building techniques, based on the postulates derived from the sustainability strategy of effective resources management corresponding to the object's lifetime performance.

The degree of sustainability of buildings and their components in the design strategy is defined by the materials' durability-related features that correspond to the objects' life cycle performance [23]. These comprise the following factors that are meant to function- and technique-related solutions: (1) functional effectiveness defined by low-cost and simple

building technologies; (2) adaptability, meaning easy change in function and potential for relocation in the future; (3) ease of demounting process and separation of combined materials or components for further reuse; (4) susceptibility of selected products and materials to recycling; (5) transparency and simplicity, understood as the clarity of applied technical solutions complemented by easy inspection; (6) dynamism of systems allowing for ecological risks instead of their stability.

Among the issues essential for the aesthetical longevity of objects manifested through the physical condition of the object's surface are the following:

- Amenability for and ease of maintenance [24,25], as well as its low frequency;
- Evolutive capacity, meaning the possibility of future improvements in the building's technical life cycle;
- Ability of materials to withstand time-related malformations or those provoked by users, supplemented with the introduction of envelope patterns to absorb possible buckling "without detracting from the appearance" ([25], p. 87) of the object's finishing layer and that of the object as a whole.

These factors influence the perception of a building as a subject of continuing physical degradation and disfigurements and have an impact on its durability. To assure the steady performance of a building shell in a lifespan, the applied construction techniques, treatments and selected building materials usually improve its technical durability and formal soundness, as well as its aesthetical approval. As a concept, the apparent destruction architectural design refers to the interconnectedness of human-made and natural environments in view of the building's lifespan. The concept employs technical durability accompanied by aesthetical longevity as the criteria of sustainability-oriented architectural design. The above-mentioned building skin sustainability features and the indoor-outdoor relationship, unlike indoor environment parameters irrelevant for this study, are considered in the following sections.

3. Destruction in Architectural Design

The deterioration over time of building facades is a common occurrence and is a noticeable phenomenon. The main three environmental conditions that have the greatest effect on the built fabric are temperature (ambient and surface), humidity (absolute and relative) and sunlight (ultraviolet), along with atmospheric pollution [26], while additional human-induced degradation features, related to the object's operation and users' behaviour, are littering, graffiti and vandalism [26].

These transformations concerning the building's envelope usually do not cause any direct inconveniences in terms of the real objects' functionality and to a certain point, have technically harmless effects. Their negative connotations usually decrease the overall aesthetical value and thus can have, in some cases, an indirect impact on functional features. Destruction, for the purpose of this specifically oriented analysis, is to be defined as pursuing the disintegration of the above-mentioned characteristics and parameters of the building over time. They differ significantly from the initial stage, expressing the originally developed form. There are different indirect levels of destruction to be recognised within the temporal range before the final stage and the extremal form assigned to this process.

It is reasonable to recognise other notions to describe the process of multilayered changes in the building fabric, including deformation, disfigurement, degeneration and disintegration. Destruction, as it embraces the above-mentioned, seems to be the most appropriate term and thus is referred to in the following sections of this paper.

3.1. Formal and Aesthetical Destruction

The SITE group dramatised the disposable and substandard qualities of selected buildings in the projects realised from the 1970's [27]. That, as Wines admitted, made them appear as "arrested somewhere between construction and demolition" ([28], p. 98). Their objects, frequently realised in the form of artificial ruins, remained "simultaneously unfinished and decaying" [27], witnessing the unsettling process of completion, anticipating the

inevitable future destruction of buildings that were created in a way to emphasise their material “fragility and ephemerality” [27] in view of the progressing physical decomposition over time, and the final disappearance as a result of nature’s dominance. Artists and architects from SITE recognised in the creation of the buildings as “monuments of entropy” ([29], p. 428), being a partial response to the whole spectrum of social concerns that arose in the 1970’s, and to the criticism about the expansion of the consumption model. Their buildings’ formal appearance as artificial ruins, as well as the exposure of nature’s role in the process of specific consumption of building fabric, were the most often explored SITE design method. This was possibly associated with the investigation of the destruction, decay and incompletion constituting fundamentals of the architectural design concept.

The Maison Zalotay by Elemer Zalotay, representing the architectural design exploring the destruction of material substance that expanded in time remains one of the most extravagant examples of the architectural “design of the concrete” [30] based on considering the acquisition of available artefacts and projecting possible effects of their reassembly in a new context. This redesign concept, being a response to problems caused by the accumulation of solid post-construction and post-consumption waste, vastly introduced the materials acquired by scavenging as valuable resources. This building, exploding out of its natural surroundings, resembled “a collage choreography that fills the site with a cacophony of anarchic movement” ([31], p. 109). It constituted the specific spatial composition of used parts that had undergone degradation. They were reclaimed and then purposely assembled together to shape an unconventional form of housing construction.

Although this object was not erected on the strictly defined destruction aesthetic concept, the final effect referred to its main postulates, including the exposure of the lapse of time and limited material durability. It accomplished the sustainability paradigm requirements, proving its low energy consumption level, ease of accessibility of local resources featuring building components, as well as formal cohesiveness to enable adaptability. The Maison Zalotay, constructed entirely with different reclaimed solid waste, including aluminium, plastics and glass, exemplified a model of spontaneous architecture or garbage architecture, which, along with Reynold’s “radically sustainable architecture” [32], featuring the tentative and largely autonomous “earthship biotecture” [33], was the ultimate example of experimental handmade structures. The Maison Zalotay constructed with reclaimed materials and repurposed solid post-consumption waste was conceived with the consideration of sustainability issues to decrease the impact of materials’ lifecycle on the environment and increase their durability. The upcycling of reclaimed objects and products, based on their introduction in a new formal and functional context, remains a proposal for the effective management of waste.

3.2. Cultural Determinants

Culture unquestionably has important influences on multidimensional aspects of individuals’ relationships with the physical environment [34]. The coexistence of symbolic durability and physical impermanence, being the distinguishing feature of the Japanese architectural culture, concentrates on acceptance and demonstration of transience, imperfection, change in various ways, the effects of weathering [35] and the incompleteness of things together with a contribution to resource efficiency. The aesthetics based on these determinants and derived from the wabi-sabi concept refers to the beauty that is deficient, impermanent and incomplete and still remains “the most conspicuous and characteristic feature of what we think of as traditional Japanese beauty” [36]. As Powell indicates, wabi-sabi nurtures all kinds of material objects that remain authentic by acknowledging some certainties. These can be summarised as follows: nothing lasts, nothing is finished, nothing is perfect [37].

This approach, being opposite to the European concept, acknowledges the temporality of material objects and their lack of precision caused by the changing usage methods implying fallibility and limited lifespan. The analytical valorisation of the damage to material substances, including architectural objects, provides them with contemplation-

oriented values. The process of the growing old of the introduced building materials, according to the wabi-aesthetics, adds to their attractiveness caused by the demonstration of physical changes occurring over time. Thus, objects gain a positive perception by observers and occupants.

The wabi-aesthetics, celebrating irregularity, rough surfaces or defects [35], seems to expose the value of the destruction concept in architecture in the function of the flow of time and to accept its occurrence in buildings. Although the philosophy of constant renewal of building substance, being the essence of cyclic reconstruction of architectural objects present in Japanese architectural tradition, stands in contradiction to the mentioned wabi-aesthetics, the practice of systematic rebuilding can be explained as a need for providing objects with stable identity through the impermanent consecutive embodiments. The analogical inconsequence is present in some European philosophy concepts that maintain the inexistence of identity in view of constant evolutions of material substance. The variability in architecture presently frequently analysed is the postulate of sustainable design guidelines concerning functional solutions.

4. Apparent Destruction Design

The apparent destruction scheme, in terms of the extension of building materials and products technical life, supplements the related sustainable design strategies already well recognised and analysed in the literature as follows: (1) design for repair; (2) design for remake and replacement; (3) design for reclamation, allowing the avoidance of reprocessing or decrease in repairing processes; (4) design for disassembly; (5) design for deconstruction, understood as the process being “construction in reverse” [38], and conceived to avoid the costly and environmentally harmful final demolition phase.

Related architectural interventions to enhance the environmentally responsible architectural design are:

- Architectural design for adaptive reuse, defined as the reintroduction of salvaged building components or products into the structure of a newly conceived or refurbished building, executed in distinct functional, formal or spatial contexts [39], introduced to complete the building envelope;
- The dematerialisation scheme, a basic strategy in sustainable design, considered through: (1) reduction in the quantity of materials used in construction and finishing works; (2) design cost-effectiveness in terms of maintenance, replacement or alteration of building components; (3) sporadic substitution of originally installed building components, leading to economical and environmentally responsible use of materials throughout the buildings’ life cycle [24].

The dematerialisation scheme, which precedes the discussed apparent destruction design concept, emphasises the dynamics of changes in artificial forms with the passage of time, with ongoing exposure of signs of wear and tear on the enclosures due to environmental conditions occurring in the natural surroundings.

The following subsections discuss the most important aspects of the concept: (1) “passage of time” ([40], p. 17); (2) entropy in terms of acceleration of building skin’s visual maturity; (3) technical durability; (4) aesthetical longevity; (5) biophilic design patterns.

4.1. Apparent Destruction and Time Passage

Considering that no physical structure remains “immune to the passing of time” ([41], p. 10), the apparent destruction concept raises an issue of *temporal framework* [35] as relevant to the architectural design methodology. This design scheme anticipates architectural technical decay or the ultimate dismantling processes due to the deterioration of the material’s value from the passage of time. These processes are responsible for the building’s premature and multidimensional obsolescence, stimulation of users’ negative aesthetical experience, and generating additional financial and environmental costs caused by partial replacement, deconstruction and/or ultimate demolition.

The apparent destruction scheme mediates the architecture–nature relationship with emphasis on the dimension of time, acknowledging that time is an inevitable, continuous and ongoing process of change [41], as well as “a material to be used in architecture” ([42], p. 192). ADAD provides the alternative proposition in the discussion on the relationship between matter and time to overcome the building skins’ specific vulnerability to the effects of time and the visible revenge of time [43]. It does accommodate while shaping building skins, the compound and unavoidable processes of ageing and weathering that feature the “breakdown and alteration of materials by mechanical and chemical processes” ([26], p. 109); processes that are not usually considered as “conscious and positive elements in design” ([43], p. 79). ADAD provides a solution to the change of position of architectural objects being in “a deep defense against the terror of time” ([8], p. 59).

The decay and deterioration of material substance become a relevant element of the character of the architecture itself due to their creative transformation of the assimilation of possible changes in a building’s quality prior to its real appearance after the passage of time. The exposure of building fabric to climatic factors causes physical changes that alter the performance and physical characteristics of the affected building materials.

4.2. Apparent Destruction and Entropy

Destruction of the building’s envelope material, in its natural, spontaneous, purposeful or accidental form, generates an increase in the entropy of a system, such as building fabric. In consequence, there is an intensification of the formal complexity since the formally and aesthetically consistent building elements become less organised. The lack of tidiness follows the spontaneous and unintended appearance of additional elements of spatial layouts or surface arrangements caused by deterioration. The latter provokes the dissonance within the originally developed structure and finally implies the negative perception of an architectural object, and thence of its disapproval.

Considering the issue of destruction in architecture, we have in mind a different degree of this process. The same relates to facades. We analyse the problem of the natural degeneration of the technical and aesthetical state of external surfaces of buildings, aside from the potential mechanical human-related damages. Natural destructive processes are the result of entropy, which in the changing environmental conditions are unavoidable. Therefore, in its life cycle, every building is subject to gradual destruction. Entropy is defined as the “quantitative measure of the degree of disorder in a system”; furthermore, it maintains that “physical systems move towards a state of maximum disorder” ([44], p. 8). As Arnheim underlines, “the more remote the arrangement is from a random distribution, the lower will be its entropy and the higher its level of order” ([44], p. 16). During the operation of a building, we undertake corrective actions to rectify its degradation, and finally complete destruction as a result of the action of the Second Law of Thermodynamics, and “the degradation of the matter and energy in the universe to an ultimate state of inert uniformity” [45]. The exterior facades of buildings are subject to this law as they are in constant movement from a state of order to disorder.

Destruction or disappearance can become inspirational as a design process. Entropy provides buildings with dynamics in the function of time, with the gradual vanishing of the elements that originally made up the spatial-material composition toward the development of new ones of usually negative connotations. Since this process frequently intensifies beyond the author’s control, it is difficult to predict intermediate phases of the change within the object’s multidimensional disposition originally developed by designers.

The apparent destruction design concept takes from some point of entropy development of a facade material and uses it at a point of installation. The dynamic entropic process proceeds in a highly randomised sequence, so its effects are usually unpredictable. In architecture, entropy can be considered from a physical and technical viewpoint or from the artist’s perspective. The image of a façade changes in line with the entropy of the façade material turning into a natural pattern. This process can be illustrated by the curve presented in Figure 1.

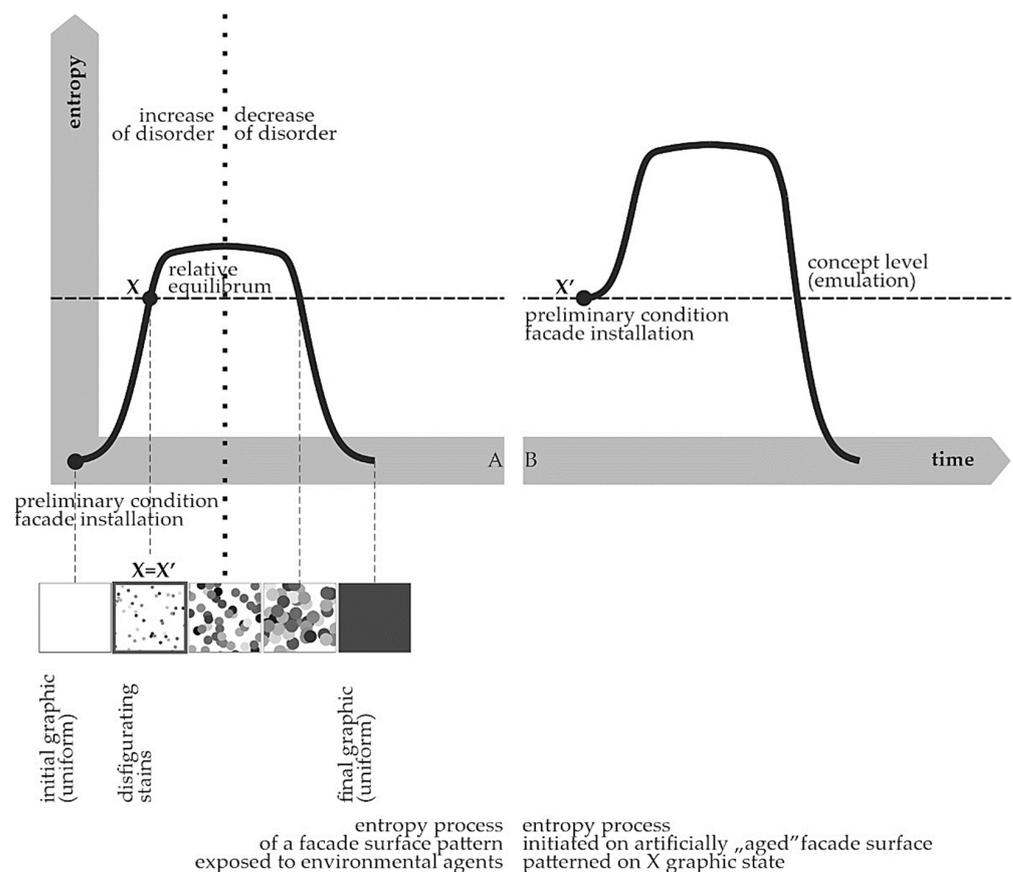


Figure 1. The mechanism of building skin graphic entropy plotted as a function of time (A) and its emulation in the ADAD concept (B) is considered from an art perspective.

The increasing disorder continues theoretically to the point of total destruction in the physical and technical senses, as this is considered an irreversible process. However, in the art aspect, it stops at some apex and then continues toward a greater order. The initial image turns gradually to its negative as a result of the increased complexity of degradation spots, as illustrated in curve A. This can seem similar to the entropy in reversible processes in physics; however, the final result is different from the initial state in terms of the colour, texture or integrity of the material. The intensity and/or uniformity can be equal, as indicated in Figure 1.

The advanced state of entropy is seen as a certain disorder in its visual composition that can be imitated in a new façade material at the moment of its installation in accordance with the ADAD concept. The process of entropy then begins and proceeds in a way similar to that of the original material; however, its range of relative equilibrium (apex) is achieved by the higher degree of entropy (curve B), which is due to the initiation of entropy at a later stage of its theoretical development and in new environmental conditions.

The ADAD is to create an effect of accelerated and purposely induced visual maturity of an enclosure that accommodates the signs of weathering and materials' malformations occurring over time. It is to "resist the inauthentic and unreliable feeling of the artificial environment" ([46], p. 129).

4.3. Technical Durability

Durability is enhanced with the more rational maintenance of building components, where maintenance could be defined as "routine work necessary to keep the fabric of a place in good order. In other words, the main objective of maintenance is to limit deterioration" [47]. Nevertheless, the area and frequency of these works should be substantially limited. The low frequency of maintenance operations, as well as the rarity of replacement

of the components installed in a building with new elements, depend, among other things, on the avoidance of technologies and building materials vulnerable to deformations due to accelerated unfavourable weathering process or intentional or accidental mechanical damages. The priority of high durability is crucial when drawing up the specifications for the building materials and products that are to be introduced [24].

The technical durability, conditioned by the physio-chemical characteristics of building materials, techniques of assembly, methods of finishing and climatic factors, remain in tight relation to the formal aspects of architectural design, emphasised mainly in a developed aesthetical concept. Because it features aesthetical longevity, the ADAD concept provides the enhancement of design for the sustainable durability strategy.

The concept of Apparent Destruction Architectural Design (ADAD) allows the durability aim to be achieved and, therefore, underlies the sustainable strategy of efficient resource management. This model of controlled and deliberately employed deterioration, in order to support the durability scheme and, in consequence, the sustainability goals, comprises the following:

- Adequate shape of a building volume enabling undemanding fixing of the cladding;
- Application of construction techniques and manufacturing technologies to diminish or ignore the presence of factors that harmfully affect the physical parameters of the finishing layers of the built structures (e.g., disadvantageous location of objects in places exposed to intentional or accidental mechanical damages, exposure to intensive and destructive effect of adverse climatic conditions);
- Selection of recommendable building materials, possibly recycled and recyclable;
- Selection of materials of which physical properties allow stable performance to be applied, including multiple tool cutting, chemical treatment or profiling.

The consideration of the environmental responsiveness of buildings remains unseparated from the analysis of the aesthetic-related issues [48]. It does require the simultaneous recognition of physical and functional aspects, as well as an aesthetic concept. The latter component, while revealing “mediation between culture and nature” ([4], p. 10) and remaining the “site for the development and display of a new cooperative contract between built culture and nature” ([48], p. xiv), proves its significant role in building up occupants’ understanding and acceptance of the architects’ environmental-oriented approach.

The controlled destruction of a building’s structure is associated with the assimilation of signs of the flow of time in which they emerge. The negative and disqualifying perception of the buildings’ fabric that shows gradual dissonance between initial perfection of manufacturing and continuing signs of weathering or deterioration due to intensive or careless use is to be partially tempered by the introduction of inventive design methods and techniques. These are to evoke a positive perception with the purposely introduced apparent destruction scheme, where the carefully displayed visible and tactile attributes of forms and finishes, sometimes completed with purposefully exposed imperfections, serve the assimilation of the signs of ageing within the component’s composition. Imperfections and visible signs of physical deterioration initially considered in the component’s configuration, although apparently omitting the phase of contemplation of the original state or observed through the cause of transformation, still allow the observer to experience the object’s impermanence as representing the reflected aesthetics over and against natural processes.

4.4. Aesthetical Longevity

The design methods and techniques to decrease the separation of the occupants from the natural environment realised through physical boundaries materialised in the appearance of the building’s enclosure are to limit the negative effects, such as “inadequate contact with natural light, ventilation, materials, vegetation, views” ([40], p. 5). They are to correct the forms of artificial structures toward their formal unobtrusiveness within the surroundings, through the effectiveness in resources management, as well as the lean design and construction scheme that imposes significant limitations on the usage of building materials and the production of solid waste. The implementation of building technolo-

gies and techniques is to define the aesthetic framework of the formal environment's homogeneity-oriented architectural design.

The ADAD addresses the methods to demonstrate the continuity of the phenomenon of a building's ageing, being "always time-specific" ([49], p. 209). Apparent destruction as an aesthetic concept draws on examples of the degradation of building substances arising over time, mainly due to unfavourable climate-related conditions and factors, such as rainwater, winds, sun or radiation. The range of material losses occurring on the surface of a building's envelope as a result of these processes combines irregular stains or dye penetrations visible on the cladding material. The spatial or structural destruction refers to the building's single elements or to their composition-forming building parts. The extreme situations cause its visual degradation, structural damages, loss of physical qualities or other failures, suggesting progressive devastation of the object.

These above-mentioned visible indicators of a building's continually occurring physical changes can be analysed as stimulating factors for the search for new aesthetic concepts, as well as to become instruments to build "consonance of nature and artificially created work" ([50], p. 75). Apparent destruction is a design device valued in a formal as well as in an aesthetical aspect. It does assist to "capture a true sense of connectedness and bio-integration" ([51], p. 415).

ADAD extends the simple introduction of building materials for finishes simulating malformations or physical symptoms of time-related material destruction toward its systematic consideration in the context of the sustainability paradigm in architectural design. The concept discussed is situated near the whole-systems model in its formal and aesthetic aspects. It does echo the reconciliatory approach in design that acknowledges the integral aspects of humans and natural systems acknowledged in the Trajectory of Environmentally Responsible Design by Reed [52].

4.5. Biophilic Design Attributes

Inclusion of the selected patterns of biophilic design into the environment-oriented design methodology allows the avoidance of the dominant approach to modern architectural and landscape design, where nature is treated mainly as a "trivial and irrelevant consideration" ([40], p. 5), to "connect human occupants and passersby with the experience of nature" ([53], p. 110) and to get compound proficiency of the nature in the human-made environment through the developed solutions concerning formal and technical aspects. The development of these, in particular, "encourages an emotional attachment to particular settings and places" ([40], p. 7).

The apparent destruction refers to the changed approach to the understanding and appreciation of nature in its origin, structure and function. This is realised even with the exposure of conceived artificial elements inspired by natural structures initially regarded as "aesthetically negative" [54] and thus bringing detrimental connotations. The creative transformation of these attributes allows the observers' acceptance and positive perception to be gained. The apparent destruction design concept is a proposal to complement the discussion on the aesthetics of sustainability with regard to the formal expression of building envelopes, with the inclusion of attributes of biophilic design viewed as the "largely missing link in prevailing approaches to sustainable design" ([55], p. 5).

The proposed design concept is aimed at the conjunction of the postulates of a sustainability design framework concerning efficiency in the resource management discussed in the context of building materials' longevity with design methods and techniques addressing the aesthetics model of "visual ecology" [56]. This model addresses the inclusion of the concept of biophilia into the sustainable design methodology, as well as various forms of biomimicry applied, in particular, in terms of an architectural object's formal appearance, as inspired by nature in terms of the functional concepts of an organism [57], and mimicking its selected features in a search for unconventional solutions in compliance with sustainability postulates [58]. These proposals should combine the developed construction techniques with the selection of building materials of specific physical characteristics and attributes,

enabling their permanent integration with the environment within the structure's lifecycle. This study is an attempt to supplement an "aesthetics of ecology" ([59], p. 28), considering the principles and mechanics that prove the object design as environmentally responsive and responsible alike. Through the apparent destruction concept, as a sustainable architectural design scheme applied to define the enclosure, the building is to "express its qualities in the intelligent economy of reduced means" ([11], p. 49) as a support of the strategy of effective resources management.

The possibility of the coexistence of the built environment with the natural environment "depends to a great extent on the designer's ability to understand and creatively integrate various technologies in an appropriate manner" ([60], p. 66). This harmonised interrelationship comprises the abilities of human-made objects, being temporary structures placed in the surrounding natural environment ([60], p. 69), to overcome the changes caused by various factors related to climatic conditions. The capabilities of artificial structures to accommodate these changes are to be recognised by designers in an aesthetical context as well. Purposefully exposed imperfections or unfinished elements of external surfaces, giving an insight into the methods of processing and assembling, as indicated by Walker while discussing product design methods, might "absorb wear and tear" ([25], p. 87), allowing effective assimilation of the damaging results of weathering or physical damages caused intentionally in time, and thus remaining conformed to the overall appearance of the building designed in conformity with the apparent destruction scheme.

The apparent destruction concept, derived from the symbiotic design and endorsed with selected attributes within biophilic design patterns, responds to the demand for the *visual congruency* of human-made structures with natural settings [34]. This interrelationship of artificial and natural environments is achieved with the effect of mingling, blurring and ultimately dissolving the physical boundaries separating inner spaces from natural surroundings. The quality of this design scheme is achieved through the display of similarities in spatial configurations, textures and colours, as well as the application of "broken symmetries" ([61], p. 78) to obtain a coherent visual effect and patterns that mimic natural objects. It is to form buildings as objects that are the "self-evident part of their surrounding" ([50], p. 17). ADAD provides a design methodology with the biophilic design postulates of complexity and order, characterised by the presence of rich sensory information that is configured with a coherent spatial hierarchy, similar to the occurrence of design in nature [62].

The following section relates to the architectural discipline's aesthetics while discussing the environmental sustainability-related questions, with emphasis on architectural design methods to align the surface of external enclosures. The discussion over architectural design methods and techniques addresses the layout of envelope surfaces and materials specification with regard to sustainability issues.

5. Apparent Destruction—Application Modes

As Carlson indicates, every natural object demonstrates an integral relationship to its own environment [63]. The interventions undertaken by architects should be, then, focused on creating the similarly stable interconnectedness between artificial objects and their natural surroundings, in the formal as well as aesthetic aspects, understood as relating to the ways in which people respond to a place (e.g., local building materials, designed and natural landscapes) through its multi-sensorial and intellectual experience ([26], p. 269).

An aesthetics-oriented appreciation of the natural environment as a source of inspiration for buildings tends mostly to be the exposed component of the built environment. It does require original measures for analysis, interpretation and creative use of natural processes. Within the design process, including the building being treated as a complex construction product, addressing sustainability issues and proving to possess an environmental consciousness, there is a need to generate design solutions that, as Walker indicates, challenge conventions and well-established notions of aesthetics, as well as inspire new studies [25].

The apparent destruction model applied to a building skin addresses this postulate with the consideration of the physical characteristics and processing of materials. Design methods, comprising the core of the apparent destruction model in the search for formal continuity and the relationship between an architectural object and its natural surroundings, include the following:

- Selection of durable materials to assure their long-lasting appearance and performance to eliminate the need for excessive conservation and maintenance;
- Consideration of building materials as aesthetically appealing in their natural state;
- Reproduction, put in effect by the application of patterns, rhythm, tectonics and textures borrowed from abiotic forms;
- Imitation of destructive processes occurring in the appearance of natural structures from weathering;
- Assimilation of possible negative effects caused by the weathering assured by a surface layout;
- Accidental arrangement of openings that remain in accordance with functional requirements and effectiveness in terms of spatial layout;
- Employment of different processing of materials forming the cladding to achieve the effect of accelerated ageing;
- Broad exposure of signs of apparent destruction in finishes throughout the building skin inherent in the envelope's composition;
- Employment of techniques to emphasise the signs of a building's visual maturity as opposed to its aesthetic obsolescence;
- Reduction of a building's geometry to a minimalist form to vastly expose the envelope's texture.

Coexistence and continuity of artificial and natural environments is articulated with design techniques to observe constant and inevitable physical changes in a building's envelope influenced by environmental conditions over time. The appearance of potential conspicuous defects of the building cladding, caused mainly by changing weather conditions, ageing, wear and tear or destruction, as well as naturally developed changes, constitute a valuable factor in defining the formal identity of the structure and its connection to the natural context. The apparent destruction concept incorporates biological references into the design of the enclosure in terms of their composition, realised through a formal configuration of surfaces, placement of nature-inspired patterns and textures in the enclosure layout and the arrangement and shaping of openings. The ultimate objective of this concept is to avoid a building's premature aesthetic obsolescence [25] that might be caused by the aesthetic perfection of design, provoking the exposure of parts demanding replacement due to their defective appearance. The ADAD scheme, accommodating the ongoing physical changes in building fabric caused by weathering or operation, denotes the "symbiotic interrelationship between building and the site" ([64], p. 249) and thus complies with the complex sustainability issues.

The emerging new building techniques and technologies based on software along with computer-controlled machining tools allow the graphic design to be made full use of in the production of building materials to apply the apparent destruction design concept, mimicking the physical changes that develop naturally on a building fabric with the passage of time. These mainly concern decolourisation, texture irregularities appearing on the finishing layer or perforation of material in the case of the long-lasting influence of specific aggressive external factors. The following subsections examine the apparent destruction concept through the discussion of the exemplary types of surface compositions. They are developed in anticipation of the impact of meteorological factors on the deterioration of the materials' physical parameters and mimicking them to build a cohesive aesthetical scheme. The selection of the composition and its critical analysis is made with an emphasis on attributes of selected patterns and processing techniques applied to imitate the naturally occurring decay or deterioration of matter, building materials and characteristics of surfaces.

5.1. Flat Compositions

The apparent destruction concept exercises the defining of surfaces through their irregularities as a result of the process of the ageing of building materials. This mainly concerns experiments with the shaping of building facades. The colour and graphic scheme of the building materials used to realise this concept imitate materials undergoing an intensive and advanced process of degradation appearing over time. This approach, anticipating future physical changes, can be described as deceptive and anachronistic since it falsely suggests the flow of time and its destructive consequences on the building fabric. However, the value inhering in the objective of this ADAD concept is its own justification and thus withstands the criticism.

In order to intensify the destruction-related changes that naturally develop over time and to avoid repeatable arrangements, individually developed building and processing techniques are exercised to achieve the effect of apparent randomness in the configuration of components, repetition of patterns, rhythmic variations and contrasting juxtaposition of textures. Still, the composition and assigned technical measures enable recognition of the “organized complexity” ([40], p. 19) of the enclosure’s layout, allowing observers to experience it in an orderly and organised way.

The design techniques to realise the plane apparent destruction scheme in flat compositions, preconditioned by the selection of durable building materials to withstand the applied physical or chemical treatments (e.g., stainless steel, Corten, concrete, brick, stone), comprise the following:

- Visual patterns featuring irregular stains occurring on the finishing layer executed with Corten caused by chemical reactions triggered by ongoing meteorological phenomena;
- Shading applied to the adjacent modules to control the sharpness of surface boundaries and to facilitate its formal blending with the surrounding;
- Seemingly uncontrolled configuration of the openings being disposed accordingly to functional demands;
- Individually developed building treatment techniques for the finishing layer (e.g., embossment, brushing, sheet-metal forming, perforation);
- Mixture of processing techniques to obtain apparent malformations in the surface layer that are deliberately introduced and to anticipate possible damages occurring in the span of time due to intensive usage (e.g., brushing and perforation, fading out and colour saturation);
- Spontaneous yet carefully controlled juxtaposition of adjacent modules differing in finish (e.g., bright and matte, satin and rough, plain and perforated).

Possible effects of building material selection, graphic layout and employment of processing techniques to execute the apparent destruction concept in the flat compositions of enclosures are presented in Figure 2.

The apparent destruction design concept is investigated in the context of selected sustainability considerations focused on buildings within an architectural design framework. Among them is conservation, understood as a measure of the object’s physical durability and effectiveness in terms of formal quality, aesthetic identity and sensorial stimulation, all influencing the social perception of a human-made object. In the search for design techniques that comply with these sustainable approaches, the apparent destruction concept examines the formal and technical means to figure out the objects relationship with the natural surroundings. This approach remains in tune with Venturi’s opinion that buildings have been made to communicate the ideas hidden behind the architectural concept through their enclosures [65]. The design concept is defined jointly by the composition, the applied building techniques and the used building materials, which all together enable this expression. These main categories were used to create the typology of unconventional design interventions to affect the building envelope. The inclusion of selected attributes into the building components’ design framework assigned to the category of biophilic design based on natural patterns and processes [55,66] adds to the meaning of the physical presence of nature and awareness of natural processes, especially seasonal and temporal changes.

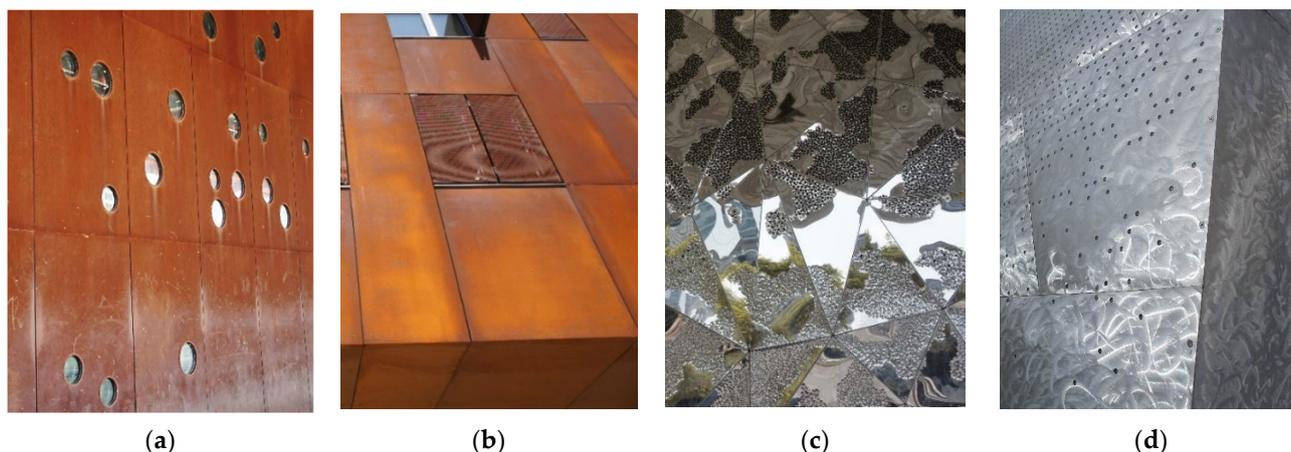


Figure 2. Application of ADAD concept in the flat composition of an enclosure; (a) Façade cladding in Corten steel sheeting, Centro de Convenciones de Barcelona, Barcelona, Spain, arch. Josep Lluís Mateo-MAP Arquitectos, 2004 (Photo by M. Celadyn, 2014); (b) Inner courtyard walls' cladding with plane and perforated Corten sheeting, Teaching Center Vienna University of Economics and Business, Wien, BUSarchitektur ZT GmbH, 2013 (Photo by M. Celadyn); (c) Façade cladding in partially perforated and stamped stainless steel sheeting, Museu Blau, Barcelona, arch. Herzog and de Meuron, 2011 (Photo by M. Celadyn); (d) "The wings" sculptures fabricated with panels of brushed aluminium, EXPO Mediolan, arch. D. Libeskind, 2015 (Photo by M. Celadyn).

Table 1 identifies the main attributes of the flat composition scheme with applied techniques to realise the ADAD conceptual framework, as well as the possible impact of these variables on the formal appearance of the building enclosure.

Table 1. Typology of flat composition in ADAD concept.

Plane Composition Attributes	Processing	Material	Surface Appearance
Accidentality	Manufacturing process to obtain the effect of premature ageing due to corrosion	Corten plain sheets	Random configuration of openings contrasted with rigid arrangement of cladding
Shading	Manufacturing process to obtain the effect of premature ageing due to corrosion	Corten plain or perforated sheets	Discolourations, softening of colours, rupture, irregularity in displacement of stains, dissolving
Seriality	Mechanical working based on embossment	Stainless steel, aluminium	Unconstrained placement, repetitive forms, monochromatic collage of polished, shiny, brushed and matte modules, clustering of perforations
Complementary Contrasts	Perforation, brushing, grooving	Stainless steel	Scratches arranged randomly, malformations of cladding, scratches, cuts

5.2. Relief Compositions

Similar to flat compositions, the application of design techniques to realise relief compositions is preconditioned by the selection of durable building materials to withstand the chosen physical processing or chemical treatment. The relief compositions of building skin introduced traditionally used building materials (e.g., wood, copper, concrete, brick), as well as these recently vastly employed, especially in public buildings, such as aluminium, stainless steel, Corten or titan.

The design techniques to realise the apparent destruction scheme in relief compositions comprise the following:

- Layout featuring embossed or press-formed metal modules with visible deep gaps between;
- Random arrangement of repeated forms;
- Tectonic articulation;
- Broken rhythms of adjacent modules;
- Graded porosity of segments.

Distinct modes of application of the apparent destruction concept to relief compositions employing tactile patterns illustrate the dependence of aesthetic effects on the material's physical parameters and applied specific processing methods, as well as the spectrum of possible results influencing the dynamics, colour saturation and tectonics of the enclosing surface. The possible modes of application of relief compositions to building enclosures are presented in Figure 3.

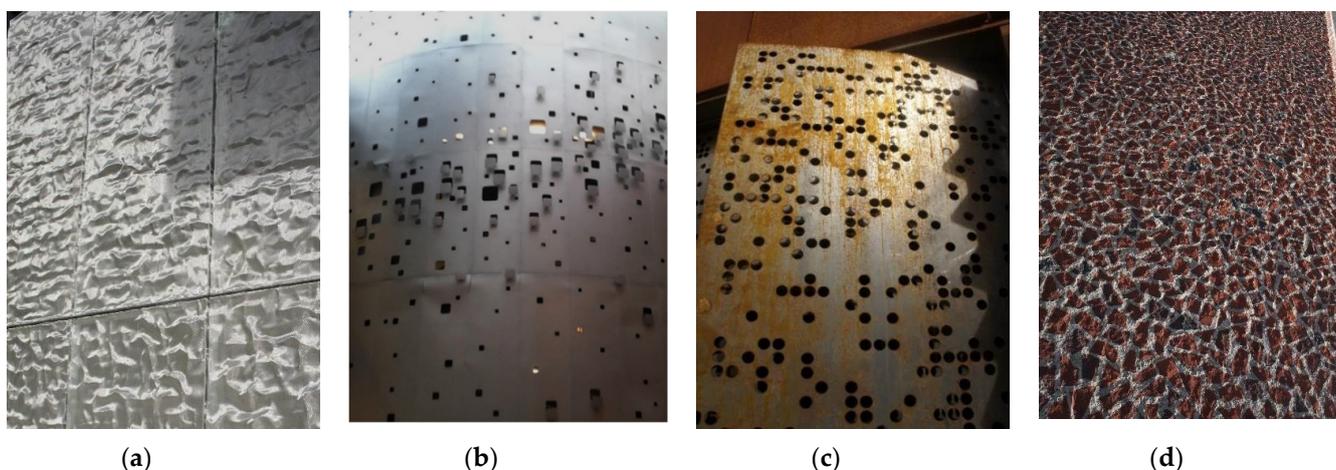


Figure 3. Application of ADAD concept in relief composition of building enclosure; (a) Façade cladding in wrinkled steel mesh, pavilion, EXPO Milan, 2015 (Photo by M. Celadyn); (b) Inner courtyard walls' cladding with perforated stainless steel sheeting, Stary Browar (Old Brewery) Commercial Center, Poznan, Poland, arch. ADS Studio, R. Kaja, 2007 (Photo by W. Celadyn, 2014); (c) The external pivoting doors with perforated steel and stains from the Corten-finished walls' cladding, British pavilion, EXPO Milan, 2015, (Photo by M. Celadyn); (d) External wall cladding with *picado* technique, CKK Jordanki Congress and Culture Centre, Torun, Poland, arch. Menis Arquitectos, 2015 (Photo by M. Celadyn).

The typology presented in Table 2 combines the selected relief compositions that emphasise the range of examination of the appearance of finishing layers on the façade. The various processing techniques applied were examined as means to modify the building's volume, to transform its surface and moderate its interference in the setting.

An exemplary list of processing methods contributing to the surface effects comprises these commonly used techniques that are based on modern technologies as well as innovative ones that explore mixed techniques to reinterpret traditional building techniques. One of them, named *picado*, offers the concrete-clinker brick conglomerate made with crushed red brick [67] reclaimed from a local factory and then embedded into the thick reinforced concrete to shape three-dimensional building cladding [68]. This technique represents an unconventional way toward the reduction of the negative impact on the natural environment and addresses an efficient resource management sustainability strategy. It merges the design for reuse with the aesthetic concept of apparent destruction.

Table 2. Typology of relief composition in the ADAD concept.

Relief Composition Attribute	Processing	Material	Surface Appearance
Crease	Embossment, stretching, folding	Stainless steel	Wrinkled mesh, undulating, folds, bulges of metal sheets causing deceptive illusion of building volume or slight movement, slots, irregular texture
Abrasion	Mechanical treatment of building materials	Stainless steel	Irregular openings, porous, rough, robust layer of the cladding, clustering, random disposition of repeated projecting pieces
Puncture	Grooving	Stainless steel	Perforation on an irregular grid, breaking, cutting, collapse
Chipping	<i>Picado</i> conglomerate of reclaimed building materials, crushing, adaptive reuse of recovered building products of high durability	Reused brick, concrete	Roughness, robustness, hardness, brutality

6. Discussion

The apparent destruction of architectural design concept is to add to the discussion about potential methods for making contemporary architecture more sustainable. As mentioned earlier, much has already been said and written about operational energy saving in buildings and also about the reduction of embodied energy in buildings through a suitable choice of building materials and components. Relatively lower attention is assigned to the issue of the longer technical durability of building systems. The ADAD concept indicates ways to prolong the life cycle of conventional building materials in both the technical and aesthetical and symbolic meaning. This component of the scheme partially refers to architecture that is resistant to the pressure of changing styles and traditional perception of building aesthetics that are a restrictive factor for the implementation of “aged” materials. It can introduce new aesthetic and technical values to contemporary architecture, as well as contribute to its interconnectedness with nature through the exposure of creatively transformed nature-produced signs of decay of the building fabric. External surfaces’ accommodation of the effects of environmental factors results in the gradual mingling and dissolving of the object’s outlines. The softening of the building edges’ sharpness and strength evolves with the application of processing techniques along with graphic patterns introduced to provoke the blurring of lines limiting the façade material in the process of transition between the artificial and natural.

Apparent destruction architectural design aiming at the increase in technical durability of building skins introduces a sort of camouflage of the actual age of buildings, which could be contested as a means of purely aesthetic treatment. However, there are some features that stand behind such an approach to the issue of architectural design and sustainability; these comprise the following:

- Extension of the life cycle of materials and building components due to the acceptance of their time-responding aesthetics;
- Decrease in embodied energy of buildings due to less frequent maintenance procedures executed in view of expected aesthetical corrections;
- Reduction of new building materials used in renovation works or as replacements;
- Aesthetic and formal integration of buildings with their natural surroundings.

All these features are directly or indirectly part of the sustainability paradigm for architecture. The building envelope concept faces changing climatic conditions as well as the consequences of the occupants’ conduct while showing its eco-aesthetical aspect that reflects the object’s resilience and longevity alike.

ADAD considers anticipation, accommodation and creative adaptation as well as the progressive transformation of the signs of matter's decay caused by environmental factors related to time passage. As a result of the assimilation of possible changes in a building's quality prior to its real appearance and their creative altering with selected building techniques, the decay of the surface itself becomes a relevant element of the character of the artificial. Therefore, the discussed design concept is to transcend the distractive evidence of time passage and to substantially weaken the phenomenon defined as buildings' captivity to transformations in the function of time.

Furthermore, ADAD recognises the similarity of morphologies of building skins and those observed in components of the natural environment as complementarities derived, in part, from the biophilic design. This component of the scheme partially refers to architecture that is resistant to the pressure of changing styles and traditional perceptions of building aesthetics that are a restrictive factor for the implementation of "aged" materials.

The environment-responsible postulate of the formal integration of artificial and natural forms proceeds within ADAD in two interconnected areas. These comprise the following:

- Alteration of signs of physical decomposition of building fabric denoting the passage of time to underline the physical transition between the artificial and natural, remaining as the leading design principle;
- Bio-mimicking of the enclosure's composition to enhance the human-made object's formal integration with the natural surrounding and their aesthetical interdependence.

The increase in the durability of buildings and their envelopes goes against the current trend in architecture characterised by frequent exchange of facades and exterior finishes, technical services and "interior constitutive components" [39]. This tendency is to be stopped with the introduction of unconventional design methods and techniques. Apparent destruction addresses the time-dependency of the building skins' physical properties manifested by the destruction and re-figuration of building fabric. This design concept offers a solution to the disturbing problem of architecture's impermanence and enhances the issue of sustainability of building fabric over time.

The paper attempts to investigate the realm of the interrelationship between the human-made and natural environments through the examination of the building's envelope while underscoring the interconnectedness of these environments and continuity of space. The concept is designed not only to indicate a novel idea for architecture and the building industry but also to spark discussion on some unconventional ways to perceive architecture through the lens of the extended view of sustainability in the built environment and some new challenges for the public in the perception of our buildings.

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