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Article

The Transformative Potential of Ruins: A Tool for a Nonlinear Design Perspective in Adaptive Reuse

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Abstract: In recent years, the heritage preservation debate has seen a growing interest in emerging theories in which the concept of potential plays an essential role. Starting from the assumption that memory is an evolving mental construct, the present paper introduces the concept of “transformative potential” in existing buildings. This novel concept regards the inevitability of loss and the self-destructive potential as part of the transformation of each building. The “transformative potential” is defined here as the relationship between spatial settings and material consistency. This research hypothesizes five “transformative potential” types by analyzing five best-practices adapted ruins in the last 15 years. The analysis integrates quantitative and qualitative research methods: morphological analysis (dimensional variations, critical redrawing, configuration patterns) and decay stages evaluation (shearing layers analysis, adaptation approaches). The goal is to test the “transformative potential” effectiveness in outlining patterns between specific stages of decay and adaptive design projects. Adaptation projects may actualize this potential in a specific time through incremental and decremental phases, outlining a nonlinear relationship between decay and memory. The study provides insights for future research on adapting existing buildings in a particular decay stage.



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Keywords: transformative potential; adaptive reuse; decay; ruins

1. Introduction

According to the standard view, destruction and loss endanger the preservation of cultural heritage. Novel theories recognize heritage as continuously growing and evolving [1–5]. Assuming a “self-destructive potential as inseparable from the idea of growth, life and construction”, all objects embody a perishable memory [2].

Memory is not fixed nor permutable. It is not carved in stone. Memory can disappear, change, or even increase by incorporating extraneous features. The conscious or unconscious act to remember something embeds the destruction of other memories [6]. All approaches to the existing architecture (a different average of conservation, preservation, conversion, and demolition) underlie a political choice concerning what humans want to remember or forget.

The connection between buildings and memory is widely acknowledged [7]. Embracing decay is not a recent thought, having been first described in the 19th century by Ruskin, considering memory as an architecture pillar, together with tradition and truth. Through architecture, a human being recognizes the past, and time emerges as a crucial in-state value. He wrote that “[. . .] the greatest glory of a building is not in its stones, nor in its gold. Its glory is in its Age, and in that deep sense of voicefulness, of stern watching, of mysterious sympathy, nay, even of approval or condemnation, which we feel in walls that have long been washed by the passing waves of humanity” [8].

According to Diderot and d’Alembert’s *Encyclopédie*, a “ruin pertains solely to palaces, lavish tombs, or public monuments”, stating an essential difference between anonymous and monumental buildings [9]. Woodward recognized the interest in ruins over their

consideration as monuments, as incomplete objects triggering human creativity [10]. According to Simmel, “Our fascination for ruins goes beyond what is merely negative and degrading”. In ruins, the decline of human forces is balanced by forces and forms of nature “between the not-yet and the no-longer” [11].

This paper refuses to recognize absolute values in defining heritage, arguing that an empiric analysis might address similar issues to the whole built environment, not stemming from a traditional heritage idea. Indeed, the “heritage industry” can promote conservation of the past as a relic disconnected from the present, and the preservation debate must evolve to propose a more critical perspective [7]. As the “experimental preservation” remarks, the turning point is to open up the conservation of other kinds of memory. Such an approach chooses objects excluded by the traditional narrative to test their potential as heritage, hypothesizing their capacity to become valued to be preserved [3]. The issue of recognizing a proper past to build our future needs to address the discourse about which past we want to pass down to the next generations [12].

According to Bergson, memory “marks out upon matter the design of its eventual actions even before they are actual” and fills the gap between what is already done and what might be done [13].

The concept of potential emerges as crucial and related to different stages of buildings’ decay. The origin of the concept of potential comes from ancient Greek, specifically from the term δύναμις, (dúnamis), which derives from the verb δύναμαι (dúnamai), meaning “I am able to”. DeLanda declines the concept of potential as “virtual”, which represents all the possible actions even if some are not available anymore, but still embedded in the object as once-possible trajectories. This stems from the roots of Bergson’s “virtual” as real but not actual in the “structure of the space of possibility” [14]. In the last decades, the concept of potential became used and abused in architecture, particularly concerning design strategies in the built environment.

The adaptive reuse discourse underlines the untapped potential in existing buildings as an unstated value waiting to be released [15–18]. The potential as “unstructured” may refer to an open-ended feature, opening up an idea of a “positive indefinite” [19].

This work focuses on highlighting transformative patterns within adaptive reuse practices and addresses the concept of potential in the dynamic of building adaptations [15]. Brand divides a building into “shearing layers” to analyze the buildings’ adaptability across time, based on Duffy’s theory. Duffy defined four layers: “Shell” (the structure of the building that might last for 20–50 years); “Services” (the lifespan of about 15 years); “Scenery” (partitions and dropped ceiling that last about five years); and “Set” (furniture that might change frequently) [20]. In 1994, Brand expanded this concept to six layers: “Site” (urban location, which is “eternal”); “Structure” (foundations and load-bearing elements, with lifespans ranging from 30 to 300 years); “Skin” (exterior surfaces might change every 20 years); “Services” (communications wiring, electrical wiring, plumbing, etc., with lifespans from seven to 15 years); “Space Plan” (interior layout, such as walls, ceilings, floors, etc., which might change in three to 30 years); and “Stuff” (furniture can change continuously) [21]. Back to Habraken’s “Supports–Infills” theory, it is possible to distinguish construction components by different lifespans and diverse building levels (urban tissue, support, infill) or by differences in dealing with fixed or variable components [22].

The present paper analyses five ruins as post functional vessels of memory, free from functional constraints and valuable due to its inherent qualities [23]. In the analyzed buildings, the adaptive design started from diverse completeness of former buildings’ layers.

Each case is representative of a ruin type, based on their embedded “transformative potential”:

- active ruin-ificative potential
- hard constructive potential
- passive ruin-ificative potential
- soft constructive potential
- ideal reconstructive potential

These five kinds of “transformative potentials” are neither unique nor exclusive: many other kinds of “transformative potentials” exist based on other elements.

Quoting Borie et al.: “On peut donc préciser la définition de la forme architecturale comme étant un certain état d’équilibre entre la structuration de l’espace et celle de la matière”; “form” means a particular “stage of equilibrium” between the structuring of space and the asset of matter [24]. Thus, the research will consider buildings’ physical features.

The objects of analysis are buildings that we call ruins, where memory has evolved in terms of form and significance, thanks to powerful adaptation strategies. In the present paper, ruins represent transience and precariousness instead of “monuments” [10]. All the cases embrace the inevitability of loss in preservation, opening up a wide range of possibilities in conserving or neglecting a memory [5].

The research follows the multiple case study methodology [25], integrating two main empirical methods, the morphological analysis [24,26,27] and the decay stage evaluation [21], in adaptive reuse intervention theory [28–30].

The selection of case studies will consist of studies within five relevant cases of adaptive reuse project, where adaptive reuse is considered “as a process of reusing an obsolete and derelict building by changing its function and maximizing the reuse and retention of existing materials and structures” [31]. These reuse interventions occurred during the last fifteen years, and each design approach deals with memory in a particular way.

The selection of case studies includes four European cases and one case from Asia. Preservation attitude in Western and non-Western cultures is diverse, particularly about the “loss acceptance” [1]. This non-Western case enlarges the design options to consider an extreme demolition that rarely occurs in western countries. This choice is reasonable because this transformative potential of building is related to the physical form only and not from social, economic, or geographical context. However, all case studies will be related further to other comparable cases. The memory embedded in these buildings relies on each decay stage as the primary condition that triggers a specific design approach in converting these ruins to new uses. The findings may underline a correlation pattern between the formal starting conditions and its adapting reuse intervention. The results will overrule the traditional perception of decay as a “loss of potential” [15] by showing alternative conclusions.

2. Materials and Methods

The research relies on the methodology of the case study [25]. The use of multiple case studies is a well-established approach in adaptive reuse studies [29,30,32–34]. According to Yin, the multiple case study analysis ensures a detailed understanding. Therefore, the investigation focuses on the case in two key moments: before the adaptive reuse intervention and after the new design. These time frame allow us to analyze both the process of decay and the new intervention. The sample consists of five adapted buildings that differ in shape, materials, conservation stage, size, and location. However, all cases are “dismissed” buildings successfully converted to other functional purposes, enabling a critical cross-comparison. The term “dismissed” here comprehends buildings abandoned, not hosting any function, and facing an “absolute obsolescence” as “the condition referred to the state of the building itself, regardless of the state of other buildings or of user demands” [35]. These buildings in ruin embed a selective memory that plays a crucial role in the new design. Each of these cases illustrates a hypothetical type of “transformative potential”: “active ruin-ificative”, “hard constructive”, “passive ruin-ificative”, “soft constructive”, and “ideal reconstructive”.

The analysis of case studies focuses on documentary sources: reports, publications, original drawings, and photos, mainly provided by the architects. Here, the redrawing is a tool to understand the dimensional configuration of each case deeply. Dimensional and spatial data rely on a critical redrawing process based on the original plans and the available data, employing 2D drawing software (AutoCAD 2020, Adobe Illustrator 2019), 3D modeling software (Rhino 2020, AutoCAD 3D 2020), and spreadsheets to organize

numbers and data (Microsoft Excel 2020). As Figure 1 shows, the research integrates (1) the morphological analysis of building adaptation and (2) the decay-stage evaluation.

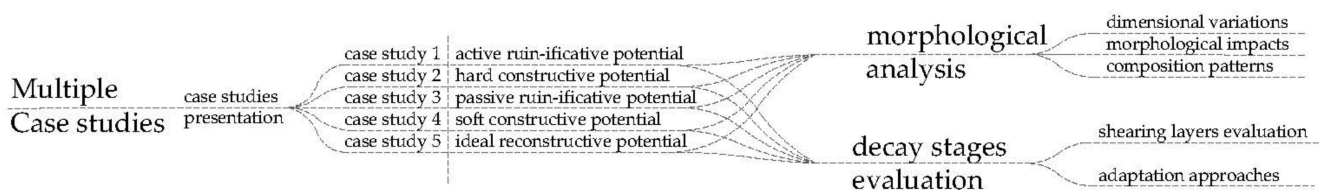


Figure 1. Methodology and Methods applied in the present research.

1. The morphological approach to adaptive reuse represents a critical analysis of the form and deformation of these ruins. Firstly, research focuses on dimensional features (size, lengths in the plan, height) in original and adapted ruins, involving the studies on geometry and form [26,27]. According to Ching, the first approach is to analyze the “massing” [27]. Secondly, a critical redrawing provides a deep understanding of the architectural objects and allows the examination based on the dimensional and spatial elements to outline cross-features. Such a morphological analysis highlights the “deformation” introduced by the adaptive reuse intervention in terms of dimensional and spatial variations, geometry, and configurative evolution [24].
2. Decay stages evaluation integrates a reviewed theory of “shearing layers” with intervention approaches. Here, the “shearing layers” assessment represents a method to underline the building integrity across time, starting from how many layers are in place before and after the adaptive reuse intervention [20,21]. This analysis highlights the impact of decay through shearing layers’ presence and their relative completeness, considering not all layers essential in defining a “building”. Layers are defined for each case and then explored by established categories for adaptive reuse interventions [28,29]. To conclude, decay stages are linked to “incremental” or “decremental” design approaches by following buildings’ variation in terms of “shearing layers”.

3. Results

The multiple case studies methodological approach leads to analyze effectively adapted buildings to test the “transformative potential” as a relationship between matter and space in a specific time. This study proposes five adaptive reuse projects as relevant examples of “transformative potentials”. Such cases are representative of a novel typology of ruins in terms of potential.

The presentation of case studies introduces the adaptation process of these historic buildings. Then, a morphological analysis highlights materials and spatial flows involved within adaptive reuses.

3.1. Presentation of Case Studies

The case studies are five ruins that faced an adaptive reuse project in the last fifteen years. Each building embeds a type of “transformative potential”: Tainan Spring in Taiwan (active ruin-ificative potential), the Kraanspoor in The Netherlands (hard constructive potential), the Panorâmico de Monsanto in Portugal (passive ruin-ificative potential), the Can Sau. Emergency scenario in Spain (soft constructive potential), and the Basilica di Siponto in Italy (ideal reconstructive potential).

Table 1 summarises the general data related to the cases by comparing the situation before and after adaptive reuse interventions.

Table 1. Basic information of case studies.

Case Study	Transformative Potential	Original Function	New Function	Architect/Designer	Original/New (Year)	Location
1. Tainan Spring	active ruin-ificative	Shopping Mall	Urban Lagoon	MVRDV	1968/2020	Tainan (Taiwan)
2. Kraanspoor	hard constructive	Crane	Office	OTH Architecten	1952/2006	Amsterdam (The Netherlands)
3. Panorâmico de Monsanto	passive ruin-ificative	Restaurant	Stage/Viewpoint	Câmara Municipal de Lisboa	1983/2017	Lisbon (Portugal)
4. Cau Sau Emergency scenario	soft constructive	Private house	Urban Stage	Unparell d'arquitectes	NA/2020	Olot (Spain)
5. Basilica di Siponto	ideal reconstructive	Basilica	Installation	Edoardo Tresoldi	1117/2016	Siponto (Italy)

3.1.1. Tainan Spring's Active Ruin-Ificative Potential

MVRDV architectural firm designed the Tainan Spring project on top of the China-Town Mall foundations in Tainan, in Taiwan Island. The former large-scale residential and commercial building in the Zhongzheng Business District in Western Tainan was designed in 1983 by Li Zuyuan Architects [36]. The China-Town Mall was demolished in 2016, in the context of the urban renewal of Tainan Road [37] (see Figure 2).

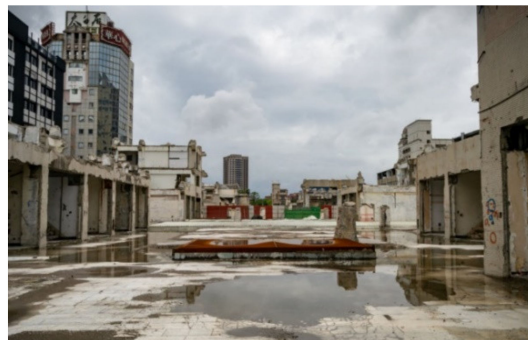


Figure 2. Alexander Synaptic, All that remains of Chinatown, 2017, © 2009–2020 Spectral Codex.

The Urban Development Bureau of the Tainan City Government commissioned a large urban project to redevelop the site that leads to Tainan Spring, “a lush lagoon and park in the preserved ruin of a mall in central Tainan” (Source: MVRDV, Press release, Rotterdam, 10 March 2020), inaugurated in 2020. The adaptive reuse design conserves the mall’s foundation, particularly 162 existing steel-reinforced concrete pillars, and recycled 95% of demolition waste. The underground plaza 7200 m² wide hosts a playground in the new lagoon. The new “follies” along the longitudinal borders are inserted in the existing structural grid, which hosts gathering spaces and stages convertible to kiosks or shops. The new urban lagoon includes an urban poll, and several plants, to recall the previous landscape of Tainan city by employing vegetation and water.

As Figure 3 shows, the project has preserved just a small part of the existing building, leaving pillars as “contemporary ruins” under the city level.



Figure 3. Daria Scagliola, Tainan Spring, 2020, © MVRDV.

3.1.2. The Kraanspoor's Hard Constructive Potential

The Kraanspoor (from Dutch literally “crane”) is located in the Buiksloterham district of Amsterdam in the former shipyard site. In 1952, the architect JD Postma designed this industrial structure on the IJssel river bank.

For about three decades, the shipyard Nederlandsche Dok en Scheepsbouw Maatschappij (NDSM) used this platform for sliding the cranes. In 1984, after the bankruptcy of the NDSM, the shipyard area was abandoned. The structure remained dismissed until 2007 when the Ing Real Estate Development Netherlands commissioned the adaptive reuse project designed by OTH architectural firm to transform the reinforced concrete structure in an office building. As shown in Figure 4, the original building was a massive platform. The new project adds on this platform a 12,500 m² building with a volume of 40,000 m³. The design approach aims to conserve the existing structure as a foundation system for the new building. The former crane is 270 m long and consists of 22 reinforced concrete portals connected by longitudinal and transversal beams. The new building has the same length as the original crane, but it is 13.80 m wide, with different overhangs on both sides of the platform. The three-story glass volume is structured on steel portals, hosting an office area of 2700 square meters for each floor. As shown in Figure 5, the gap between existing concrete and new prefabricated glass panels underlines the difference between old and new, giving the perception of a new volume floating over the crane.



Figure 4. OTH, Kraanspoor before, 2004 © OTH Architecten.



Figure 5. OTH, Kraanspoor today, 2020, © Elena Guidetti.

3.1.3. The Passive Ruin-Fication of Panorâmico de Monsanto

The former Panorâmico restaurant in Monsanto Park has a 270-degree view over Lisbon. This building (designed by the architect Chaves Costa) opened in 1986 to host around 600 people in a luxury context. The restaurant run only for two years, then occasionally hosted a disco, a bingo, a corporate office, and a warehouse. From 2001 to 2007, the building management went to the Municipal Chamber of Lisbon (see Figure 6), which attempted several long-term and temporary uses.



Figure 6. Departamento de Projetos e Equipamentos da CML, Exterior view, 2004 © Impresa Publishing Sa 2018.

This circular building in reinforced concrete occupies more than 7000 m². Far from the city centre and public transport lines, the isolated location fed a growing public disinterest that led to close the Panorâmico in 2001. According to Lisbon's Municipality, an eventual refurbishment would cost around 20 million euros. Besides, project developers and the local government disagree on the plan. The Panorâmico de Monsanto reopened in 2017 as a viewpoint and an event stage without requiring significant design intervention (see Figure 7).

The building remains a skeleton of the former restaurant, where the concrete structures have been secured, the stairs repaired, and the glass and waste removed. For one week a year, the building hosts the "Iminente festival", which brings around 5000 people each year.



Figure 7. João Carlos Santos, Panorâmico today, 2018, Expresso—© Impresa Publishing Sa 2018.

3.1.4. The Soft Construction of Can Sau Emergency Scenario

The Cau Sau emergency scenario is an adaptive reuse project realized in the historic center of Olot, a small town in the Catalan region of Spain. In 2018, the architectural firm “unparelld’arquitectes” designed the project to convert a partial wall and four stepped buttresses that faced the side facade of the central city church into an urban stage. As Figure 8 shows, in 2017, Olot’s Municipality demolished a part of the building in this area because it was crumbling and not aligned with the urban block.



Figure 8. Unparelldarquitectes, Situation after the demolition, 2017 © unparelldarquitectes.

Upon requesting a pavement project and an ongoing contract for a waterproof metal cladding, the assignment was reformulated. Three vaults and four niches were built as a “scenographic support to urban life”. The project guarantees to preserve the existing wall and introduces a permeable facade to accommodate multiple functions (see Figure 9). Bricks and lime mortar joints articulate the main structure and completes the load-bearing walls and solves vaults with a single sheet with braces and steel pillars. According to the architects, this project aims to conserve Olot’s different traces, preserve the signs of domestic activities on the existing wall, and fill an abandoned area. The small intervention (about 113 m² of gross surface area) focuses on the vertical plane, considering the “work of formal definition based on completing the existing: buttresses and party walls—linking the new parts with the old ones, with the intention of configuring a unitary final structure” (Released by unparelld’arquitectes to the authors on April 2020).



Figure 9. Unparellarquitectes, Escenografia urgencia, 2020 © Josè Hevia.

3.1.5. The Ideal Reconstruction of Siponto's Basilica

The intervention realized in the Archaeological Park of Siponto (a small town close to Foggia, in southern Italy) rebuilds and reinterpreted the ancient early-Christian basilica built close to the existing Romanesque church.

As Figure 10 shows, the ruins of the former church were incomplete, and the installation attempts to create a bridge towards the memory of the place. Tresoldi's design intervention allows the public to relate to time and history. The transparent sculpture is a contemporary artifact and perfectly integrated with the surroundings. This project creates a new dialogue between ancient and contemporary and opens up innovative design possibilities to enhance archaeological heritage. As Figure 11 shows, wired meshes build the structure to create a completely reversible frame. It consists of modular elements of galvanized steel characterized by a squared grid. In particular, the crests of walls have been restored and reinforced to build a support surface (Source: Edoardo Tresoldi press release. (Accessed 25 March 2020)). Today, this place behaves as a dynamic cultural venue and attracts many visitors.



Figure 10. Edoardo Tresoldi, Basilica di Siponto, preesistenza © Ginevra Panzarino.



Figure 11. Edoardo Tresoldi, Basilica di Siponto © Roberto Conte.

3.2. Morphological Analysis

The morphological analysis considers the building forms' evolution a unique condition between space and matter. At first, quantitative variations outline dimensional evolution in the adaptive reuse project. Secondly, a critical redraw shows the morphological impact of the new design over the former building. Therefore, composition patterns between old and new emerge from simplified geometries and configurations [26,27].

3.2.1. Dimensional Variations

Footprint, as the building area at the relative ground floor, the height as the total medium height, and the gross surface area (GSA) represent the essential criteria for the dimensional comparison. As Table 2 reports, each case study variates at least one of these parameters after the new design.

Table 2. Dimensional comparison.

Case Study	Footprint Old = New (m ²)	Height Old (m)	Height New (m)	Height Variation (m)	GSA Old (m ²)	GSA New (m ²)	GSA Variation (m ²)
1. Tainan Spring	7720	24	−5	29	38,500	7720	−30,780
2. Kraanspoor	2280	13.5	27.5	14	2280	12,500	10,220
3. Panorâmico de Monsanto	1072	26.5	26.5	0	7400	7400	0
4. Cau Sau Emergency scenario	113	0	11	11	113	113	0
5. Basilica di Siponto	426	0.5	14	13.5	426	426	0

As Table 3 shows, the analysis underlines approximate percentages of the cubic volume variation. The balance between demolished, preserved, and added measures cubic volume (m³) estimation by the digital 3D model of each case. All values are rounded to the nearest whole number.

Table 3. Dimensional flows.

Case Study	Demolished %	Preserved %	Added %	Cubic Variation %
1. Tainan Spring	80%	20%	5%	−55%
2. Kraanspoor	0%	100%	350%	+350%
3. Panorâmico de Monsanto	0%	100%	0%	0%
4. Cau Sau Emergency scenario ¹	95%	5%	20%	−70%
5. Basilica di Siponto ²	0	100%	0%	0%

¹ Demolition of the former housing in 2017 is here a part of the adaptive reuse project officially started in 2018. The cubic volume added includes only the volume under the vaulted structure. ² This permeable structure is not considered a proper cubic volume.

3.2.2. Morphological Impacts

A more detailed account of morphological evolution is given in the critical redrawing of buildings. As Figures 12–16 show, the 3D visual and a relevant plan allow us to understand the qualitative and quantitative impacts of adaptive reuse approaches.

This critical redrawing marks in red for the new intervention, in black for the former building, and in grey for the context in proximity. These drawings (Figures 11–16) highlight the quantitative impact of adaptive reuse additions over the existing buildings. Moreover, these drawings (Figures 11–16) display the adaptations' morphological impact in qualitative terms.

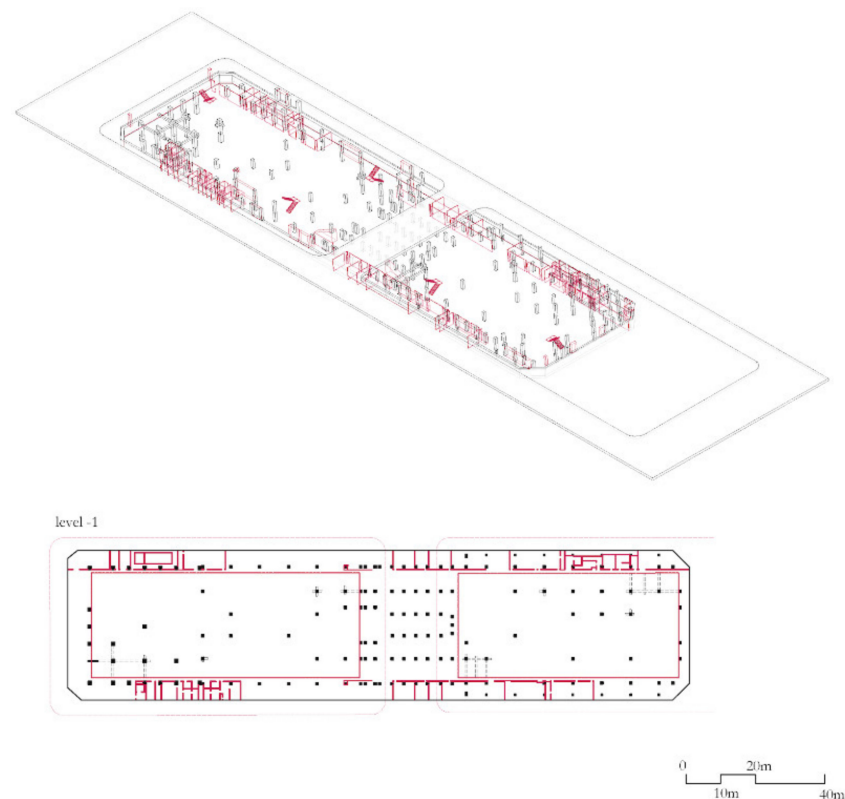


Figure 12. Case study 1. Tainan Spring's critical redrawing.

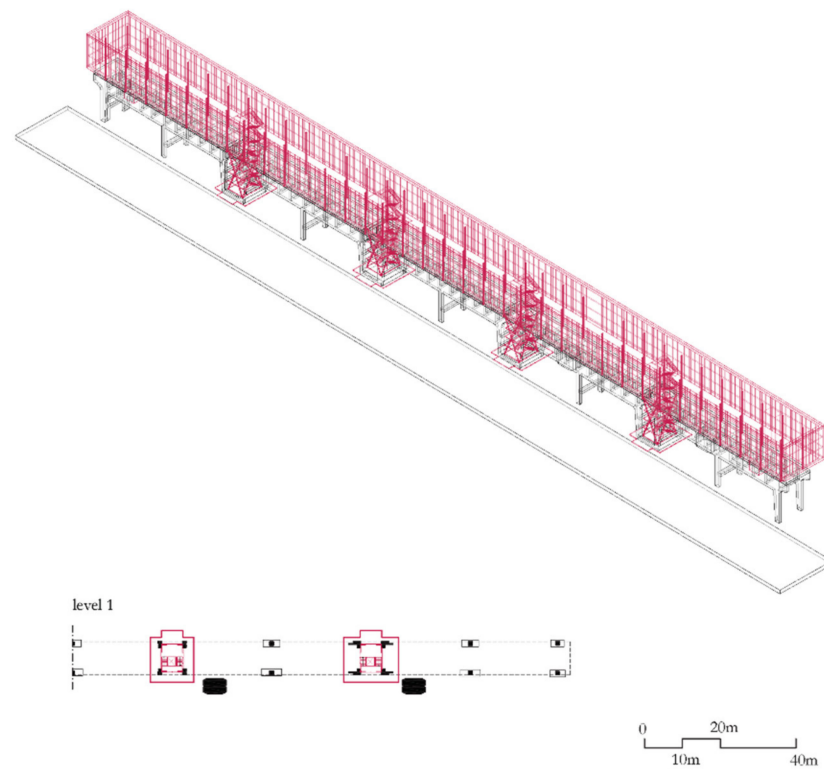


Figure 13. Case study 2. Kraanspoor's critical redrawing.

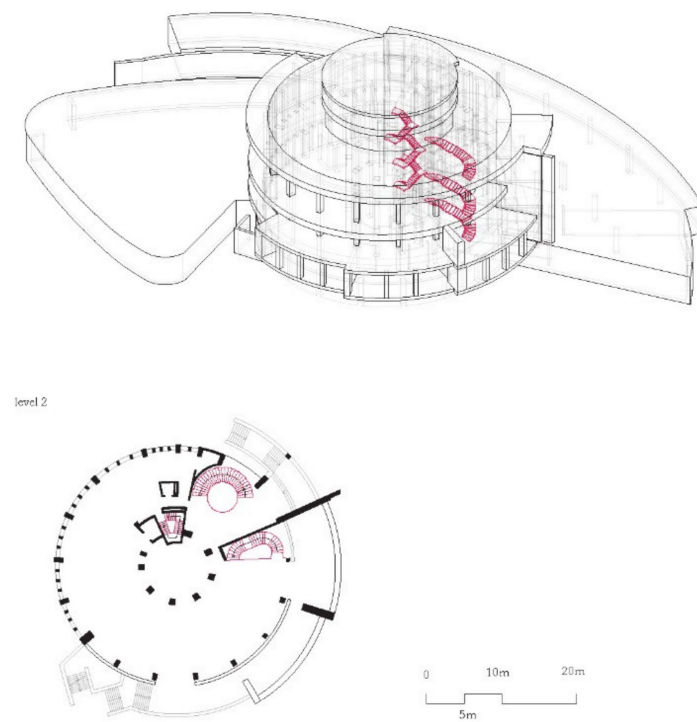


Figure 14. Case study 3. Panorâmico de Monsanto's critical redrawing.

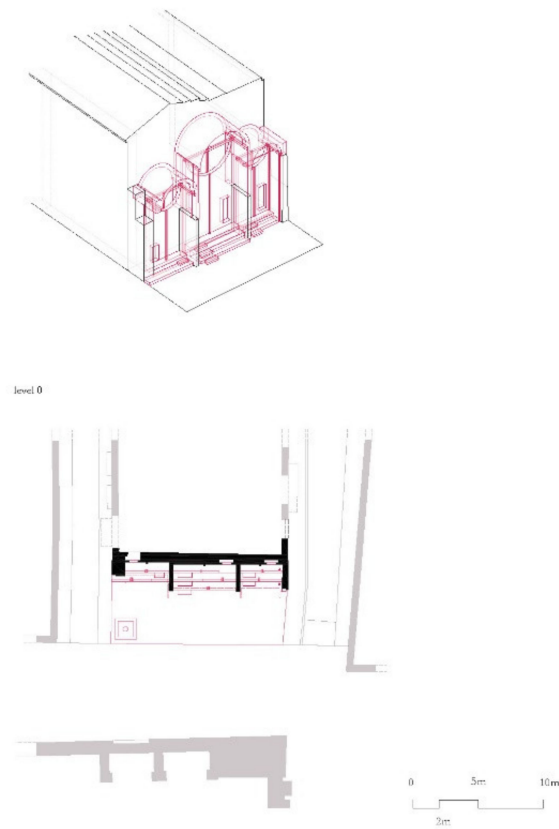


Figure 15. Case Study 4. Can Sau Emergency scenario's critical redrawing.

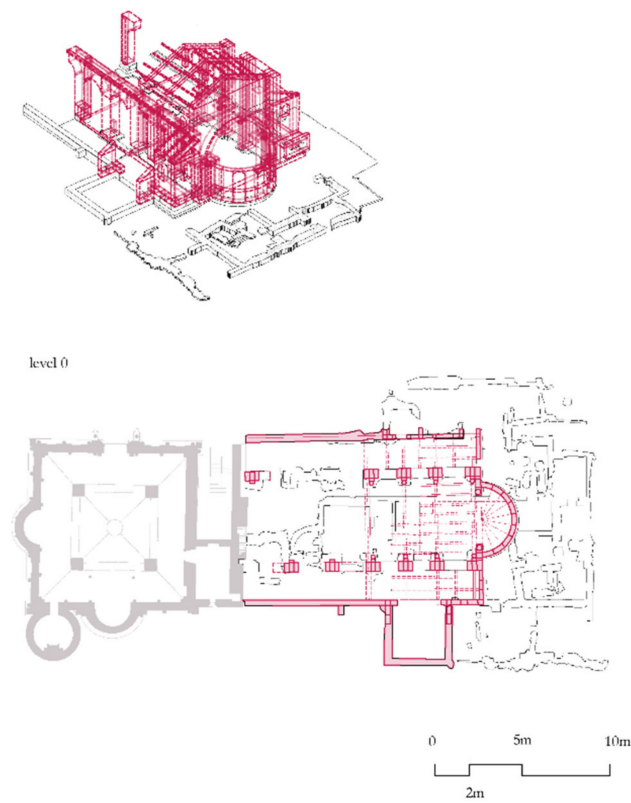


Figure 16. Case study 5, Basilica di Siponto's critical redrawing.

3.2.3. Composition Patterns

In the present paper, composition patterns refer to the evolution of simplified geometries and configurations. Here, these geometries can underline the main changes between old and adapted to analyze forms' evolution. According to Ching, "configuration types" are classifiable as spatial organizations: "centralized" (a central, dominant space about which several secondary spaces are grouped), "linear" (a linear sequence of repetitive space), "radial" (a central space where linear organizations of space extend in a radial manner), "clustered" (a space grouped by proximity or the sharing of a common visual trait or relationship), "grid" (spaces organized within the field of a structural grid or other three-dimensional frameworks) [26]. As Table 4 shows, here, the established categories of configuration and geometry are adapted to suit the analysis of ruins. However, each configuration, intended as spatial organization, has formal characteristics, spatial relationships, and contextual responses that may be perceived in terms of evolution. According to Clark and Pause, critical diagrams can be outlined from plans, sections, and 3D models. Diagrams are intentionally simplified to fit basic configurations. Here, the geometry considers both plane and volume to examine the built form [27]. The present analysis shifts this concept of geometry from the plan to the volume to integrate general massing into a single scheme.

Table 4. Composition patterns, configuration and geometry.

	Case Study Composition	Configuration Evolution	Geometry Evolution
1		grid/linear 	box/negative space
2		linear/grid 	shifted plate/box
3		radial/radial 	cylinder/round plates
4		NA*/linear 	vertical plane/vaulted space
5		linear/linear 	rectangular + circle / framed volume

Evolutions emerge both in configuration and geometry. All cases analyzed changes in geometry, and the majority of cases modified their configurations.

3.3. Decay Stages

As pointed out in the introduction of this paper, decay plays a crucial role in shaping the idea of ruin. These buildings represent unconventional ruins, except for Case 5 Basilica di Siponto, listed in the UNESCO heritage list. Before the adaptive reuse project, each case was in a particular condition of decay within its lifecycle.

3.3.1. Evaluation of Shearing Layers

According to Brand, the building may be divided into multiple layers [21]. The lifespan of each layer analyzes the completeness of ruins, which has lost some of these classes of elements due to time or anthropic actions. The case studies analyzed here include buildings that are born without all layers. As Table 5 shows, shearing layers are analyzed

at the initial stage, at the ruin stage, and adapted stage for each case. Here, six are layers considered, overlooking the layer “Stuff” as not relevant for buildings in ruin and suitable to change continuously. The relative evolution of ruin stage through the modification of layers underlines the need to unfold the traditional shearing layers’ classification to analyze the ruins’ adaptation.

Table 5. Shearing layers’ evolution across time.

Case Study	Time (Original-Ruin-Adapted)	Original Stage	Ruin Stage	Adapted Stage
1. Tainan Spring	1968–2017–2020	Site, Structure, Skin, Space Plan, Services, Stuff	Site, Structure, Skin, Space Plan, Services ¹	Site, Structure
2. Kraanspoor	1952–2000–2006	Site, Structure, Services	Site, Structure	Site, Structure, Skin, Space Plan, Services, Stuff
3. Panorâmico de Monsanto	1983–2015–2017	Site, Structure, Skin, Space Plan, Services, Stuff	Site, Structure, Skin ¹ , Space Plan ¹	Site, Structure
4. Cau Sau Emergency scenario	NA-2017–2020	Site, Structure, Skin, Space Plan, Services, Stuff	Site, Structure ¹ (wall)	Site, Structure, Space Plan ¹
5. Basilica di Siponto	1117–2014–2016	Site, Structure, Skin, Space Plan	Site, Structure ¹ (foundation)	Site, Structure

¹ Here, the layer is partial.


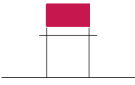

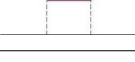

Results lead to consider building adaptation not as the reintegration of lost elements but as reducing the layers instead.

3.3.2. Adaptation Approaches

The adaptation process can be implemented through the following approaches that have been classified as specific intervention types or more general attitude [28,29]. As Table 6 shows, unconventional adaptive reuse practices (i.e., the Basilica di Siponto or the Panorâmico de Monsanto) seem not to find a place in White’s intervention categories. “Attitude” refers to a broad relationship between the existing building and a new project. The progression evaluates decremental or incremental approaches, attempting to simplify complex dynamics.

Overall, these results indicate that well-established studies about adaptive design exclude adaptive reuse approaches focused on minimum interventions (i.e., Case 5 and Case 3).

Table 6. Intervention approaches.

Case Study	Intervention ¹ [28]	Attitude ² [29]
1. Tainan Spring	underground/plaza	 Intervention
2. Kraanspoor	Hat	 Insertion
3. Panorâmico de Monsanto	pause *	 Installation
4. Cau Sau Emergency scenario	urban roof	 Intervention
5. Basilica di Siponto	3D frame *	 Insertion

¹ According to White, several categories for remodelling exists. Here, not all cases find a proper category of intervention. The authors propose novel categories to fill situations not reported in White's interventions marked with an asterisk). ² According to Brooker and Stone, adaptive reuse approaches are "Intervention": a process that activates the potential or repressed meaning of a specific place through a process of uncovering, clarification and interpretation. Intervention can be destructive as much as it can be constructive. "Insertion" means a process that establishes an intense relationship between the original building and its adaptation and yet allows the character of each to exist in a solid independent manner, i.e., new elements inserted alongside old buildings; "Installation" refers to projects where old and new not compromise or interfere each other.

4. Discussion

Having reported how to construct the "transformative potential", the discussion of results addresses how dimensional and morphological features in specific decay stages trigger consequential design approaches.

The previous section highlights patterns in morphological evolution related to the decay stage of these cases. Such cases share analogies with other buildings in ruin, already adapted or still dismissed. According to the multiple methods applied, the discussion of results follows four main headings:

- The evolution of form, both in dimensions and configurations.
- Stages of decay in ruins and relative approaches.
- Cross-features in constructive and deconstructive approaches.
- "Transformative potentials" in the memory continuum.

4.1. The Form Leading to Different Design Choices

In ruins, previous functions seem to not influence the design attitude both in qualitative and quantitative terms. Would be the ruins' intrinsic physical features the main drivers in their adaptive reuse?

The case of Tainan Spring presents an extreme demolition of the original building to configure a public space. These left fragments are contemporary ruins that erase the previous use of this space (China-town mall) but instead built a new narrative to convert these remains to serve as an urban lagoon. Indeed, Tainan chooses to present itself as a sustainable city. The massive structure in reinforced concrete and the width of the former building triggers the realization of this type of project.

In the case of the Kraanspoor, this massive platform allows building a new volume by using the existing structure as a foundation. The former platform defines a morphological rhythm for design the new building. In comparison, the Panorâmico de Monsanto acts as a "stable ruin", thanks to its morphological features: the large dimension, the "radial configuration" (See Table 4), the unique relationship with the landscape, and the structural solidity. The reuse of this building has required only minimal interventions (removing windows and some unstable interior elements and the refurbishment of stairs) to realize a safe viewpoint and a crowded concert venue.

In contrast, Cau Sau's demolition of an obsolescent building has activated the untapped potential of this central venue in Olot. In this case, the maintenance of partial walls and the addition of brick vaults configure an open-covered space in an urban backdrop. In particular, this case proves that whole dimensions do not influence potential variations in cubic meters by an adaptive-reuse intervention. Considering the relative values, Can Sau counts the smallest footprint of all the case studies here examined. However, it is second for relative variation in cubic meters, where the intervention preserved only 5% and added 20% of the building volume, and demolished around 70% of the former volume (i.e., the wall and the three partial retaining walls remain standing).

The Basilica di Siponto does not variate its volume and basic configuration due to Tresoldi's project, but the partial reconstruction geometry changes a two-dimensional geometry into a three-dimensional frame. In this case, it is not the "basilica" function that drove the design outcome, but the desire to recall a memory of place by using a new form. Results consider the new addition, not as a proper volume. The metal wire frame gives the perception of an iconic place that no longer exists, and it never existed in the first place.

As Figure 17 shows, the research compares the demolished, added, and preserved features of each adaptation project and the difference between them in terms of cubic variations.

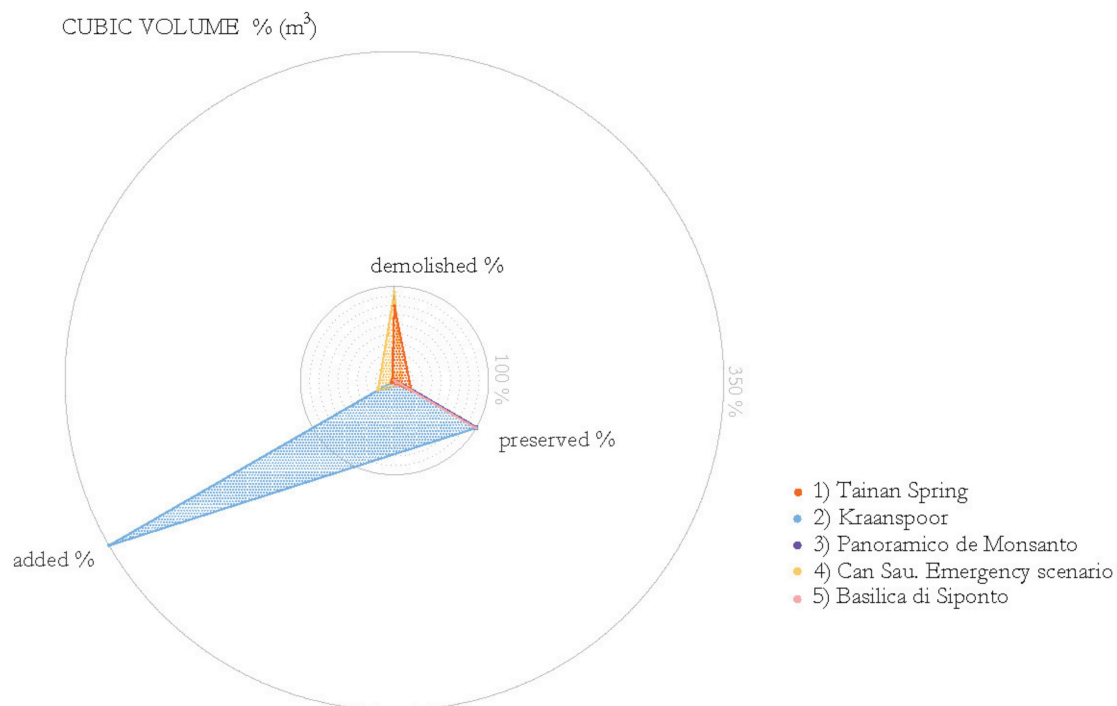


Figure 17. Cubic volume comparison.

Morphology and dimensional relationships emerge as more relevant than functional classifications of former buildings. As Wachsmann argued, structural types design analogous spatial assets and somehow a novel classification of the built environment [38].

Morphological schemes require integration with buildings' decay stage to provide reliable considerations, especially in ruins. The research considers the decay stage in the specific moment when the adaptation has started. Indeed, the results outline a need in considering the state of ruins to understand when it may not be relevant to apply methodologies established for well-preserved buildings (not ruins).

4.2. Decay Stages Foster Design Approaches

The case study selection shows how Brand's "shearing layers" can be not fully representative to analyze all cases [21]. Indeed, the idea of what could be considered a building or not might be questionable. For instance, the Kraanspoor is a crane, and it is an infras-

structure. The Can Sau project is a shred of a former building that conserves traces (partial walls) and an urban void.

These layers outline the buildings' completeness, not in a positive manner only. Might this completeness be relative to a previous decay stage? Would relative completeness involve a decremental evolution?

Here, the term "building" comprehends not covered structural systems, following the broadest interpretation as 'fence' or 'wall' [39].

As Figure 18 shows, in the evaluation of ruins, the layer "Stuff" is overlooked, and the layer "Structure" distinguishes sub-components that interest all cases during the shearing layers evolution (see Table 4). In particular, this layer "structure" includes "footprint" (i.e., Case 5, Basilica di Siponto), "foundation" (i.e., Case 1, Tainan Spring), "partial structure" (i.e., Case 4, Can Sau), "complete structure" (i.e., Case 2, Kraanspoor and Case 3, Panorâmico de Monsanto). Such a novel "layering" includes decay, focusing on the structure: the most durable buildings' component (after the site). In terms of structural type and decay stage, the analysis of case studies underlines the impact of structure in dimensional and morphological changes. For example, the Kraanspoor quintuplicates its GSA thanks to its solid and free structure (see Table 2).

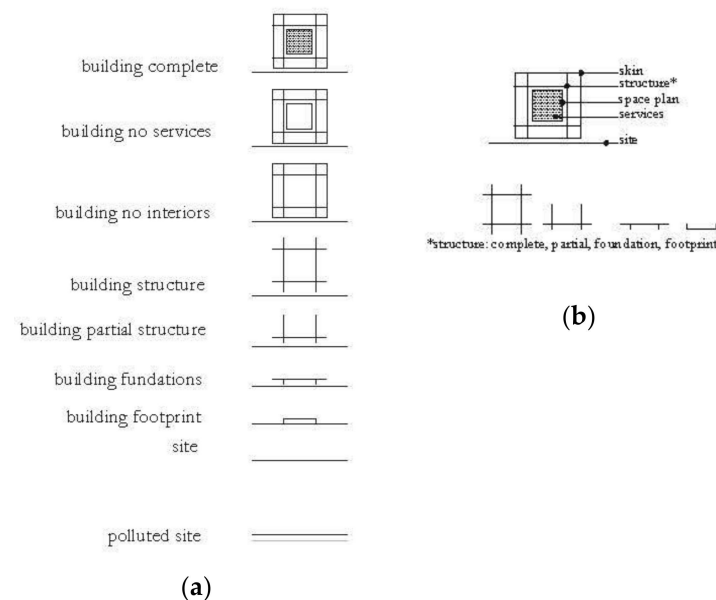


Figure 18. Decay stages in ruins "shearing layers". (a) shows the steps in decay stages emerged from the case study, except for "polluted site" (b) explain the "shearing layer" application to ruins, where the structure needs to be analyzed according to the decay stages.

Figure 18 includes "polluted site" as a decay stage, on the basis that site conditions could trigger or not adaptation projects. A growing literature argues that site conditions are fundamental to deliver an adaptation project, especially in postindustrial sites [18,40,41]. A prominent example is a project in Duisburg Nord by Latz architects [42]. This project has conserved the polluted soil to be remediated through phytoremediation and/or stored in the existing bunkers. The former sewage canal has turned into a method of cleansing the site. The new design has addressed new uses for many old structures by converting the industrial site into a multi-functional park.

4.3. Constructive and Deconstructive Approaches Show a Nonlinear Progression

Results underline that White's intervention types are ineffective for all cases, i.e., Case 3 and Case 5. As Table 7 shows, through the lens of "Actions", the principal operations carried on existing ruin emerge. Such actions unveil the leading strategy, divided into "deconstructive" or "constructive". However, both constructive and deconstructive strategies seem capable of producing effective adaptation projects, as the case studies have outlined.

Table 7. Actions, Strategy and Phases.

Case Study	Actions	Strategy	Phases
1. Tainan Spring	Demolition/Floor Surface	Deconstructive	Decremental + Incremental
2. Kraanspoor	Preservation/Hat Addition	Constructive	Incremental
3. Panorâmico de Monsanto	Consolidation/Cultural promotion	Deconstructive	Decremental + Incremental
4. Cau Sau Emergency scenario	Demolition, Consolidation/Light construction	Deconstructive	Decremental + Incremental
5. Basilica di Siponto	Consolidation/Sculpture installation	Constructive	Incremental

Both the Can Sau and the Tainan Spring started from an analogous decay stage: complete buildings obsolescent in physical terms. Indeed, the residential building in Olot did not respect the new street alignment, preventing an efficient public circulation, and Chinatown Mall in Tainan had wrecked services and partially collapsed interiors. that embraced a “decremental” progression (see Table 6). In terms of decay stages, these two adaptation projects involved a drove-decay shifting from an analogous stage of “complete building” to new stages of “partial structure” for the first and “foundation reuse” for the second. The Can Sau project focused on design actions as “light construction” and “cultural promotion”.

According to Figure 19, design options marked in red and decay stages are strictly related. Tainan Spring intentionally becomes a new ruin, leaving traces of the former foundations and reusing the ex-underground parking lot. Panorâmico di Monsanto had crumbling interiors and no services, and the owners decided to demolish part of the interiors (broken windows and partitions) and not replace services. In this case, the ruin is now at the decay stage of structure, triggered by cultural activities. Kraanspoor’s new design has relied on a consistent addition that rests on the existing structure, originally designed to be just a structure. The new Basilica di Siponto has given rise to an evocative three-dimensional frame from a partial footprint. A sculpture installation is a particular event and involves art expressions more than adaptation processes, opening up a “transformative potential” starting from the scarcity of original materials.

The “transformative potential” in ruins outlines a pattern that relates decay stages and intervention types in terms of decremental and/or incremental approaches (see Table 6 and Figure 19). In most cases, the incremental and decremental phases were both undertaken in diverse moments within buildings’ lifetime.

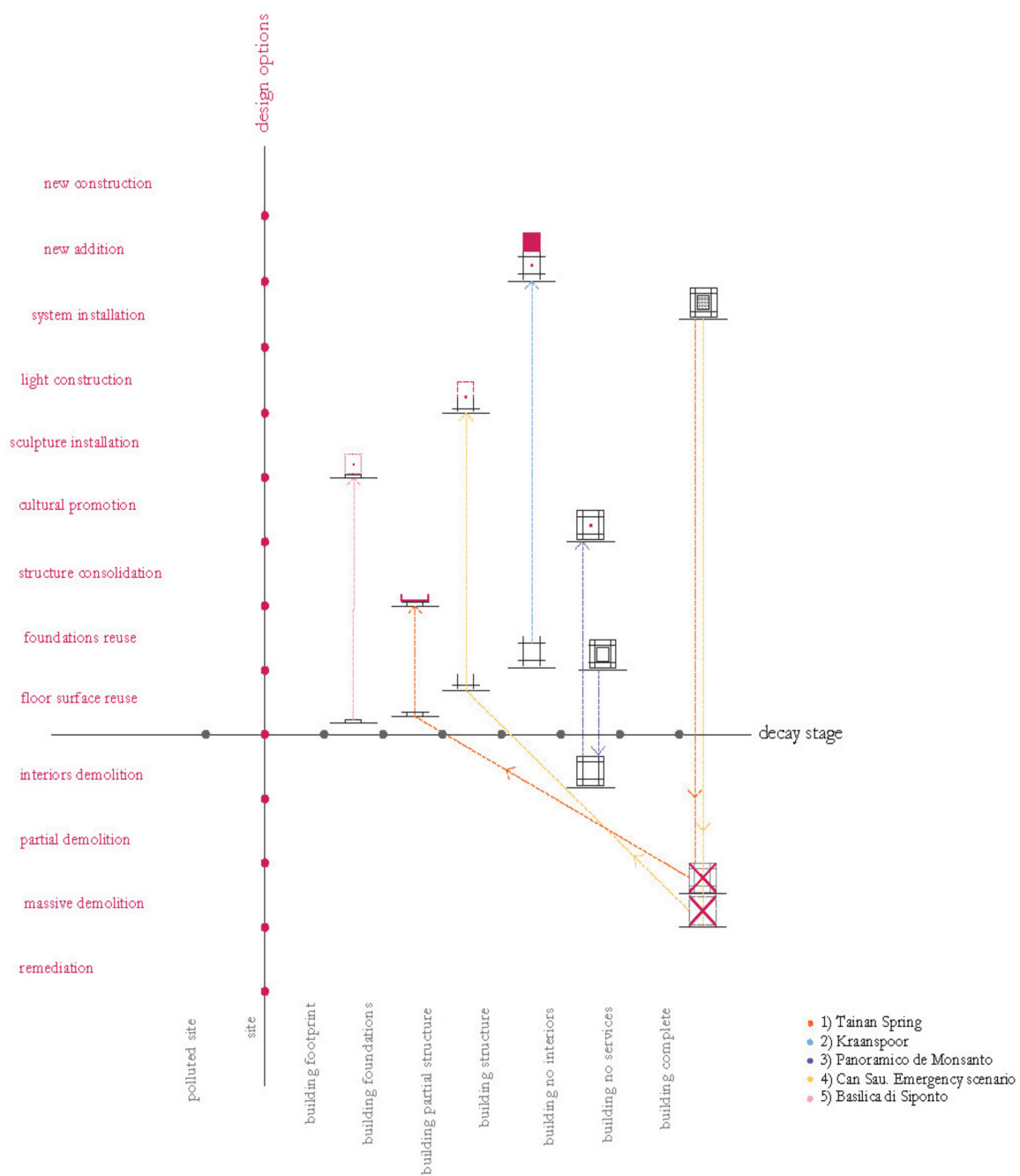


Figure 19. Design options in decay stages.

4.4. Memory through Reconstruction and/or Deconstruction: Case Studies and Comparables

As previously highlighted, the paper considers memory-making an active choice that could be undertaken through construction and deconstruction. These five cases share an analogous interventions strategy with other adaptive reuse projects.

As Table 8 shows, the selected cases are comparable to other adaptive reuse projects in terms of “transformative potential”. Each of these “comparables” shares an analogous evolution. These other cases are not equal but similar.

Table 8. Comparables in terms of “transformative potentials”.

Case Study	Comparables	Transformative Potentials
1. Tainan Spring	(a) Gasholders Park, London, United Kingdom. (b) Skatepark Parco Dora, Turin, Italy	Active riun-ificative
2. Kraanspoor	(a) Gasholders London Apartments, London, United Kingdom, (b) Viaduct Arches, Zurich, Switzerland, (c) Elbphilharmonie, Hamburg, Germany	Hard constructive
3. Panorâmico de Monsanto	(a) St. Peter’s seminary Cardross, Scotland, (b) Eichbaum Opera, Mülheim an der Ruhr, Germany, (c) Tzimpla Kert, Budapest, Unghery)	Passive riun-ificative
4. Cau Sau Emergency scenario	(a) Granby Winter Garden, Liverpool, United Kingdom, (b) Cité de la Mode et du Design, Paris, France, (c) Niop Hacienda, Champton, Mexico (d) Alveole-14, Saint-Nazaire, France	Soft-constructive
5. Basilica di Siponto	(a) Can Tacò, Montornès del Vallès, Spain, (b) Szatmáry Palace, Pécs, Hungary	Ideal reconstructive

For instance, Case 1 and its comparable cases conserved a part of the former structure and demolished a large part of the original building. The second set of cases adds a large amount of space and materials, using the existing structure to build a new building. Case 3 and the other similar cases focus on retaining the basic former structure and embracing the decay by simply keeping it standing and safe to use the existing building for other functions (mainly temporary uses). In the fourth set of cases, a part of existing has been demolished, leaving space for the reuse by minimum design interventions within the old remains. The fifth group of cases reconstructs an idea of the former building on traces and a low amount of existing materials.

Design options are open to multiple solutions, which happen more than once during the life of buildings. As case studies have shown, design actions can be subsumed as mainly “constructive” or “deconstructive”. More than one case study shows that “decremental” phases may prepare for “incremental” ones.

For instance, the Can Sau is a “deconstructive” project. This project conserves the traces of domestic activities on the existing walls, reminding the former use of this space and involving the near church facade in the new design amplifying the historical memory for the local community. Would the memory be more active in preserving the existing building as crumbling and dismissed? The analysis leads to answer no to this question. In Can Sau, the demolition and the partial reconstruction give the chance to evolve the memory of the place and use the near cathedral facade to design the new structure. The original wall stays and remains with all its scars. In Tainan Spring, the Municipality of Tainan wanted to demolish the former China-town mall as a part of the urban renewal project. This obsolescent shopping mall’s memory was consciously erased and reframed as

a public urban lagoon that stands on its ruins. The former building is presented as a ruin of the old Tainan before the “sustainable urban renewal” [37].

The Panorâmico de Monsanto adaptation is a “minimum intervention” project, where physical conditions are almost frozen. This case is an example of accepting feasibility limits and recognizing the place potential. This case accepts that renovation would require an unsustainable cost for the owner, the Municipality of Lisbon. The Panorâmico de Monsanto was already a well-known destination for urban explorers; the adaptation project embraces the landscape potential and transforms this place to a public viewpoint. This case confirms that in some circumstances, “a state of gradual decay provides more opportunities for memory making and more potential points of engagement and interpretation than the alternative” [4].

In Siponto, Tresoldi delivered a reconstruction of an ideal place that never existed as it and aimed to remain partial. This “ideal place” considers the term ideal as “a principle, idea, or standard that seems very good and worth trying to achieve”. (Source: <https://www.collinsdictionary.com/dictionary/english/ideal> (accessed on 10 March 2021)). The Kraanspoor in Amsterdam was listed for demolition until the OTH’s founder recognized the structure as a base to be implemented and became a new building. This constructive approach is the more invasive one within the sample analyzed but still uses the existing building like a foundation for a new building, making its memory evolve from the Industrial Age to the creative era [43].

The “transformative potential” analyzes the adaptability of ruins following a non-linear perspective. Assuming that, structures produce meaning in their preservation and persistence and their decay and disintegration. Even if multiple other factors may influence decision-making that affects ruins, the present paper argues that an analysis based on their morphological features and the decay stages unveils their “transformative potential”.

These results provide further support for the hypothesis that “transformative potential” types proposed are: “active ruin-ificative” (i.e., the Tainan Spring), “passive ruin-ificative” (i.e., the Panorâmico de Monsanto), “ideal reconstructive” (i.e., the Basilica di Siponto), “soft constructive” (i.e., the Can Sau), “hard constructive” (i.e., the Kraanspoor).

Memory making can pass through constructive or/and deconstructive projects. Memory survives even without the extreme preservation of ruins. On the contrary, other design approaches may foster memory-making through an evolution of ruins. Through the lens of “transformative potential”, these adaptation projects stand out not just as a surgical intervention to repair buildings in decay, but also as attempts to shape memory according to its physical characteristics, sometimes embracing the decay for a while.

5. Conclusions

The aim of the current study is to introduce the “transformative potential” in ruins. Such types depend on morphological conditions influenced by decay processes across time. This study has proposed five types of “transformative potential” in ruins (i.e., active ruin-ificative, passive ruin-ificative, ideal reconstructive, soft constructive, and hard constructive), that further research could implement and enlarge. A series of conditions may trigger design approaches over others. First, large existing buildings lead to more extreme interventions regarding relative demolitions or additions (i.e., Case 1 and Case 2). Secondly, the state of decay is always crucial in delivering a successful design approach: small traces trigger soft constructions or “ideal” reconstructions (i.e., Case 4 and Case 5), well-conserved structural systems trigger hard-constructive projects (i.e., Case 2) or minimal interventions (i.e., Case 3). Overall, the results show both additive and subtractive design options with a nonlinear relationship to the physical conservation of building memory. Instead, adaptive reuse is a process, occurring over time, whereby construction and deconstruction phases follow each other to pass down an evolving memory. This new understanding should help to improve predictions of design strategies on existing buildings, not just on ruins.

This research shows how decremental approaches may effectively deliver successful adaptive reuse projects that embrace the places’ memory evolution. Besides, the

well-established methods to analyze adaptive reuse interventions and morphologies do not suit ruins' analysis. Therefore, a further study focusing on minimum intervention/deconstructive approaches in adaptive reuse theory and ruin morphology is suggested. The fundamental theoretical shift that emerges is the active contribution of ruins to deliver memory as an evolving concept.

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