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Chernobyl's Palimpsestic Shelters

A Concrete Tale of Forms of Delay

▼ **SPECIAL ISSUE ARTICLE** in *Entangled Temporalities*

▼ **ABSTRACT** The more than 400,000 cubic-meters of concrete meant to contain the deadly debris of the largest nuclear accident of the 20th century in Chernobyl in the Ukraine were named "Sarcophagus" in the Western world—an architectural term describing the stone enclosure of a dead body. It would not remain the only structure built to contain the catastrophic fallout. After 1986, the supposedly ever-durable material of modern architecture started to crumble under the radiation. A new enclosure needed to take shape. In an international architecture competition held in 1992 by the Ukrainian government, an arch was chosen as "New Safe Confinement" (NSC) to keep the toxic matter sealed inside. Built from steel this time, this new shell was completed after lengthy delays in July 2019—a monument containing a brutalist radioactive ruin. Its building technology, implemented to delay leakage to protect future human generations, in turn needs those very generations precisely for its own maintenance. This article poses the many hulls of Chernobyl as architectural palimpsest: a deathly bind of matter and time, of decay, ruin, and construction in the fall-out's ongoing aftermath. Written as history of architectural knowledge, the making space for a destructive non-human occupant (under human care) turns a seemingly straightforward architectural narrative into the story of a structure built too late to keep the world around it inhabitable.

▼ **KEYWORDS** Modern Architecture; History of Engineering; Chernobyl; Concrete; Steel; Cold War

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Prenote: A "Turn of the Times"

Since the conception of this project, the full-scale invasion of Ukraine by Russia on February 24, 2022, has challenged both this article's intentions and my approach. When Russian forces attacked first Pripyat, the city near the Chernobyl nuclear plant and then the plant itself, reports spread about a fire in the vicinity of the so-called "exclusion site." Fear rose throughout Europe including in Germany, where I lived both when the Russian attack on Ukraine started and during and after the 1986 Chernobyl catastrophe. It was a fear of a nuclear catastrophe that recalled the original disaster itself, except that this time the news spread almost in real time. News agencies and social media sent a wave of information into the cloud, moving mostly West like that other cloud carrying radioactive dust had.[1] When German chancellor Olaf Scholz coined the beginning of the Russian invasion of Ukraine as a "Turn of the Times [Zeitenwende]" he implied that nothing would ever be as it had been before, at least not for a long time.[2] Yet, rather than affirming terminologies of rupture, break and shifts, or the "befores" and "afters" familiar from Western political narratives on Russia, the compound of confinement structures—a multitude of protective layers built around moments and events—confounds conventional temporal sequences precisely through its amalgamated forms and architectures.[3] Where a new building had been constructed to confine the dust and particles of an old accident, now the long temporality of half-times was met with the temporal loop of an impending repeat of a historical disaster—rather than a "turn of the times," a looming reset of sorts threatened the fragile material negotiation of already uneven temporalities of artifactual construction, human maintenance and the cycles of the fallout. It is those entanglements this article will feel its way into rather than trying to tidily unravel them.

Chernobyl: An Architectural Palimpsest

The more than 400,000 cubic-meters of concrete meant to contain the deadly debris of the largest nuclear accident of the twentieth century in Chernobyl in Ukraine was named "Sarcophagus" in the Western world—an architectural term describing a stone enclosure for a dead body. Conversely, in Russian and Ukrainian that first structure from 1986 was called "shelter" (укрытие and

1 While the first time the movement was dictated by weather, the second time it was the political climate choosing the West as its destination.

2 Olaf Scholz gave this speech in the German Parliament on February 27, 2022, three days after the Russian invasion of Ukraine.

3 As the conference (and forthcoming book manuscript) "Temporality and Material Culture under Socialism" organized by Deschepper, Kalashnikov, and Rossi showed, Russian and Soviet art history is no longer theorized along an axis, but "Re-stitched," as "fragment," "Simultaneous" or "Disconnected Temporalities."

Figure 1. The New Safe Confinement steel structure in Chernobyl before being moved on top of the existing concrete Sarcophagus structure from 1986 that was poured onto reactor number 4. Photo by Francis Vigouroux, Courtesy Bouygues Construction.

укриття respectively), but not shelter for what the Sarcophagus held, but shelter for the world outside. The history of architecture has many origin stories going back to that of the primitive hut as sheltering humans from nature, to answer questions of form in relation to time—a narrative increasingly under pressure.[4] After all, what is a building if it is designed to be un-inhabitable—built instead to keep the world around it inhabitable? What are the possible life cycles of construction materials and their forms when they must prevail over seemingly endless half-lives?

Itself a fragile construct, the concrete mass would not remain the only shell built to contain the catastrophic fallout. From the 1986 accident, those hundreds of thousands of cubic-meters of concrete, the ever-durable material of modern architecture, started to leak and crumble under the radiation. A repair was ultimately declared impossible, and a new enclosure was needed. In 1992, the Ukrainian government held a competition for a new structure, going through the conventions of architectural production: among several hundred entries submitted by international offices, the French project called "New Safe

4 The image of the "primitive hut" illustrated Laugier's publication as the frontispiece and has been used frequently since then. See frontispiece in Laugier, *Essai sur l'architecture*. Yet the story of shelter is not as straightforward as long told, but it is also the narrative of architecture as solution to the threat of a dangerous "nature," as Ayala Levin argues, who calls instead for the analysis of the primitive hut as a site to untangle the context and environment of its production. See Levin, "Man, Nature."

Confinement" (NSC) was chosen to keep the toxic dust inside for the next 100 years.

Built from steel this time, the new shell was completed after lengthy delays in July 2019, built next to the old Sarcophagus and moved into place with hydraulics—the largest movable structure built thus far. How long it will last, nobody can tell. Building technology will aid as protection against decay through ventilation against condensation. But for this technology to weather radiation for generations to come, it is, in turn, dependent on these generations to *come* to it, and to keep coming, to maintain it repeatedly and tirelessly. The making of space for non-human occupants (the radioactive inhabitant), which over time disintegrates the building material from within, becomes an unstable narrative.

Following historian Serhii Plokhy's title of his book on the Chernobyl disaster, the decomposing ruin of reactor 4 and its makeshift concrete Sarcophagus betrays a history of tragedy.[5] And indeed the history of Chernobyl is a history of too-lates and not-yets, of missed synchronizations and rapid escalation. It is a material history of eager atomic manipulation and desperate monumental confinement, and of the many timescapes contained in them. The (political and constructive) engineers of the Chernobyl power plant deliberately decided to forego building a confinement around the reactor, despite an accident involving an identical reactor in Leningrad in 1975 (during the construction of the Chernobyl plant). Neither were the plans updated after problems with Chernobyl's own reactors in 1982. So when engineers conducted a stress test in 1986 that got out of control leading to the incontrollable fuel rod burning and explosion of the reactor, it was the *absence* of a building that ultimately provoked thousands of tons of material to be belatedly compiled in a multitude of structures.[6]

At the same time, the construction of the NSC, the largest movable structure ever built, which was shifted into place in 2019, can be read as an attempt to re-inscribe engineering prowess and perfectly controlled technology onto the site. The *forms* of entangled temporalities baked into these nested objects speak of their human and non-human temporalities: that of the construction and maintenance of an arch and its history, a concrete bunker and its current form as ruin, both built to last long enough to have decayed sufficiently for humans to move around them without protection. This article will not focus on one over the other, but try to regard the layers of bunkers and protective structures in Chernobyl simultaneously. By treating them not as chronologically sequenced built history, the zooming in on different temporal and material entanglements might bring a different, slightly blurry, architectural construct

5 Plokhy, *Chernobyl*.

6 Given the ongoing anthropogenic manufacturing of future catastrophes it may be worth noting that also here the cost for the post-facto confinement of this man-made catastrophe extended the originally "saved" budget by the billions, if calculable at all.

into view: that of an architectural palimpsest, a compound typology of the twenty-first century.

In post-catastrophe Chernobyl, this compound sits on geological and biomorphed layers of what has been called "deep time"—a site that speaks both of physical and physiological devastation and surprising biological avenues of resilient recoveries.[7] They are at once materialized developmental arcs in modern architecture (and modern technology) from concrete to steel, from massive construction to light-weight engineering. At the same time, they perplex such narratives by constantly evoking pasts and presents through architectural forms and their histories: the historico-aesthetic connotations of concrete and steel to the materiality of building technology; values of modern architecture such as 'stability', 'duration' or 'timelessness' against the crosstemporal collective memory built into architectural iconic forms such as the arch or the different cycles of construction, erosion and maintenance. They are built on a site under siege from within and without.

As a spatial complex defined by collective memories and material histories, human care and molecular change, the palimpsest that is Chernobyl resides in a temporal paradox: built as a twenty-first-century answer to a twentieth-century catastrophe, the only way to truly fulfill its function would require for it to have been built before it was needed. In this article I will therefore not construct one narrative or one history, but look at the multitude of matters short handedly referred to as "Chernobyl" by tracing its many entangled material and temporal layers in a series of architectural histories. I will write of monuments and ruins as humans attempt to mark and read their environment;[8] of origin stories (and counter-narratives) of the primitive hut as foundational tale for architecture as shelter;[9] and of building materials promising of safety, and their human caretakers.[10] Through these approaches from different angels and on different scales, I will sketch histories of knowledge located within architecture—an architecture history of knowledge that might help in understanding the entanglements of building within a history and towards a future. After all, the growing concern of historians of science and architecture about the production of knowledge-making in temporal "extremes," namely, beyond time-spans conventionally considered human-scale, is dramatically countered by the shortening perspective of humanity's presence on the planet.[11]

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7 See Woods, "Telling Time with Mammoths," in this special issue, on the emergence of materials from the "deep time" that the soil and earthly ground holds.

8 Riegl, *Der Moderne Denkmalkultus*; Allais, *Designs of Destruction*.

9 Picon, "Dom-Ino: Archetype and Fiction"; Rykwert, *On Adam's House*.

10 Forty, *Concrete and Culture*; Slaton, *Reinforced Concrete*; Mattern, "Steel and Ink"; Milojevic, "Time Constructions."

11 Hsiung, Lenel, and Meister, "Introduction: Entangled Temporalities."

Histories of Knowledge Residing in Material Constructions

The interrelation of architecture and histories of knowledge has received increasing attention in both fields over the last decades. When historian and philosopher of science Peter Galison investigated how "architecture has been 'scientized'" and how "science has been architecturally sited"[12] in 1999, or Antoine Picon and Alessandra Ponte looked into how engineers have constructed some of architecture history's most iconic spaces, they joined an ever-growing vibrant field of historians and architects exploring the production of knowledge in both science and architecture as cross-contamination over the next two decades.[13] And yet, that relationship has been largely explored with a focus on "exchanging metaphors,"[14] a history of exchange told by each of the disciplines about the other. How then would one write this history as history of knowledge *through* architecture? As architectural historian Jean-Louis Cohen states, the history of architecture in Russia is key to investigating the cultural exchange (and battles) between the Cold War parties, as any such history necessarily includes "material production."[15] This does not mean to take the built structures around and above former reactor 4 in Chernobyl as symbols or symptoms of concurrent technologies, politics and sciences, but that they embody knowledge *through* architecture.

If we take architecture to be matter formed by knowledge, and histories to be knowledge gained from material, then the increase of histories of knowledge that revolve around materials receives an additional analytic category: that of form across time, which, in turn, requires a reading of temporalities as bound up in matter. Galison stated that the authors of *The Architecture of Science* purposefully avoided the appearance of a "single transtemporal, transcultural entity" that would encompass their diverse aspects and disciplinary categories.[16] And histories of both objects and subjects have changed with shifts in both fields for technologies, science and architecture alike: wrangling with temporal entanglements (not least through queer and post-colonial studies) has moved historical disciplines away from narratives of ruptures or progression, questioning the modern concept of time's linearity.[17] New materialist readings take objects as glue and actants for communities or communal practices, and matter and materials could be read ontologically, bound to human and non-human actors in active networks,[18] opening up decentering perspectives and an object

12 Galison, "Buildings and the Subject," 1.

13 Picon and Ponte, *Architecture and the Sciences*, 11.

14 Picon and Ponte, *Architecture and the Sciences*, 11.

15 Cohen, *Building a new New World*, 20–21.

16 Galison, "Buildings and the Subject," 1.

17 For a more thorough and critical analysis of this construct, see the introduction to this issue: Hsiung, Lenel, and Meister, "Introduction: Entangled Temporalities."

18 For questions of actors in networks see Latour, *Reassembling the Social*; for inbuilt "behaviors" of matter see Bennett, *Vibrant Matter*; for communities constructed around things and their practices see Bray et al., *Rice*; for a feminist perspective on matter organizing care see Puig de la Bellacasa, *Matters of*

history extending the situated knowledge introduced by historian Donna Haraway decades earlier.[19]

This non-linear negotiation however is not abstract, but a material and formal process. For art historian George Kubler, a history that "seems to be composed of many envelopes" with "different contours" and thicknesses was the condition to situate artifacts as much as place.[20] This situating, however, is not an unambiguous location in a system, but an overlapping, intermingling plurality of "clusters of traits, or aspects, each with its own age, like any other organization of matter"[21]—meaning for Kubler, the structure of time and history is a decidedly *material* question. Why one shape changes and another one remains stable, how one form is read one way in one generation and differently in another is enmeshed with the temporalities these forms are bound up with and that they, in turn, produce.[22]

Narrative Speeds of Technological "Progress"

The first structures erected over Chernobyl's former reactor 4, a brutalist, technocratic construct, were soon overridden, eroded and replaced: not just by endless cycles of repairs of technological equipment or the new construction of a (hopefully) safe confinement above and around its eroding core, but by the re-inscriptions of architectural forms on a site that *itself* has been inscribed into the history of modern technology, science, biology and, as I argue here, architecture.[23] This first Chernobyl Sarcophagus became the ruin of a technological promise, a veritable monument to a modernist techno-utopia turned to toxic dust.

Two "knotted" temporalities were simultaneously at play:[24] the progress metaphor of the "nuclear arms race" and the "race to the stars" emphasizing the notion of speed in technological development as a politically defining temporal mode;[25] and that of belated political reaction, of postponement of

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Care. In a volume edited by Joseph Bedford, architecture (if belatedly) engages with Graham Harman's concept, including a feminist critique by Peg Rawes that addresses the universalist tendencies of a non-feminist object oriented ontology often found in fields like architecture. A critique of OOO by Andrew Cole is helpful for understanding the ideological implications in shifting agency into objects. See Cole, "The Call of Things."

19 Haraway, "Situated Knowledges."

20 Kubler, *The Shape of Time*, 99.

21 Kubler, *The Shape of Time*, 99.

22 When Swiss art historian Siegfried Giedion attempted to construct a new history of society with his seminal book *Space, Time and Architecture* he wrote a history of technology *as* history of modern architecture with technology as a still hopeful and defining instigator, more than three years before the end of WWII and three decades before the Chernobyl catastrophe. See Giedion, *Space Time, and Architecture*.

23 See Riegl, who treated monuments as "legible histories."

24 See Hsiung, Lenel, and Meister, "Introduction: Entangled Temporalities."

25 After the "race to the stars" and the close call of nuclear war in the Cuban Missile Crisis of the 1960s, in the 1970s such competition no longer meant a continuous opposition between the so-called "West"

warning, and the stuttering of knowledge production in the lagging study of long-term effects.[26] These temporalities were not at odds, quite the contrary. The Sarcophagus at Chernobyl was not only built to contain radiation, but to protect the integrity of a crumbling system beyond its death, while being made necessary by the failure of the very technology supposed to secure the system's dominance. Mikail Gorbachev's *Glasnost* politics and the subsequent *Perestroika* modernization processes and the dissolution of the Soviet Union were the political background against which the Chernobyl catastrophe unfolded—or, arguably, a development accelerated by it. To be first—aided by the temporal stretching of news cycles—promised not only to mark a point on a timeline, but to secure an unerasable advantage in the histories to be written. Hence, political delays of information about catastrophic effects and failures like Gorbachev's belated appearance more than two weeks post-accident were necessary to secure such advantage.[27]

As both Adriana Petryna and Kate Brown laid out in their in-depth studies of the long-term impacts of the Chernobyl accident, the different speeds unfolding in and around the site were not just political developments—neither were they merely the political moves of repetitive, constant delay of information, research and action.[28] These temporal currents at play drifted against those of the material changes within living bodies and cells. The contrast between the slow half-time decay and the fast decomposition of biological tissue was mimicked by its political counterpart of a fast "clean up" (and its financing) as event and the massively underfunded long-term studies on the effects of chronic low radiation on human bodies. Put into architectural terms, the initial desperate dumping of concrete into lost steel formwork on top of the burning fuel rods sits against the multi-generational aspect of passing radiation on to the next generation; and when that mass of concrete started to decay, another act of force produced the funding for the construction of a new structure—yet not for its long-term maintenance.[29]

The discourse in architecture about the desired timelessness of the so-called "new architecture" of the early twentieth century and its chosen materials, steel and concrete, garishly reverberates with the pressure to construct a shelter for toxic inhabitants "for all time"—or at least for 400 generations.[30] As Peter Galison writes, humans are advised not to dig at the sites of the Waste Isolation Plant (the storage site for the waste of American nuclear

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and the USSR, as Audra Wolfe explains, but an alignment of scientific efforts, evident in the joint Appollo-Soyuz Project and the Helsinki Accords of 1975. See Wolfe, *Freedom's Laboratory*, 177.

26 Petryna, *Life Exposed*, 1.

27 Petryna, *Life Exposed*, 1.

28 Brown, *Manual for Survival*.

29 See more on the motivation to raise money for a symbol like the arch in the section "The World Gave an Arch" below.

30 Galison, "Underground Future," 304–5. The European Bank for Reconstruction called the Chernobyl Fund also "Chernobyl Shelter Fund" in 1997, signifying the importance of this term.

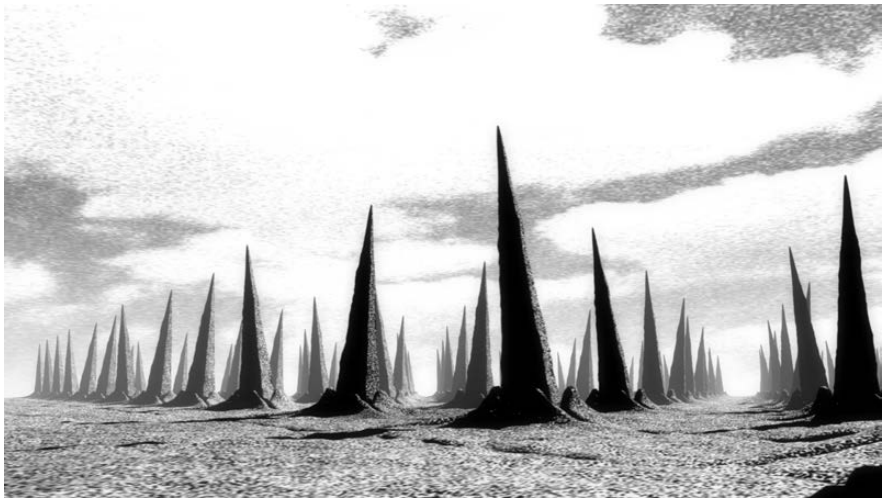

Figure 2A. Film still depicting a spike field from the Film "Containment" (2015), produced and directed by Peter Galison & Robb Moss, animation by David Lobser.

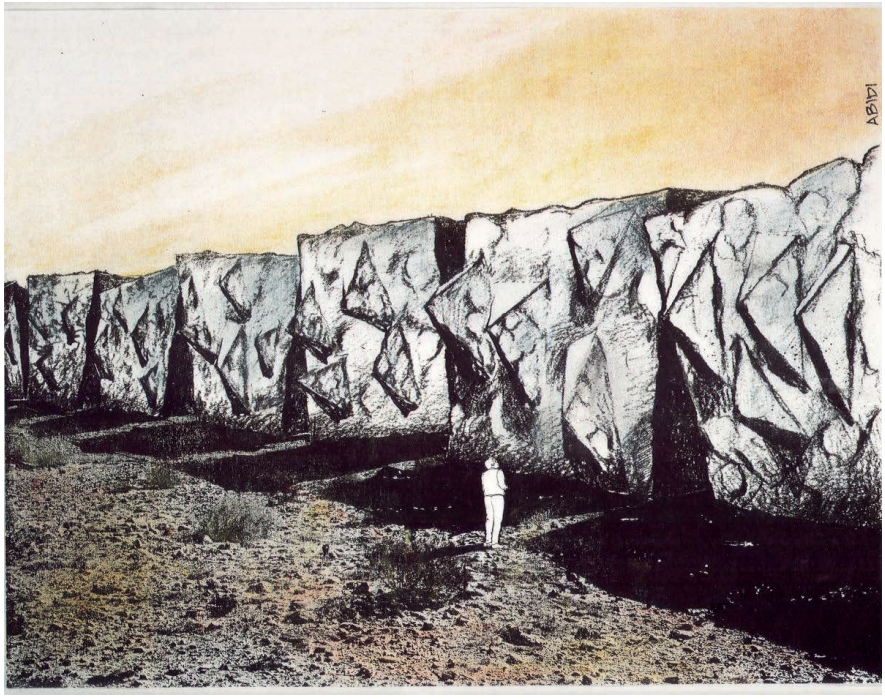

Figure 2B. Image of the "Forbidding Blocks" meant to deter human presence. Concept: Mike Brill. Drawing: Safdar Abidi. Image courtesy of BOSTI.

bomb production) for "10.000 years, some twice the time since the beginning of human writing."[31] One wonders how such instructions may travel across 400 generations or more—other than through the proven time traveling modes of myths, legends and lore. One proposed answer is, again, architecture: a proposed monument of "forbidding blocks" or a "spike field" full of needle-sharp obelisks is meant to prevent human presence.

Galison and Robb Moss' film *Containment* (2015) investigates such trans-generational shapes meant to convey nuclear fallout across time.[32] In Chernobyl, no spike field warns future visitors, but the poured concrete from 1986 formed a mega-block that long forbade not only human presence, but architectural alternatives of its own future encasing.[33] The occupation of space through matter however became a very temporary message on a site where decay is accelerated by radiation, and was soon replaced not by more concrete, but by an architectural form speaking of protection rather than deterrence.

"The World Gave an Arch": The Duration of Form

In architecture history, the building for a time beyond one's own is a well-known trope and practice. The Gothic cathedral, an often-used example of trans-generational architectural aspirations, comes to mind: to build for another life, a different existence, and one's offspring, however remote into a far future. In Chernobyl, the "disruption to time precipitated by nuclear materials" as diagnosed by Galison questions narratives of form as much as material durability:[34] if the search was for a construction to outlive the "next 100 years" according to the brief for the competition, what form should such a monument be given? Constructing it required the coordination of several different kinds of knowledge—engineering, aesthetic, and symbolic—all carrying their own history.

As a bulwark against modern technological destruction the arch as the chosen shape is hardly atemporal, or, as the engineering rhetoric of modernity will have it, merely 'functional'. Rather, it can be read against the foil of longer histories of architectural form-giving—despite, or rather because of the parallel histories of rhetorics of function-driven design as problem-solving methods in engineering histories as well as modern architecture. When the competition for the NSC was announced in 1994, any licensed architect could participate (it was an open competition resulting in over 300 submissions). The proposals demonstrated a stark formal variety, counting even "a pyramid full of sand"

31 Galison, "Underground Future," 304–5.

32 Galison, "The Half-Life of Story," 112.

33 In Chernobyl, however, the Exclusion Zone remains accessible, regulated by the signing of written rules—hence, through bureaucratic means themselves bound to their specific time. See Hunchuck, "Chernobyl after Chernobyl," 28–31.

34 Galison, "The Half-Life of Story," 110.

among them according to engineer Nicolas Caille, project leader for the two-billion-dollar project.[35] There was, as Caille describes, a variety of structures with "all the forms you can imagine." And yet, two companies— Vinci and Bouygues Construction, both of them French—proposed an arch: one made from concrete, the other one made from steel. When they won, they called the consortium "Novarka," the new arch.[36] But why were there two French arches? Why an arch, one of the oldest architectural expressions of structural prowess to begin with? If one contends that forms are indeed, as Kubler states, materially entangled with multiple temporalities, the choice to propose an arch as well as to select one as the winning entry is a charged one.[37]

For at least 2000 years, arches have weathered empires and gravity alike, engraving themselves into architecture history as particularly durable architectural forms, often even triumphal. As Leah Sinclair asks, "does any other fragment present a feat of structural engineering with such seemingly effortless grace?"[38] In Chernobyl, this architectural grace was built 300 meters away from the old Sarcophagus in stark contrast in size, material, and not least, form. Where the Sarcophagus looks like an impromptu brutalist building from the late 1970s (despite being poured a decade later), with rust bleeding out at the seams of the formwork, the new building was a gleaming feat of engineering.

Arches as forms that "resist gravity and differentiate space" hence often stand for the endurance of a human-made artifact over time, while creating actual spatial differences through its existence.[39] In Chernobyl, both became essential: the spatial difference between the inside and the outside, but also between the before and after—and the necessity for this differentiation to last and last. As Sinclair writes, "technology may have shunned the arch from our everyday structures, but it is this same advancement in technology that has seen its symbolic and mechanical meanings take an even greater hold."[40] The arch of the NSC, the "new arch," is no everyday structure to be sure. This arch has been made urgent by precisely the "advancement in technology"—namely, fusion technology and its fallout—that allowed its construction in the first place: no industry needs as much power than steel production.[41] The steel arch

35 Meister, Interview.

36 Meister, Interview.

37 When Eero Saarinen submitted his winning proposal—a concrete arch—to the competition for a memorial in St. Louis 39 years before the Chernobyl disaster, he referenced the arches of French engineer Eugène Freyssinet in Orly, stressing the "monumentality" of their form as aspiration for his own submission. Campbell, *The Gateway Arch*.

38 Sinclair, "The History of Architecture in Eleven Arches."

39 Campbell, *The Gateway Arch*, 65.

40 Sinclair, "The History of Architecture in Eleven Arches."

41 This very bind of energy, material and politics resurfaced in the debates over an embargo for Russian gas in spring 2022, when German industries, especially the high-quality steel industry, announced the impossibility of such an embargo and warned the German government that the steel industry might "move to France" due to the nuclear power available there. See Ahlers, "Arbeitgeberverband Stahl," and "Klimaziel."

Figure 3. The "Cascade Wall" of the Sarcophagus in 2016 with the lost formwork from steel, now rusting, that was used to hold the concrete. Photo by Carina Buchspies (@sichtweisend).

thus sits on a node of energy production, consumption, and containment of its aftermath; a cycle tragically mismatched with human life cycles.

Architectural form was called upon to negotiate these mismatched cycles. As much as the modern architects aiming for industrial forms materialized their desire for 'timeless' forms, so took the NSC an architectural form lodged in architecture history. The arch's parabola stands for engineering potential, a veritable, built parable for generations: the materialization of mathematic calculations simulating human control. Both "Urform" and element of sacral buildings, the arch oscillates between architecture's temporal aspiration of a longue durée and the engineering skills required to span large widths across infrastructures, waste sites or technologies. Modern architects, however, repeatedly redrew the disciplinary distinctions between architecture and engineering, an effort all the more surprising given how modern architects and historians of modern architecture have taken engineering's efficiency to be their aesthetic guide from the early twentieth century.[42] The project leader of the NSC—himself an engineer—redrew this familiar line between the structure's architectural quality compared with its engineering traits: "You can imagine the *architecture* in Chernobyl was not the biggest challenge. It was very much an industrial building."[43] And sure enough, even Eugène Freyssinet's

42 For the model role of engineering structures for the "new" modern architecture in the early 20th century see Le Corbusier, *Vers une architecture*; Giedion, *Mechanization Takes Command*; Banham, *Theory and Design*. On the shared education and training especially in 19th- and 20th-century Europe and the United States see Pfammatter, *The Making*; Saint, *Architect and Engineer*. On the role of the engineer in architecture history see Picon, *L'art de l'ingénieur* .

43 Jacks, "No 'Boring Life.'"

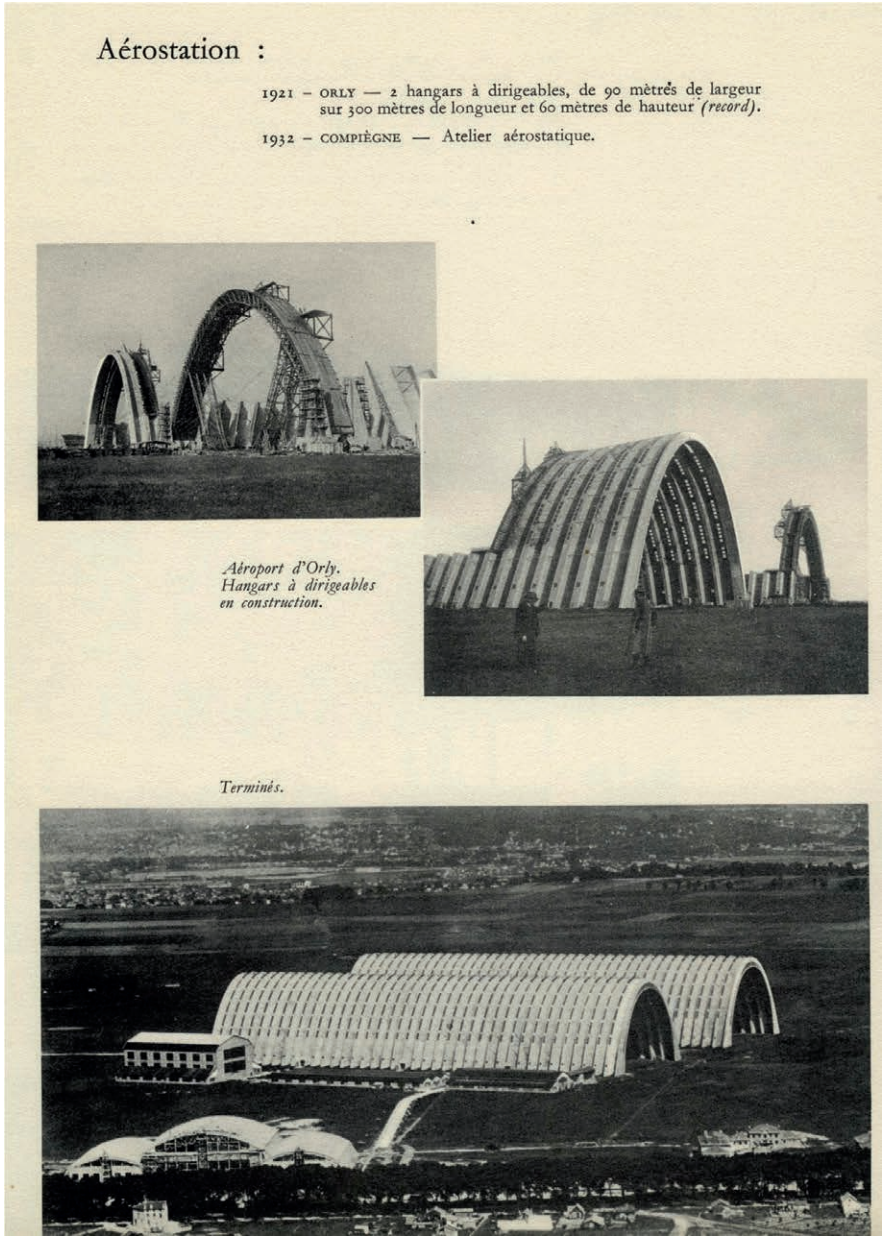

Figure 4. Hangars in Orly by Eugéne Freyssinet, 1923. Copyright: Explorations Architecturales.

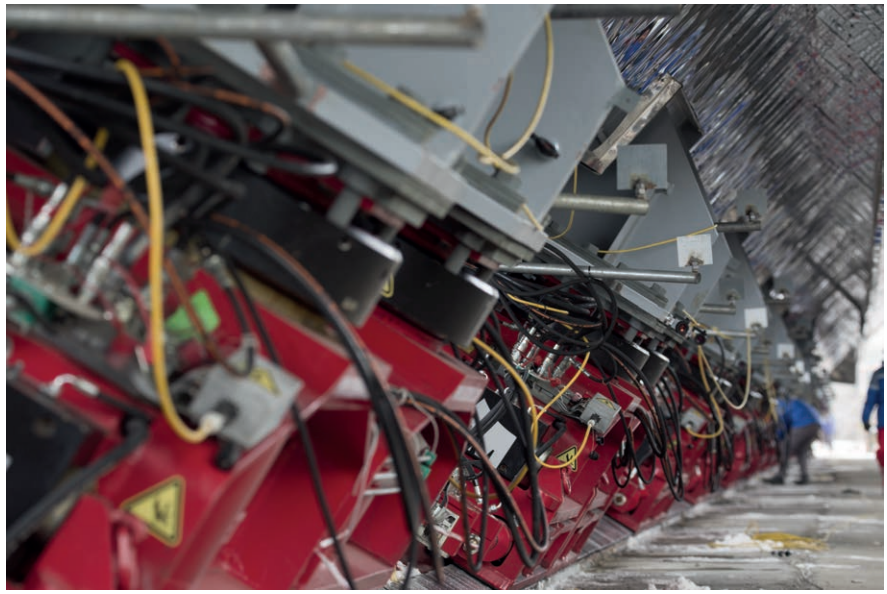

Figure 5. The synchronized jackhammers before the sliding operation in November 2016. Courtesy European Bank for Reconstruction and Development (EBRD).

arches had been contested by French architect Auguste Perret regarding their status as architecture, asking "but is this architecture? No! Not yet!"[44] Engineering, the ever innovative discipline, was now behind: its forms borrowed, its structures stable, it was left wanting for the architecture yet to come. What critics like Perret underestimated, however, was the symbolic power of the arch as architectural form beyond the signification of structural soundness. And indeed, the NSC utilizes a familiar form for an unknown typology suspended between its history and its future: part hangar, part shed, part bunker, the steel structure is decidedly a product of the twenty-first century. Not least because it is a mobile structure produced off-site, and slid into place. The mobile modernist architecture that proponents of industrial structures like Le Corbusier had dreamed about at the beginning of the twentieth century became possible almost a century later.[45] The NSC was an architecture not produced on its site, recalling modern architecture's dream of mobility, of architecture that would land or slide into place rather than being bound to the ground. Such projection of liberation by dissecting building and site, has its own history in modern architecture—a charged one, in fact, as it carried discriminatory assumptions of

44 Perret cited in Campbell, 65.

45 Interestingly, Freyssinet's hangar combined the two forms in its construction over time: starting as one arch, similar in shape to the one in St. Louis, the shape was extruded by moving the formwork, creating not a mobile building, but one constructed by moving its supporting structure over time, thus creating the hangar shape. See Figure 4.

cultural, historical and social "emptiness" of sites such as colonies or existing settlements or land belonging to someone else. What would be moved where was rarely decided by those on site.

In Chernobyl, the off-set between construction and building site was merely 300 meters, and it was an involuntary one at that, necessitated by the existing structure above reactor 4 and the radiation levels around it. Not a demonstration of agile performativity, the NSC's mobility was meant to remain a one-off.[46]

The monumental arch could only move with the help of Teflon (a material invented to improve fridges and accidentally discovered to have the lowest friction values), as any wheels would have been crushed under the building's weight. Pushed by 140 synchronized jack hammers in a process that Caille describes as a series of interruptions, recalculations and corrections, the rhythmic effort here resonates with Bachelard's "anarchy of vibrations."[47] Where the pyramids of Egypt, monuments of eternity, for him were "endless cacophonies," now massive technological exertion literally materialized his description. To create it, however, not only did the machines have to work in sync, but the expertise and knowledge of the international group of engineers needed to be synchronized, as well, in a "fraught and fragile coordination [...] in provisional tension" to construct a building for a different timescape altogether.[48]

Of Caves and Concrete

According to architectural historian Reinhold Martin, "what is commonly called a material in architecture is [nothing more and nothing less than what the philosopher of science Bruno Latour has called] a 'nature-culture hybrid.'"[49] In short, to be a material in the architectural sense, the *stuff* in question cannot remain in the state of being a resource or raw matter; rather, it requires technological or manual (or, simply, cultural and conceptual) manipulation. In Chernobyl, the materials at question were concrete, steel, and building technology—and constant human intervention.

Swiss art historian Siegfried Giedion, chronist of technological architectural histories, drew a strict line between naturally emerged form and humanly shaped material, using caverns as examples. While, according to Giedion, "Everyone is free to interpret the fantastic forms occurring in these caverns

46 A building by the New York architecture firm Diller, Scoficio and Renfro called "The Shed" opened in the same year as the NSC was entrusted to Ukrainian authorities. It too recalls a hangar repurposed for a new typology. It too is a shelter, yet one not for toxics but for "New York's creative community." It too is a moveable structure put together elsewhere—but its mobility is not temporary. This shed can afford to move back and forth at will, repeatedly, and swiftly at that: the deployment of the shell takes approximately five minutes. See "The Shed."

47 Hsiung, Lenel, and Meister, "Introduction: Entangled Temporalities," 1.

48 Hsiung, Lenel, and Meister, "Introduction: Entangled Temporalities," 2.

49 Martin, "What is Material?"

as cathedrals, banquet halls, galleries, chapels, or what have you," for him they "have no connection whatever with architecture."[50] Because for Giedion, stressing his point, structures need an intentionally shaped exterior to be architecture, while "the caverns possess only an interior; they have no exterior. In all this they are quite different from the architecture later invented by man."[51] In Chernobyl, the spatial configuration was the reverse. The new building arguably has an interiority, or, one might argue, several: the old Sarcophagus, and, within it, former reactor number 4, and, within that, the fuel rods. It was not empty, but full—an interior without empty space. When the new arch was built, the remaining interior space between the Sarcophagus and the arch was not built for human occupancy—rather, the building was built to externalize its interior from its surroundings. It was built to allow for its inside to disappear: Only when the radioactive dust above the decaying concrete mass could be safely contained could the concrete (and, ultimately, the fuel rods) be dismantled and properly disposed of. The Sarcophagus (flesh-eater) finally lived up to its name with the addition of the NSC, an arch constructed to let the flesh inside be eaten. This approach was, to recall architectural theorist Reyner Banham, the ultimate result of a process of modernization, seeing as those, according to Osman, "tended to produce an ever-tighter fit between architecture and its user, with the astronaut's space suit as the apotheosis of this tendency."[52]

For this architecture to serve its protective purpose, the technical support to ensure the survival of the built structure must function for several generations. The building built for a future that might outlast its human servants relies on precisely these human maintainers to ensure their generational survival. In short, to build for such different timescapes means to design cyclical maintenance, repair and replacement in an environment where in some places work is only safe for several minutes at a time due to high radiation levels. It also means constructing an interior to ensure the exterior's safety, aided by technologies to get into and out of the building with doors and airlocks as well as complex installations for ventilation. Recent histories of air conditioning and ventilation have highlighted the culturally coded values such building technologies reinforce and produce: who is comfortable at which temperature, what is clean air for whom are not innocent or neutral questions.[53] The control of air flow in Chernobyl however does not discriminate: it is not employed to improve comfort, but to increase survivability. All the more important is that this "passive house" (a house where air exchange is tightly monitored as to decrease energy consumption, and an energy standard defined as needing no heating besides that of the required fresh airstream) relies on maximized

50 See Giedion, "Space Conceptions," 71–89.
51 See Giedion, "Space Conceptions," 71–89.
52 Banham cited in Osman, *Modernism's Visible Hand* , xvi.
53 Chang, "Thermal Comfort"; Barber, *Modern Architecture and Climate*.

air-tightness. After all, it is not the rise of temperature due to solar intake, but the radioactivity of the crumbling materials that leads to the radiation of the interior from its very inside. What is radiating here is not the sun, but the energy source within. One might read the NSC as the world's first (and potentially only) reverse "passive house": a constructed enclosure where the air-flows are restricted to prevent exchange between the inside and the outside—built in Chernobyl not to minimize energy *consumption*, but to maximize energy absorption.

In a documentary on the NSC from 2018, filmed after the structure had been moved into place but before it's completion, the film makers documented the confinement's interior.[54] From within the dark space where journalists measured radiation levels, the camera points to the bright white gaps between hull and the concrete of the old shelter—the outside light leaking in, brightly highlighting the inside air leaking out. When the film was shot, the new structure did not yet confine the air inside tightly, it was not yet the safe confinement it was named for. A technical system is not likely to outlive the built structure it services, and in this case, the planned scenario is not one of thirty years up to capitalist obsolescence; neither is it the cultural expectation for built monuments to last beyond the current politico-societal context.[55]

"New Safe Confinement" is a suggestive name promising an airtight seal between disaster and environment—in short, it is a built claim to the absence of leakage, porosity or erosion and to contain the radiating material within its space. It takes the rhetoric of modernity to declare through the form of the arch: it is safe. The only potentially troubling adjective might be the "new," hinting at the necessity of its future (potentially regular) replacement. After all, the NSC became necessary despite the first one, erected in the months after the catastrophe, having been built from massive concrete.

The promise of the Sarcophagus had been to deliver the eternal stability modern architects had hoped for since the early twentieth century, when they began to advertise concrete as *the* new material for a new architecture. Concrete, the material with world-making potential if one were to believe its proponents such as Walter Gropius or Sigfried Giedion—the material that (at a time) had no inherent form, only formal potential, no history, only future. As architecture historian Adrian Forty writes, "concrete is *modern*," yet retains its "residual primitivism," a tension of temporalities he calls "characteristic for many things with claims to modernism." Furthermore, concrete was, for Forty, always "at risk of slipping back into its [...] earthbound origins."[56] In Chernobyl, this slippage was exacerbated by the fallout: the decay of the (accidentally) brutalist structure meant to last was countered by the erection

54 "The story of Chernobyl's New Safe Confinement," a documentary commissioned by the European Bank for Reconstruction in 2018, minute 6:48.

55 Abramson, *Obsolescence*.

56 Forty, *Concrete and Culture*, 14–15.

Figure 6. The preparation works (2016) within the New Safe Confinement before the sealing of the gaps between the old and the new structure. Courtesy European Bank for Reconstruction and Development (EBRD).

of the technologically enforced steel construct of the NSC. This layering both echoed and reversed the material affinities of modern architectures from iron in the nineteenth century to concrete in the twentieth century. Material here is not just a "nature-culture" hybrid, but a temporal construct with shifting stakeholders. And not just the materials themselves or the techniques of their production shift, but also their cultural connotation. Where concrete had promised modern architects flexibility and timelessness, Giedion praised iron and steel as a new material for new expression for the new architecture of the twentieth century, calling them exemplary of a new paradigm where "[b]y their design, all buildings today are as *open* as possible. They blur their arbitrary boundaries. Seek connection and interpenetration."[57] The NSC reverses such material-temporal constructions in two ways. The earlier massive, yet provisional, covering of concrete was now re-housed by a steel structure—ironic in the face of concrete's original "displacement of steel as the material of modernity," albeit temporarily.[58] And, secondly, here it is the steel structure that has no architectural interior: the new shell, made from the next, more modern material, became the cavern—not pre-historic, but post-historic this time. The

57 Emphasis in the original. Giedion, *Building in France*, 91; originally published in German as Giedion, *Bauen in Frankreich*.

58 Forty, *Concrete and Culture*, 23.

concrete, its interior, was meanwhile crumbling, increasingly revealing its own (radioactive) insides.

Where steel is presented as the construction material used, as Caille states, one finds rust as its "enemy." In conventional steel maintenance procedures, another material is layered upon the steel to protect the structure from corrosion: paint. But, according to Caille, the (uneven) radiation levels around the old Sarcophagus prevent such maintenance works, given that workers can only spend a few minutes in those areas within the new structure with the highest radiation levels.[59] To keep steel functioning as material, the repainting was replaced with building technology, namely, ventilation. Conventionally, what is understood to be the material in building production is differentiated from building technology. And yet, in the development of passive houses and smart homes, of climatized factories and cooled storage, this line between structure and technology no longer holds.[60] In the case of the NSC, building technology becomes arguably as much a material as steel or concrete; or rather, an inherent part of their material function. Only with sufficient airflow could steel corrosion due to radiation be slowed down. If one take's Martin's definition of material seriously, in this case, the material of the steel construction in Chernobyl is not simply the molecular compound of iron-turned-steel, but is contingent with its architectural function—and it can only endure with constant technological support to redirected airflow from trans-national wind systems to cyclical ventilation.

As Osman reminds us, technological systems depend on their representation for societal impact.[61] As much as the grand arch of the NSC promises stability and safety through its very geometry, it also demonstrates airtight distinction between inside and outside. The rubber seals closing off airflow from the interior to an outside were, so project director Caille, the "parts which are weaker than others," those that would need human intervention first. And yet, in a building constructed to sustain the seasonal temperature extremes of a continental climate, the most sensitive material is not the plugged-in hardware, but the software relying on updates to keep running the ventilation as programmed. As Caille states, "if they are not upgrading or changing the [...] software of ventilation, then the corrosion may start and then the structure [...] may last 150 years"; much longer, potentially, when "properly maintained."[62] But the promise of a lasting structure is the visible part of the bargain: an appearance of stability and airproof seclusion. In a building of constant leakage, of permanent material penetration, however,

59 Röhrlich, "Tschernobyl."
60 See Osman, *Modernism's Visible Hand*.
61 See Osman, *Modernism's Visible Hand*.
62 Meister, Interview.

the inseparability of dichotomies such as "inside and outside, life and death, profit and loss"[63] only becomes all the more apparent, despite sustained and concerted attempts of all actors to prevent it.

Monumental Ruins: Theseus' Ship and Sisyphus' Rock

In histories of architecture (as well as in the histories of nation states), ruins often serve the role of historico-spatial markers. For art historian Alois Riegl, founder of what one might call European preservation theory, ruins presented the one state of a monument that might not need intervention: their "age value" accrued precisely by the decomposing of cultural form over time.[64] By identifying "Russian" ruins in sites no longer (or not yet) part of Russia, for example, territorial claims were made via architectural heritage.[65] And yet the "ruin-ness" of a built structure betrays a multiplicity of temporalities embedded in a structure: the process of *becoming* a ruin was not an unambiguous definition, but a constant process with shifting aesthetic and political stakes. As depositories of lost or past cultural objects or projections, ruins as monuments of a past are used to bolster the forging of a specific present or future. Not all ruins have nation-making potential, but the Sarcophagus not only united 26 countries in a massive financial investment for the New Safe Confinement, it also sparked an international engineering effort.[66]

For the Chernobyl Sarcophagus, continuously oscillating between its potential *becoming* of a ruin and having been one from the time of its erection, these temporal identifications were not merely aesthetic, but existential: the threatened destruction of the ruinous remains were utilized from both sides in the Russian war on Ukraine to mobilize military and political action. The old Sarcophagus in Chernobyl had become a ruin more quickly than it should have, its chunky concrete crumbling almost immediately. It rains frequently in the area, and freezes for long periods in the winter, rendering it (not unlike other concrete structures) into a formerly unlikely competitor for fast-lane modern ruination. Concrete needs constant maintenance as without it water enters through fissures and gaps, freezes in the winter, blowing off bits and pieces of the concrete covering the reinforcing steel rods; those then get exposed and start rusting, bleeding the rust to the outside of the concrete structure, its marks visible in photographs and film footage taken of the Sarcophagus. And yet in Chernobyl, the main erosion of the material is not from the outside due to weathering but from the radiating fuel rods inside it, the

63 See Osman, *Modernism's Visible Hand*.

64 For the definitions of the different value systems by Alois Riegl see Riegl, "Der moderne Denkmalkultus."

65 See for example Demchenko, "Decentralized Past," 64–80; Deschepper, "Between future and eternity," 491–506.

66 See Meister, Interview.

ones it was built to cover. The seasonal impact tragically reverted, the roof is not protecting the interior from impacting weather events, but from the much slower half-time cycles from within.

Three decades after Riegl's definition of monuments, the art historian Lewis Mumford declared the "death of the monument" and denied, as architectural historian Lucia Allais outlines, the possibility of a "modern monument" altogether.[67] But as Allais shows, war and monuments share a long history in modern architecture. When man-made destruction during WWII provoked architectural measures constructing protective layers against wartime attacks, the result was another kind of monument altogether, albeit unwillingly. Given the unwanted attention that some of the larger structures attracted (making them in fact more likely to be bombed than protected), soon, the massive accumulation of matter *around* the monument gave way to a reverse encasement, swapping the interior (the monument to be encased) for the exterior to be separated from it: "It was not the monument but the visitor that was encased."[68] What is the consequence of such reversals for the monument as time-slowing instrument for cultural marking? If the ruin or the monument is used to mark permanence in the face of seasons and human bio-cycles, the question of preservation becomes a different question for architecture history. Speaking with Riegl, one could either preserve the so-called "historical value": to maintain the status as found post catastrophe and freeze it to show that historical moment to future generations—except that that is impossible given the radioactivity. Another way (if we stay with a Riegelian evaluation system) could be to preserve the "age value," which would mean to not interfere and let the ruin decompose over time—again, impossible, or at least undesirable from an anthropocentric point of view. In Chernobyl, the ruinous remains of the Sarcophagus needed to be encased by the NSC—or rather, the human visitors needed to be protected by the encasing of the monument. Here, not the ruin *as* monument was to be protected, but a new monument needed to be built to protect the exterior world from ruination. Read as such, the NSC becomes the ultimate encasing of the entire human population, externalizing the Sarcophagus ruin to humanity's "outside." And indeed this was the monument that needed to be preserved. Returning to the Riegelian value system, this new monument in Chernobyl was the one in need of protection adhering to Riegl's "use value": the one state of a monument that would allow necessary measures to be taken to maintain the monument's function.

It is not coincidental that histories of maintenance have only fairly recently become a core concern of architectural histories, while histories of shapes and forms have dominated the discourse.[69] For the Chernobyl competition, the arch (the form) was the part of the program that was funded and presented

67 Allais, *Designs of Destruction*, 1.
68 Allais, *Designs of Destruction*, 234–35.
69 Fitz and Krasny, *Critical Care*.

first; the essential and inbuilt question of its maintenance was outsourced to the local authorities. As Caille aptly phrased it "The world gave an arch—and Ukraine had to take care of it."[70] But adding to, replacing, and maintaining monumentally charged buildings, however, is rarely a question of pragmatic repairs, rather also one of cultural and societal decay, since "against loss, knowledge requires maintenance."[71] As art historians Alexander Nagel and Christopher W. Wood lay out in their book, art works (among them buildings) can be read as remaining the "same" building despite their partial or complete replacement. How would they retain their cultural code? As Nagel and Wood describe it, the adding or even replacing of material, building parts or entire structures is understood as a substitution of an absent original, maintaining the encoded meaning throughout iterations of destruction and reconstruction, additions or redecorations.[72] Taking this theory into the twenty-first century to describe technological disaster through its architectural traces, the NSC would have taken the place of the (now finally, hopefully absent) original Sarcophagus. In fact, at Chernobyl, there could never be a new layer or a new building—at least not for the 10.000 years mentioned earlier—given the ultimate coding of the site of the disaster, not just by way of the collective memory of the 1986 event, but the actual contamination of the place through radioactive particles. It may be Theseus' ship gone horribly wrong: however much one replaces in order to maintain the functionality of the crumbling existent version, one could never actually re-code the monument itself. In fact, it might be Sisyphus on Theseus' ship fighting against the atomically sped-up aging process—without obsolescence as its liberating endpoint.[73] What one detects here, architecturally speaking, is the perfect modern monument: one never to decay completely, never to be dismantled, only to be endlessly repaired, watched as it tumbles to be renewed. The timelessness that modern architects had longed for may not reside in architecture's form or surface after all, but found its fulfillment in the temporally entangled cycles of architecture demanding care forever—or at least for several centuries.

Conclusion: Towards a Shelter Past

In an interview with an Australian newspaper, Nicolas Caille and David Coulet, the project leaders of the NSC project, stated they felt they were building "for humanity"[74]—a client not limited to a specific group of people

70 Meister, Interview.

71 Hsiung, Lenel, and Meister, "Introduction: Entangled Temporalities," 12.

72 Nagel and Wood, *Anachronic Renaissance*.

73 That the ship has yet again (after Noah's arch) become the image and symbol for saving lives as in the debate on the saving of drowning refugees on the Mediterranean sea, aids my reading of these constructs as reverse naval vessels.

74 Jacks, "No 'Boring Life.'"

(humans), but one describing a cross-generational entity with no endpoint except extinction. Such "more-than-human scale" connects building projects from Stonehenge to the Norman cathedral in Norwich, as Jeffrey Jerome Cohen describes, "designed to press relentlessly forward in time, conveying the past via dense materiality but also opening continuously to modification and change."[75] In Chernobyl, the "more-than-human scale" is that of time—a monumental construct to hold off radiation during the cruelly long durée of the fallout that despite all human knowledge is impossible to accelerate.

The NSC belongs to a class of buildings that "do not capture history; they exceed it, as objects irreducible to human narratives. They are ritual spaces [...]."[76] Except that here the ritual is not an exercise towards transcendence, but a necessary practice towards earthly survival: it is a human going into the shelter every three months to service an electrical closet, placed by the architects and engineers in a spot least tainted by radiation to negotiate the half-times with the life-time radiation accrual.[77] This is a shelter not to rest one's soul but a fragile protective shell around a technological catastrophe—a monument involuntarily built against modernity's fallout itself.

Many people depend on the NSC to keep living safely, and yet most of them have never seen it—at least not in person. Such architecture analysis has its own history: buildings one had never seen were drawn, dissected and analyzed in architecture schools. Excursions and in-person visits to famous sites sustained the "Grand Tours" taken to teach only the well-off and well-educated makers of the future.[78] For everyone else, erected as well as crumbling complexes were narrated and "visited," and cities far and lost were mapped and populated. So, when I tell the stories of a building not for humans, I, too, tell them from a distance—one that is both spatial and temporal. But how far is Chernobyl, really? The distance at stake here is, in fact, less than molecular; it is now and tomorrow and the day after. All of us might be physiologically connected to it—if not to this building, then to its place: as Kate Brown writes, the probability of any of us not having ingested polluted berries, mushrooms, deer or milk is close to zero.[79] Those affected carry this story and its damage in their bodies across the world; the substances which have radiated since 1986 will keep imprinting humans, animals and plants long after any of them can tell their story.

The construct called the NSC becomes (in a history of the knowledge of its architecture) a multi-temporal techno-material construct—a form bent on outlasting its purpose. An envelope, one might say, but not in its architectural usage as a metaphor for the material dichotomy between an inside and an outside, but recalling Kubler's multiplicity of envelopes and temporal traits.

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75 Cohen, *Stone*, 114–15.
76 Ibid.
77 See Meister, Interview.
78 Stierli, "In the Academy's Garden," 10–16.
79 See Brown, *Manual for Survival*.

One layer entangled with others, not unlike an organic body with cells dying at different rates. Hooked up to machines, the diverging life cycles of technology, material, nuclear waste not quite sleeping, not quite dying. That arch that was built for the next 100 going on 10,000 years might be the grand monument protecting humanity from man-made radiation. The multi-generational construct might be the largest moveable structure ever built. But as of today, the only real protection, the one that would protect living cells from radioactivity, is an impossible feat to construct—no arch can provide it. Because for anything to offer true shelter from the Chernobyl disaster, it would have to have been built in the past.

Any shelter built after the 1986 catastrophe would be too late, and too little, a feeble attempt at confining the manipulated matter within layers and layers of material. However long the NSC will last, a next structure will need to be built to replace it. Until then, the reconstruction efforts to disentangle Chernobyl's multiple temporalities are not those built from steel or around concrete, but the long-term reconstruction efforts on a cellular scale in bodies, berries, the soil and the air, desperately trying to repair the damage of the dust entering lungs, blood and hearts.

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