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COVER SHEET

Greenwashed Concrete

Artistic Research With, On, and Against Concrete, Concerning Conflicting Concepts of Its Sustainability

Christoph Weber and Nikolaus Eckhard

Abstract:

Environmental science has shown that the global use of concrete has led to significant challenges today and will seriously trouble future generations. Nevertheless, international building industries advertise concrete as a natural, regional, sustainable, and hence green material. In 2020, global human-made mass exceeded all living biomass, with concrete accounting for nearly half of it, making it a signal of the Capitalocene. A radical transformation of industrial building culture is asked for, otherwise anthropogenic mass will be three times biomass by 2040. The growth of the technosphere is amplifying multiple negative currents in the pluriverse — air pollution, lithospheric extraction, and hydrosphere depletion — all with catastrophic effects on biodiversity.

This exposition displays the steps in and findings of the artistic research project Greenwashed Concrete. Setting out to widen understanding of the multi-layered material concrete, this project applied a methodology of juxtaposing two sculptural practices in order to collaboratively design experimental settings to engage scholars from heterogeneous fields.

Keywords:

concrete, greenwashing, social metabolism, socio-ecological transformation, built environment, architecture, housing, growthism, climate crisis, sculpture, collaboration, interdisciplinarity, technosphere

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GREENWASHED CONCRETE

Artistic Research With, On, and Against Concrete, Concerning Conflicting Concepts of Its Sustainability

Christoph Weber and Nikolaus Eckhard

Image description: Print from the 2020 sustainability report of the Italian company Federbeton, taped to a concrete column in a university building at Vordere Zollamtsstraße 7, Vienna (Federbeton Confindustria 2020). Click https://www.researchcatalogue.net/view/1928632/1928627#tool-1928650 to view the image.

Environmental science has shown that the global use of concrete — since the great acceleration kicked off in the 1950s — has led to significant challenges today and will seriously trouble future generations. Nevertheless, the building industry advertises concrete as a natural, regional, sustainable, and hence green material (OTS 2020).

Image description: Advertisement from the ad campaign ‘Natürlich Beton’ (‘Naturally Concrete’) by Beton Dialog Österreich (Concrete Dialogue Austria): ‘Which building material enables our meadows to be preserved? Think about it. Naturally concrete’. The print has been placed in front of a construction site where two skyscrapers are being built in Vienna, next to the public park Prater. (OTS 2020). Click https://www.researchcatalogue.net/view/1928632/1928627#tool-1928652 to view the image.

Image description: Advertisement for the Austrian branch of LafargeHolcim: ‘Superheroes save CO2 and thus protect the climate! Superheroes like you and concrete!’ The print has been placed on a shelf of the comic store ‘Hutterer’ in Vienna (Lafarge Zementwerke GmbH 2021). Click https://www.researchcatalogue.net/

view/1928632/1928627#tool-1928651 to view the image.

‘Natürlich Beton’ — ‘naturally concrete’ — has been the slogan of the collective marketing strategy of the Austrian cement-producing industries from 2020 onwards. The wordplay not only claims concrete as the most natural, and hence reasonable, choice of material, but it also evokes a seemingly inherent sustainability, by highlighting its ‘natural’ ingredients. Our project, *Greenwashed Concrete*, took its name from the initial finding of apparently conflicting definitions regarding the sustainability of concrete and set out to widen our understanding of concrete’s role in the Capitalocene. The research methodology is based on merging heterogeneous scholarly expertise with sculptural practices (with, on, and against concrete), in collaborative, interdisciplinary research settings.

This exposition follows the project’s artistic research in two major areas where contradictions between environmental science and the building industry occur: MASS and TIME.

From 1900 to 2020, the globally accumulated mass of concrete amounted to 550 gigatonnes (Krausmann et al. 2018), which is around half of the Earth’s living biomass (Elhacham et al. 2020), and which, according to an illuminating article in *The Guardian’s* ‘Concrete Week’, makes it the most destructive material on Earth (Watts 2019). On the other hand, the building industry claims that even more concrete is necessary to build a sustainable future.

Until recently, the construction sector had mostly concentrated on the economic life cycles of buildings and infrastructures (approximately fifty years; Floegl 2010; Jappe 2021). Lifespans of buildings have been found to range from ten to eighty years (Andersen & Negendahl 2023). This does not correlate with the industry’s advertisement of long service life (Beton Dialog Österreich 2020), nor does it relate to concrete being considered a signal of the Anthropocene (Waters and Zalasiewicz 2018).

We think that different perspectives relating to concrete’s temporality should be applied in order to understand the radical measures that will be needed to tackle the multiple environmental problems that the use of this material instantiates — and also to successfully reach the targeted net zero CO_2 emissions by 2050. Thus, the total lifecycle must be considered: from the chemical reactions of the material’s making to the useful lives of concrete structures, while also considering the inherent geological dimensions. This project proposes a post-humanist perspective on concrete and its temporality to enhance our understanding of the materials involved and their role within the discourse around sustainability.

The installation for the *Vienna Biennale for Change 21* at the Museum of Applied Arts Vienna (MAK), individual exhibitions and performances, findings from the *Greenwashed Concrete Conference (GC Conference)*, and the final dissemination at *Posthuman Rocks*, at the École d’architecture de la ville et des territoires, Paris-Est, are displayed in the two main chapters of this exposition — ‘Grey Matter’ (MASS) and ‘Concrete Times’ (TIME). Furthermore, the exposition includes a selection of slides that were presented at the *GC Conference* by members of the project’s supporting research team.

Concrete has often been viewed through the narrow perspectives of technical engineers, who have underestimated the socio-ecological complexity of this material, normalised it as the ‘natural’ choice for building almost everything, and dominated the accompanying scientific discourse. The key researchers found it surprisingly easy to invite experts from architecture,

ecology, economics, geology, philosophy, and sociology who were concerned with the topic in their respective spheres and who stated that a project connecting them was long overdue. The design of the project allowed intellectual as well as physical engagements with the material, making art a key element of interlinking the various positions. The field of artistic research allowed artistic methods of understanding to be merged with scholarly methods of questioning, as well as applied knowledge from builders and real estate developers, thereby broadening the scientific discourse surrounding the material.

Art was initially a connecting factor and a means of improving the scientific discourse, but over the course of this project it became a benefactor itself. The recursive quality of the artistic research setting enabled scientific facts to be rooted in the evolutions of single art works.

The general design of this artistic research project benefited from art's possibilities of radically shaking belief systems — which, in this case, seem to be fossilised in society's addiction to the use of concrete — and managed to contradict the claims regarding concrete's positive qualities put forward by proponents of narrow perspectives. For example, the claim that erecting high-rises 'preserves our trees, meadows and fields' (see the advertisement) employs a narrow perspective, seemingly limited to a simplified choice between sealing a given area of land with single-family houses, and thus destroying the meadows, fields, and trees, or putting a high-rise in the middle of that land and preserving the meadows around it.

Employing a wider perspective, however, this project enabled the view that meadows, fields, and trees are impacted not only by a given construction site but also by an assemblage of negative ecological impacts linked to the concrete industry, which keeps promoting and therefore perpetuating an understanding of architecture that can never be truly sustainable. The question is not how to seal less soil, but rather how to seal no soil at all.

The photo series shown in this introduction offers a way of affirmatively subverting the industry's strategies of greenwashing concrete, by recontextualising original advertisements. As the CO_2 emissions of the cement industry (around 7% of overall global CO_2 emissions; Lehne & Preston 2018; Fennell et al. 2022) are undeniable, the hectic research activities being conducted in cement laboratories around the world — with a view to reaching the promised net zero cement production by 2050 — appear to be contributing to the desired image of concrete as a green growth material. The road map for the Austrian cement industry proposes a 44% reduction via Carbon Capture, Utilisation, and Storage (CCUS) technology, which has not yet been fully developed (VÖZ 2022). Additionally, other negative impacts — like the sealing of soils, freshwater and sand consumption (Miller et al. 2018), toxic dust, overheated cities, the creation of massive horizontal and vertical barriers, and the overall negative impacts on biodiversity — are mostly disregarded.

We would like to commend the scientists for reducing some of the problems accompanying concrete — for example, by decreasing CO_2 emissions per tonne of cement, by proposing more efficient means of construction, and by developing recarbonisation and CCUS technologies. Nevertheless, the projected growth in global concrete consumption to 2050 will hamper any efforts to convert concrete into a truly sustainable material.

As our project was triggered by the Austrian context, we have often used data from this national perspective, which is similar to that of other Central and Western European countries. That said, it is of the utmost importance to view concrete as a global phenomenon, to think

critically about decolonial perspectives, and to stop blaming China and the Global South, while the 'Western' emissions of the nineteenth and twentieth centuries still hang heavily in the atmosphere.

Challenges Regarding Sustainability and Artistic Practices with Concrete

As artistic researchers working with concrete, we faced the challenge of how to avoid being bound up with the problems that concrete causes, by producing even more of this destructive material and possibly even assisting industrial interests focused on short-term economic gains. Therefore, this project strived to develop artistic research practices that critically (self-)reflected on the use of concrete. During the course of the project, virgin concrete was poured only when strictly necessary; we took great care with waste separation and re-used concrete where possible.

Image description: Advertisement for a cementitious paving stone, 'Climate Stone', which replaces 90% of Portland cement with slag cement. The print is shown placed on paving stones close to the newly sealed area around Vienna's famous harness racing track (Rinn Beton und Naturstein 2023). Click https://www.researchcatalogue.net/view/1928632/1928627#tool-1928653 to view the image.

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INDEX

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Page description: On the right of the page, five works are introduced through slide shows and a video link.

touch fragments, cast sculptures and wall-based works, Christoph Weber, 2022. Christoph Weber tells the story of a transformation — from the extraction of fossil limestone to the building of concrete pillars for highway bridges and the ultimate consequence of the biosphere being trapped between the lithosphere and technosphere.

6.4, Christoph Weber, 2022. A series of seven sculptural objects displayed in a line in the gallery space. There is as much cement in 6.4 concrete copies of a chunk of fossil limestone from the cement industry as the industry would have obtained from the original limestone. Images show close-ups of the objects and the objects under construction. A video shows the work in situ.

12kg, Christoph Weber, 2022

Furche, Nikolaus Eckhard, 2021. Concrete, 270 x 35 x 20 cm (100cm of it buried)

Bind, Christoph Weber, 2022

For each of these works, a 'full view' is available that opens the images in a larger view accompanied by sections of the main text the works refer to.

GREY MATTER

Introduction

While the use of concrete can be traced over the past 4000 years, at least, and while cement can even occur naturally, its environmental impacts have drastically changed in a global economy that is based on growth and the exploitation of nature.

Over the course of two years, on several occasions, we have been able to research elements of the topics relating to the extraction of concrete's raw materials (hereafter, construction minerals) and the accumulation of concrete. The lectures at the *GC Conference* emphasised the direct correlation between material resource extraction and gross domestic product (GDP), the endeavours of green growth proponents to decouple extraction from economic growth, and the fact that the extraction of natural materials is not taxed. As a result, we can assert the utmost urgency of a socio-ecological transformation, after which the extraction of natural resources will be in balance with planetary boundaries.

Extraction

> Since the invention of modern cement in the mid-nineteenth century, the excavation of stone and its redistribution in concrete form all around the world has been conducted on such an enormous scale that it is perhaps the clearest marker of human intervention on and below the surface of the earth. (Plant 2015: 8)

Image description: Two graphs, showing the global material use of concrete between 1900 and 2015. Click https://www.researchcatalogue.net/view/1928632/1928633#tool-1928787 to view the image.

The main ingredients of concrete, besides water, are the so-called construction minerals — limestone (for cement production) and sand and gravel or crushed rock (as aggregates). Their extraction has significant consequences for the biodiversity of the ecosystems concerned. The first ever global evaluation of this impact shows that about half the species that are endangered through construction mining relate to rock quarrying and the other half to sand and gravel extraction (Torres et al. 2022). Overall, the research group around Aurora Torres found that 1281 species were endangered or threatened by extinction (Torres et al. 2022).

Image description: A diagram showing taxonomic group and habitat in relation to mining type for species impacted by construction mining. The width of each box is proportional to the number of species and intraspecific taxa included per group, mining type, and habitat type, while the colours denote mining types. Groups are sorted by the proportion of records for each mining type. Click https://www.researchcatalogue.net/view/1928632/1928633#tool-1928787 to view the image.

In her philosophical supervision of the *GC Conference*, Susanne Witzgall, referring to Deleuze and Guattari, explained that the original ingredients of concrete lose many of their inherent singularities and 'variable intensive effects' (Witzgall 2022). As examples, we can name limestone, which acts as a water reservoir, and sand, which acts as a water filter. In the context of 'New Materialism', sand as a non-human entity can be seen as having agency and being capable of affecting and being affected by its environment. Depending on the way in which it is used, sand can be seen as having different potentials, capacities, and effects; when it is immobilised within concrete in a process of liquid petrification, its full potential cannot be achieved.

In this project, we have mainly focused on the extraction of limestone, but Christoph Weber completed a project for the Austrian Water Biennale about the historical manual sand and gravel extraction from the river Feistritz in 2017 (Weber 2017) and Nikolaus Eckhard manually extracted sand and gravel from the river Danube for his work *Geschiebe in Form gehalten* (2021; see the section 'Concrete Times').

In the installation *Touch Fragments* (2022), Christoph Weber tells the story of a transformation within the cycle from calcination to carbonatation — from the extraction of limestone to the building of concrete pillars for highway bridges and the ultimate consequence of the biosphere being trapped between the lithosphere and technosphere. [1] Using a newly developed

photographic technique that involves moulding real-size impressions of surfaces with translucent mould-making material, then contact printing the results to analogue black-and-white photographic paper, Weber refers to human intervention via a methodology of sculptural touch. ‘He explores haunted and spacetime-mattering landscapes, as explored by Karen Barad: “Touch is never pure or innocent. It is inseparable from the field of differential relations that constitute it”’ (Derrien 2022; Barad 2012). The pictorial representations of human touch — the drilling holes in the limestone quarry, the surface of the broken limestone mountain, as well as the imprint of the concrete formwork in the highway pillars — are combined with Weber’s method of sculptural touching, which involves photographically recording air bubbles of the translucent mould material and particles of the original material. In this way, the artist reflects on his own role and use of human touch, visualising the merged character of original (extractivist) and secondary (artistic) interaction. This aspect hints at an important argument in the concluding section (‘Dissolution’) — namely, the fact that this research is directed not only against the concrete industry, as a welcome antagonist, but also against the parts of ourselves that are content with the comfort zones we have been growing up in.

The same imprints of technospheric extraction and petrification have been used to cast beeswax sculptures of average human size, where the fronts and backs bear the imprints of concrete pillars and the sides are marked by traces of extraction. There are two reasons for the difference in size — first, this reflects the typical size relation between humans and their architectural shells; and second, it emphasises a shrinking or squeezing of the biosphere, symbolising the technospheric pressure to which it is exposed. Furthermore, the choice to present beeswax as a human-sized sculpture relates to a question that scientists have posed in their assessments of anthropogenic mass and biomass: are humans part of the technosphere or of the biosphere?

The production of modern cement, including roasting limestone with clay minerals at 1450°C, is a highly energy-intensive and emission-intensive process, which results in the so-called process emissions of CO_2. The heating of limestone (calcium carbonate or $CaCO_3$) releases carbon dioxide (CO_2) from the long-term carbon cycle to the short-term carbon cycle, at a ratio of ~40% CO_2 emissions from the heating itself and ~60% from the release process. [2] Cement factories and scientists alike are trying to reduce both heating emissions, by using alternative energies, and process emissions, by altering the composition of the roasted minerals (Scrivener et al. 2018). Nevertheless, 2050 roadmaps have to rely heavily on carbon capture technologies, since process emissions are an inevitable part of cement production. An estimate of the expected consumption of concrete in the near future will be presented in the final chapter.

Regarding the question of global responsibility for cement’s environmental impacts, two common patterns of deflecting blame can be observed. First, the tendency of countries in the Global North to blame China for its overall high CO_2 emissions, while ignoring their own high per capita emissions, especially in the second half of the twentieth century. In fact, in Austria, these emissions are still high compared with other industrial nations. Second, in the case of Austria, it is argued that the percentage of CO_2 emissions from the overall greenhouse gas emissions relating to cement production is somewhat lower than the global value (3.1% in Austria compared to 4.5% globally) (Beton Dialog Österreich 2021). This, however, is just another way of saying that many other emissions-intensive sectors and industries are at play,

since the per capita emissions for cement are high.

Images descriptions:

Two graphs, the first showing annual CO_2 emmisions from cement, the second per capita CO_2 emissions from cement.

Click https://www.researchcatalogue.net/view/1928632/1928633#tool-1928787 to view the image.

For his work *sechs komma vier* (2021), Christoph Weber researched how much cement could be produced per kilogram of burst limestone. Next, he chose a freshly burst chunk of limestone weighing approximately 200 kg, quarried in the Mannersdorf cement factory. The plan was to make as many concrete copies of this piece of limestone until the amount of cement in all the copies matched the amount the industry would have obtained from the original piece. He then calculated how many copies he could produce with his typical concrete mix (cement, sand, gravel, and water), which resulted in the number 6.4. He produced the mould, deciding to separate its two halves horizontally, since the seventh cast would need to represent 0.4, which is less than a half. In a conversation with the artist, Elisabeth Fiedler, the curator and art historian of Museum Joanneum, mentioned that he was inventing the sculptural representation of the decimal point, so he decided to emphasise the typical casting process of two halves, by clearly showing the production seams.

An important aspect of this work lies in the finite character of the multiplication. During the production of the seventh copy, Weber metaphorically ran out of cement (‘metaphorically’, because the original limestone piece was never turned into cement). As such, the sculpture alludes to the fact that humankind will have to find a way of dealing with planetary limits. We simply cannot go on with the logic of the infinite multiplication of the growth paradigm.

Accumulation

As of 2020, global human-made mass has surpassed all living biomass (Elhacham et al. 2020: 1). The cause of this growth has been modernism’s promise of improvement in four key areas: ‘Living, working, recreation and circulation’ are defined as ‘the key-terms of town planning’ in the Charter of Athens of 1933 (Curtis 1986: 173). Today, concrete, ‘the most abundant novel rock’ (Waters & Zalasiewicz 2018: 75), can be considered a signal of the Anthropocene. The material’s yearly growth in abundance (27 billion tonnes in 2017; 37 billion tonnes in 2023) is around twice the river sediment flux reaching the oceans (Waters & Zalasiewicz 2018: 83).

Image description: A graph showing the global stock of 'anthropogentic mass' vs. biomass. Click https://www.researchcatalogue.net/view/1928632/1928633#tool-1928786 to view the image.

To grasp the enormous abundance of the accumulated concrete on Earth during our *GC Conference*, we calculated the average global concrete consumption as roughly 12 kg per capita per day, by assuming current global production of 4.1 billion tonnes of cement, which corresponds to around 34.7 billion tonnes of concrete for 2021 (Garside 2022). Every participant cast a small slab with a size of DIN A4 and a height of about 10 cm, corresponding to two packs of printer paper or 12 kg of concrete. After four hours of curing time, at the moment when the cement's reaction started to fire and the concrete's consistency was similar to clay, everyone uncast their slabs and threw them away in a cathartic manner.

Why is the accumulation of concrete such a problem? The industry claims that it is just creating future stock for urban mining (Beton Dialog Österreich 2021), which will be welcome when Earth has run out of sand. [3] It also claims that a real circular economy is not yet possible, because concrete's long service life hinders the reflux of enough material, and that the concrete in landfills is inert, behaving like a new kind of mountain and just waiting for future generations to use it. [4] First, it seems highly unlikely that steel-reinforced concrete waste is really inert; and second, this does not account for illegal dumping, where concrete waste can mix with other kinds of waste, making its future recycling less probable. It is, however, important to acknowledge that Austria is using more than 90% of its construction waste, mostly as downcycled filling underneath new roads. Globally, that figure ranges from less than 1% in Brazil to around 10% in China and 90% in Japan (Gross 2019).

As stated by Fridolin Krausmann in the slide below, concrete recycling is practically non-existent. First, concrete rubble can only be downcycled to new aggregate, because it is necessary to add fresh cement and water for a new mix. Second, the re-use of built concrete elements, such as whole beams, has not yet been implemented in building practices.

Image description: A visualisation and brief text introducing figures about concrete recycling. The text reads:

Since 1900 ca. 124 Gt of concrete have been discarded to the environment; currently at a rate of ca. 6 Gt/yr. For Europe it has been estimated that 60% of concrete debris is downcycled (e.g. for use in road subbase layers) and 40% are landfilled; globally, the largest part is dumped to uncontrolled landfills. Downcycled concrete replaces natural aggregates; recycling of concrete is practically non existent.

Click https://www.researchcatalogue.net/view/1928632/1928633#tool-1928786 to view the image.

Bind (2022) was made for Via Detour, an exhibition at a treehouse hotel close to Kassel and a parallel event to *Documenta 15*. As the hotel's owner also runs a recycling company (for misprinted labels), Christoph Weber asked him to obtain some concrete rubble from a local landfill. For *Bind*, he drilled 20 mm holes into a large chunk, to break it into smaller pieces, then stuck these into soft casts of beeswax, colophony, paraffin, and wood tar. The wax cubes are a representation of the biosphere, with the wood tar adding a typical sculptor's wax mixture, to reflect a site in the middle of the woods. The work is a reflection of the biosphere's

tolerance as well as the tendency of humans — or rather capitalist societies — to take the biosphere for granted and consider it capable of absorbing human waste.

Confronted with the fact that concrete is responsible for the sealing of soils, the Austrian cement industry deflects the blame onto asphalt (Beton Dialog Österreich 2021). However, roads often have a cementitious base underneath the top layer, so concrete often plays a crucial role in their construction. The second commonly used argument against concrete being responsible for the sealing of soils is that it is actually enabling architecture's vertical design (hence avoiding horizontal design and the greater sealing of soils), but this ostensibly positive feature is also playing a key role in creating overheated cities, so here again concrete cannot be absolved of its complicity.

The sculpture *Furche* (2021; *Furrow*) resulted from the collective efforts of fifteen people who were led by Nikolaus Eckhard as part of the Viennese educational project 'Welt Teller Feld'. [5] The artist and the participants reflected, through their manual work, on the efforts of modifying and sealing soil, as well as the ambiguities bound up with ground consumption.

The 'Welt Teller Feld', a project showcasing how much ground an average person in Austria consumes via their food choices, offered a fitting platform for exploring the reduction of such space through a direct and provocative act of sealing.

The participants in *Furche* manually pulled a plough across a field, a straight line breaking through the first layer of soil. This action formed a physical understanding of soil and its plasticity, while also opening up a connection with the universe of underground life: bugs running, larvae wiggling, ants digging, and roots stretching. Next to the field, concrete was mixed — and, in a collective act, it was then poured into the fresh furrow, sealing it to stillness. During the curing, the concrete rested, as a grey scar of modernity on the fertile land. Hours later, the hardened object was excavated and freed from the soil — the soil also being freed from it — before being buried in a vertical position up to half its length. The object changed its status, from sealed soil to stele, inscribed with the memory of its making: on one side, the marks of the plough's blade, imprints of plants, shells, rough earth, and people's sweat; on the other side, the sleek promise of modern living.

In Austria, an area of 15–21 km² is sealed every year (Umweltbundesamt 2022). The sealing of soils implies not only the inability of the ground to absorb water and prevent floods — a problem the industry claims to have solved, by using 'drainage concrete' in so-called swamp cities — but also the irrevocable killing of all organisms living in the soil. It therefore affects not only biodiversity and the extinction of species but also global food production, by making the soil infertile for potential farming, even after the removal of the sealing (Tobias et al. 2018). [6]

As displayed in the first slide of this chapter, the speed at which global anthropogenic material stocks accumulate is almost identical to increases in GDP, which was first introduced in the 1930s, as a response to the Great Depression. In 1960, it was adopted by the OECD, which gives the highest sustainable rate of economic growth as its top goal, indefinitely and for its own sake (Hickel 2020: ch. 1.2.4., par. 7, quoting Schmelzer 2016). 'The idea spread like wildfire. During the Cold War, the grand competition between the West and the USSR came to be adjudicated largely by rates of growth. Which system could grow GDP the fastest?' (Hickel 2021: ch. 1.2.4., par. 7). The economic paradigm of Growthism started. (Hickel 2021: ch. 1.2.4., par. 7).

Anselm Jappe describes a ‘passionate liaison between capitalist modernity and concrete’ (Jappe 2020a) [7] and labels the material as capitalism’s weapon of mass construction (Jappe 2020b). In a Marxist line of thought, he explains the accumulation of capital as the accumulation of quantities of value given by abstract labour. Jappe continues:

> Marx speaks of a ‘jelly’ to characterise this amorphous mass of abstract labour. But what corresponds better to this ‘jelly’ in material terms than certain materials such as plastic or concrete? Artificial, always the same, unrelated to its surroundings, capable of taking any form without having one of its own: concrete is perfect for concretising and materialising the fundamental and immaterial abstraction that dominates modern society […] We can use a little play on words to say that concrete is the concrete side of capitalist abstraction. (Jappe 2021) [8]

This ever-growing ‘jelly’ of concrete has cured on the construction sites of modern urban society’s housing and infrastructures. Matthias Schmelzer elaborates:

> Urban geographers have documented what is called a ‘growth coalition’ or ‘growth machine’ of elites (primarily developers and politicians) who seek to spur and manage urban growth for the sole purpose of profit, functioning as a kind of ‘real estate state’. (Schmelzer et al. 2022: ch. 3.4.5 § 1)

He also reveals that: ‘Today, roughly 60 percent of the world’s capital is invested in real estate’ (Schmelzer et al. 2022: ch. 3.4.5 § 1, quoting Stein 2019).

If society’s focus on GDP does not change, there is little reason to expect the growth of anthropogenic mass to slow down:

> The transition to sustainable levels of resource use will probably require adopting transformative post-growth and degrowth approaches, including abandoning GDP growth as a goal, reducing inequality, and organising the economy around human needs, while scaling down unnecessary commodity production. (Hickel et al. 2022: e347, quoting Kallis et al. 2018 and European Environment Agency 2021)

Concepts of housing for degrowth are currently being developed and vividly discussed by a growing number of researchers and activists (Nelson & Schneider 2019).

Quoting a study by Helmut Haberl et al. (2019), Matthias Schmelzer presented a slide about concrete’s connection to the Social Progress Index, suggesting that around 50 tonnes of accumulated concrete per capita might be sufficient for a good life. Following this argument, production above this per capita level could be considered as unnecessary commodity production.

Image description: Concrete and social progress. A visualisation and brief text. The text reads:

Correlation between social progress and material stocks / concrete?
• Social Progress Indicator: nutrition, shelter, water, sanitation, safety, access to knowledge and information, health, education, freedom, rights, and environmental quality, no GDP.
• very high levels of SPI are reached at a level of ~50 tons of concrete stocks per capita - no

clear trend in SPI prevails above those levels.

Click https://www.researchcatalogue.net/view/1928632/1928633#tool-1928786 to view the image.

Footnotes

[1] The ‘technosphere’ is a concept coined by the American geologist and engineer Peter Haff. It refers to that part of the environment that has been built or changed by humans. See the section ‘The Time of Human Intervention and Prevention’ and Haff (2014).↩

[2] The ratio of 40% to 60% is given at top-quality plants only; otherwise, process emissions are higher. See Fennell et al. (2022).↩

[3] We held a Zoom meeting with one of the executives of the Austrian Cement Association (VÖZ), in which this statement was made. Ibid.↩

[4] The ratio of 40% to 60% is given at top-quality plants only; otherwise, process emissions are higher. See Fennell et al. (2022).↩

[5] https://welttellerfeld.at/ [accessed 13 September 2024].↩

[6] Tobias et al. (2018) state that there is very little systematic research about the unsealing and restoration of soil and that more data is needed for a general description. However, their experimental setting showed that even with intense human fostering, the unsealed soil needed fifteen years to develop favourably for crop growth, but with reduced multifunctionality.↩

[7] Translated by Christoph Weber with Google Translate.↩

[8] Translated by Christoph Weber with Google Translate.↩

INDEX

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Page description: On the right of the page, four works are introduced through slide shows. All works shown on this page were part of the exhibition *Posthuman Rocks* at École d'architecture de la ville et des territoires, Paris-Est, in 2022. There is also a link to a video documentation of the exhibition.

Geschiebe in Form gehalten, Nikolaus Eckhard, 2021, and *Archiving the Redundant Information*, Christoph Weber, 2021. *Deep Time Concrete* was developed for the *Vienna Biennale for Change 21*. It investigates the origin and possible future of concrete as a human-made material. Here it is shown in an extended version, at the *Posthuman Rocks* exhibition.

le temps fossile, Nikolaus Eckhard, 2022, collaborative performance. A collaborative performance exploring the university building itself and the different bodies and materials inhabiting it.

brea.th.up, Nikolaus Eckhard, 2021. Investigating concrete by approaching it through the body: shaping it and being shaped by it.

Untitled (Beton bricht Holz, Holz bricht Beton), Christoph Weber, 2022. An experimental staging of wooden poles being pulled apart in an attempt to break the concrete casting that surrounds them.

For each of these works, a 'full view' is available that opens the images in a larger view accompanied by sections of the main text the works refer to.

CONCRETE TIMES

Introduction

Let us assume the concrete walls surrounding us need five minutes for the mixing, half an hour for the pouring, four hours for green strength, [9] and two days to be defined as cured, with the formwork being removed. They will last another forty years, until they are labelled obsolete, when they will be left alone as ruins or smashed to rubble and deposited at a landfill. Concrete is commonly described as human-made stone. The perception of its temporality seems to be human-centred, too.

This artistic research has conducted various explorations of the different qualities of time inherent in the material: by breaking concrete apart, in *Untitled (Holz bricht Beton, Beton bricht Holz)*; by feeling its curing on a human scale, in *le temps fossile*; and by researching its geological dimension, in *Deep Time Concrete*. We have thereby identified three main clusters of temporality that offer different approaches to understanding concrete's impact on our

environment.

1) *Deep time* takes the geological dimension of the material into consideration. It describes a pre- and a post-functional time of concrete. It is the temporality of the sediments and rocks before they were mined and the material life of the concrete ruins and rubble buried in landfills.

2) *Functional time* describes the timespan over which a concrete structure is used or could be used by humans, in terms of the functions it was built for, until it is either abandoned or demolished. There are two major factors affecting the duration of this category: economic considerations, concerning reconstruction, and material aspects, based on environmental stress, chemical reactions, and the 'quality' of the initial labour.

3) *The time of human intervention and prevention* describes the time of intensified human activity in relation to the planetary spheres (the biosphere, lithosphere, atmosphere, hydrosphere, and, of late, the *technosphere*) and the remaining time for humans to have some influence on the catastrophic environmental consequences of those actions.

Deep time

> If, in fact, humanity has turned into a geological force, then we can no longer speak of history as such. All history is now, by definition, geo-history, including the history of power. By brutalism, I therefore refer to the process by which power as a geomorphic force henceforth constitutes itself, expresses itself, reconfigures itself, acts and reproduces itself through fracturing and fissuring. (Mbembe 2020: Avant propos § 6)

In cooperation with the *Vienna Biennale for Change 2021*, we designed the project *Deep Time Concrete* as an artistic investigation into the past and the possible futures of one of the earliest concrete buildings in Vienna — the annex of the Museum of Applied Arts (MAK). We took a sample from the 1908 building and, assisted by a team of scholars, analysed it by means of thin sections and historic research. Through the composition of the sediments of the probe, we could identify the river from which the sand and gravel was extracted: the Danube. By analysing the ratio of carbonation of the cement, the quarry from which the limestone was quarried and burned could be located: Mannersdorf, 40 km east of the museum. In a further step, we could also identify the creatures whose deposits formed the rocks that are still present today and still mined for the making of new cement: a colony of red algae that lived approximately 15 million years ago, at the edge of the Paratethys Sea.

While concrete tends to be labelled a natural material, it is more accurately described as a fossil-building material. In this sense, concrete is similar to gasoline, which is rarely advertised as a natural product.

During the *GC Conference*, Michael Wagreich presented slides showing different organisms whose ancestors potentially form our built surroundings.

Images descriptions:

Top: 5 images of limestone thin-sections under the light microscope consit of microfossil

remnants.

Bottom: 'Carbonates are born not made' (James 1979), text overlaid on a sattelite image of the Atafu Atoll.

Click https://www.researchcatalogue.net/view/1928632/1928634#tool-1928679 to view the image.

However, concrete is a fossil material not merely owing to its biogenic sediments but also because of its interdependence in relation to the whole fossil system. Whether it is the extraction in the quarry, the baking of the stones, the transportation of the smashed mountains, or the industrial labour needed to handle the running rock at the construction site, concrete depends on fossil energies and fossil means of production, while being used to build a fossil infrastructure.

Deep Time Concrete not only accompanied this research into the history of the museum's construction material but also allowed for speculations on the building's potential future over the next 15 million years. Jan Zalasiewicz points out that when one imagines the deep-time future of any built structure, it always involves a question of either sedimentation or erosion. Depending on the given plate tectonics, any location on the Earth is either lifted up, which certainly leads to buildings being ground away by erosion over time, or sunk down, which raises the possibility of buildings and their occupants being buried, compacted, and eventually preserved in some form (Zalasiewicz 2009: 84–85). Ultimately, then, *Deep Time Concrete* comprises analysis of the geological past and speculative future of the museum's building.

Next to the information poster for the project, two epistemic objects are paired in a vitrine of the museum. 'Archiving the Redundant Information' is a 3D print made from paper pulp, clay, and calcium carbonate. It was produced from a 3D scan of a limestone rock from the quarry, with an inkjet print being placed next to the vitrine. This work refers to the shape of a stone that was destined to dissolve during the process of cement production — while also taking into account that its seemingly 'natural' shape did not evolve from a natural process but was the result of blasting during the industrial mining process. On the other hand, 'Geschiebe in Form gehalten' is made from sand and gravel from the Danube river, moulded after the shape of one of the concrete beams of the museum's cellar. Accompanied by a short essay, 'The Speculative Fossilisation of the Museum of Applied Art', it displays a possible future scenario for the building and its materials.

Images descriptions:

Top: Nikolaus Eckhard & Christoph Weber, *Deep Time Concrete*, 2021. Two posters, A1.

Bottom left: Nikolaus Eckhard, 'The Speculative Fossilisation of the Museum of Applied Arts, Vienna', 2021. Print, A3.

Bottom right: Christoph Weber, *Archiving the Redundant Information*, 2021. Inkjet print of a 3D scan of a freshly burst 15 million year old limestone from the cement industry.

Click https://www.researchcatalogue.net/view/1928632/1928634#tool-1928679 to view the image.

The functional time

To promote the allegedly long lifespan of concrete, the industry often makes reference to Roman buildings like the Pantheon, which was built almost 2,000 years ago (with self-healing concrete and without problematic steel reinforcements; Beton Dialog Österreich 2021). Nevertheless, reinforced concrete's durability is estimated to be around fifty years for bridges and up to 140 years for foundations (INQA Bauen). But the calculations of a building's lifespan depend less on the durability of the material than on economic strategies. Complex formulas include inflation, depreciation, taxes, prospective returns from tenancy, and so on. A recent big data survey has predicted the lifespans of concrete buildings in South Korea to be only 22.8 years (Andersen & Negendahl 2023). Using data from Denmark, the same study shows 'a tendency for a declining lifespan based on the considered construction period, in which the lifespans of newer buildings (no more than thirty years old) are 45% shorter than the average lifespan' (Andersen & Negendahl 2023). Following capitalist principles, the main question is not how long a building could last, but how long it can be used to make a profit for. This approach enables economic strategies — such as planned obsolescence and the demolishing of functioning buildings — for the sole purpose of enabling new constructions and generating more profit. Recently, revisions of taxonomies and legislation by the European Union and individual national states have begun to establish full lifecycle assessments, including CO_2 emissions, in order to reduce demolitions and facilitate a circular economy.

Contemporary research into new concrete recipes has reported a theoretical functional lifespan of thousands of years (Löfken 2009). But instead of being seduced by ideas of everlasting — 'sustainable' — buildings, societies should discuss what mechanisms of power are linked to particular construction materials. While the reinvention of concrete has supposedly improved the living conditions of a few generations, it is also responsible for the loss of local building cultures as well as personal disempowerment, by industrialising construction and diminishing the possibilities for home dwellers to take care of their buildings.

Nineteenth-century ferroconcrete, paired with modernism's unleashing of productive forces, has brought about a situation in which a few people (mainly white and male) have tremendous influence on the living situations of thousands or millions (Jappe 2021; Forty 2013: 18). In post-war Europe, concrete was understood as the best means for rebuilding the housing that was so urgently needed, so modernism's ideas of 'living, working, recreation, and circulation' echoed around construction sites, while local building cultures gradually diminished:

> Global *betonitis* seems to have [...] [wiped] out the infinite variations of architecture developed over millennia. Adapted to the local context, using locally available materials, variable in the details against the background of a unified whole, creative in the use of their thermal properties, often self-constructable, but in other cases resorting to a sophisticated craftsmanship, with symbols charged with meaning and sustainable […] [humankind] has demonstrated its ability to adapt to its environment without destroying it. (Jappe 2021) [10]

The long and often collective process of building has now turned into an industrial endeavour that requires only a few months for the thoughts of single planners to be transformed into 'human-made stone' — a phenomenon that can be described as the petrification of ideas. Ideas that are born within particular social paradigms are turning into solid matter, which most certainly has a different longevity to the paradigms they stem from.

While the combination of steel and concrete is statically convincing, it leaves future occupants with limited space for structural changes, fundamental adaptations, or possibilities of repair. Arguably, it is a benefit for concrete houses to need less care than those made of traditional materials, but they hardly allow home dwellers to interact with their built environment and take care of it. If the steel within the concrete walls starts to corrode, highly advanced industrial techniques are needed to save the functionality of the structure. It might be hard work to replace rotting wooden stances or dangerously leaning stone walls, but it is feasible, without depending on an industry.

Summing up, concrete has changed the housing sector in three ways: by diminishing local building cultures; by reducing individual possibilities for altering living spaces; and by creating a dependence on industrial experts for building and caretaking. Arguably, these changes have led to an erosion of society's perspectives about what good living can look and feel like. In this sense, the 'petrification of ideas' describes not only an approach to construction, but also the inability of individuals to imagine different forms of living.

The paragraphs above mainly discuss the functional lifespans of housing and the apparent necessity of using concrete, while touching less on the topic of infrastructure. Today, it seems harder to relinquish the use of concrete in the transformation from fossil power generation to hydro and wind power, due to their dependence on it. Taking the interdependence of housing and infrastructure into consideration, then, we acknowledge that this project cannot provide sufficient solutions relating to the use of concrete in infrastructure, but we can pose the question as to how much of the produced energy in the Global North is actually necessary for a good life and how much is being used to keep a destructive system running.

Nikolaus Eckhard's *le temps fossile* and *brea.th.up* both deal with the concept of the petrification of ideas.

le temps fossile (2022) was a two-day performance/workshop with architecture students from the École d'architecture de la ville et des territoires, Paris-Est. Designed as a collaborative research project, the group worked with fresh concrete to explore intra-active relationships between the body, matter, and architecture. The participants questioned the modernist understanding of concrete as a malleable material without inherent shape, by confronting it with the shapes and needs of their own physicality. Taken away from the realm of drawn concepts, where human ideas can seemingly endlessly dominate space and form, the weight

and pressure of the material became present and, therefore, immanent in the resulting pieces. The collective bodies of the group interacted with fresh concrete, finding new sensibilities towards the material — a different kind of softness, which not only comes through feeling the liquid, malleable state of uncured concrete but also arises through understanding and interacting with the hard reality of it. During the two days, a series of photos as well as three objects were created.

brea.th.up (2022) similarly investigates concrete by approaching it through the body — shaping it and being shaped by it:

> In this series of works, the setting of *brea.th.up* was the most intense I have experienced so far. Clamps blocked my body from moving while my friends Mira and Daniel poured fresh concrete into the space between my arms, legs, torso, and head. A bent copper tube allowed me to breathe. The curing of the concrete took about 40 minutes, in which I felt the slow transition from holding the material to being held by it. My body is part of the 1.1 teratonnes of biomass on the planet. 0.01% of it is made up by humans (Elhacham et al. 2020). The harder the concrete got, the more difficult it got to expand the volume of my chest — to breathe. (Eckhard, unpublished notes 2024)

The work consists of a sculpture, a video, and photo documentation of its making.

Time of human intervention and prevention

The third timescale we are considering has two sides: human intervention and human prevention. The former refers to the timespan of humans intervening with planetary spheres, by extracting, processing, emitting, building, demolishing, re-using, or depositing components of concrete. Human activity towards natural resources and their biogeochemical embedments first went beyond planetary boundaries around 1970, when global resource use exceeded 25 Gigatonnes per year (Hickel 2022: e344). The time of human prevention refers to the remaining timespan humans have to influence the degree of the climate crisis:

> Continued technological acceleration presages a fundamental problem for humans because their capacity to deal with events that unfold ever more rapidly is biologically limited. Under a continuously accelerating regime, the timescale for significant technological change will eventually become too short for humans to deal effectively with ensuing consequences, such as the emergence of unexpected and large-scale environmental and social disruptions. (Haff 2014: 142)

What Peter Haff is describing is the urgent necessity for humans to figure out a way of taming the technosphere:

> [I]ts technological and human components carpet the Earth. A network of roads, paths, pipes, railways, airline routes and shipping lanes supports long-distance transport of mass and energy, reminiscent of the circulation of atmospheric and ocean currents. In emerging as a global phenomenon, the technosphere has joined the classical spheres to become an autonomous Earth system, operating without direct human control. (Haff 2014: 139)

According to Haff, the technospheric currents involving concrete are: the extraction of the construction minerals; the baking of the limestone and the emitting of CO_2; the addition of fresh water, which starts the process of hydration (a phase of ‘liquid petrification’) and

subsequently forms the technospheric elements; and, last but not least, the demolition, re-use, or depositing of obsolete concrete structures.

Humans are now dealing with the problem of organising as a global community in order to significantly alter the technosphere's trajectory. Can humankind prevent an environmental catastrophe by reducing the amount of natural resources used to the point where ecological limits are no longer overshot?

For Christoph Weber, concrete 'represents more than a material. [It is a medium.] It offers him an opportunity for subversive interventions in a material process: an exploration of possibilities to explore materials as transformable realities' (Kroeger 2016). His works that involve breaking up concrete before it has started to properly cure may be read as metaphors for human intervention and prevention. In *Untitled (Beton bricht Holz, Holz bricht Beton) [Concrete Breaks Wood, Wood Breaks Concrete]*, Weber conducts an experiment-like repetition of the same action — namely, pulling two wooden poles apart that have been encased in a concrete cast. For one, he waits for a couple of days until the concrete is cured, subsequently resulting in the breakage of one of the wooden poles. For the other, he pulls them apart at green strength, four hours after casting, at exactly the moment the cement reaction is starting to kick in, when fresh concrete has the consistency of clay, subsequently creating fissures in the concrete cast. The work can be seen as a metaphoric call to action, as a reminder to act before it is too late.

Footnotes

[9] The 'green strength' of concrete is when the material has set but not hardened, so the vertical formwork can (theoretically) be removed without altering the geometrical shape.↩

[10] Translation by Nikolaus Eckhard with the help of Google Translate.↩

INDEX

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(Dis)solution

Over the course of the years 2021 and 2022, we created several artistic research settings to explore concrete's role in the Capitalocene. They were different types of scholarly and artistic collaborations: some were substantial events like the *GC Conference* and the *Posthuman Rocks* exhibition, while others were smaller components adding to the larger whole displayed in this exposition. We started off with a deep-time investigation for the *Vienna Biennale for Change 2021*, but our conversations with builders, material scientists, economists, and philosophers always seem to have been influenced by a geologist's point of view — a central perspective in the understanding of the Anthropocene. Intrinsic to this project was the gradual change of the artistic research, supported by a growing body of knowledge, both from reading the recommendations of our scholarly collaborators and from reflections on our settings. The further we explored concrete's role in the climate crisis, the more we realised how quickly current trends are escalating the ecological situation. This, in turn, influenced elements of the subsequent research settings. It also made 'industry' a welcome antagonist — but this research is actually directed against those parts of ourselves that are content with the comfort zones we have been growing up in, which are integral parts of our cementing societies (Cao et al. 2017).

The cement-producing industries might be disappointed by the following conclusions and claim that concrete is unjustifiably blamed, as has happened before (Michael 2019). They seem to perceive concrete and their efforts to make it more sustainable as part of the solution to the climate crisis. From the point of view of industry, its advertising is not greenwashing, but image-rebuilding campaigns, peppered with positive facts from contemporary research. Although they keep investing in spreading misinformation about the sustainability of their product, it is obvious that humankind needs to drastically change its relation with this material. If societies continue with business as usual, it is projected that in less than twenty years the anthropogenic mass will be three times the mass of all living organisms on the planet (Elhacham et al. 2020).

The following slide, presented by Fridolin Krausmann at the *GC Conference*, shows the global per capita cement stock in use and an estimation of the progressive stages of cement use in different world regions.

Image description: A colour-coded graph depicting the distribution of cement stocks around the globe. It carries the title: Global cement stocks will continue to grow: +50% /

+70% until 2050 (BAU). Click https://www.researchcatalogue.net/view/1928632/1928635#tool-1928737 to view the image.

It is estimated that most European countries and most of North America have almost reached a state of saturation in terms of in-use cement. [11] The graphic shows that China is approaching a flattening curve, while the stock in the Global South is expected to drastically rise if a building culture based on concrete continues to spread globally and at the current growth rates. While it is important to stress that all humans have the right to functional housing and infrastructure, it is also important to keep in mind that the cement-producing companies are major global players, whose main interest is still the maximisation of their profits, not true sustainability and good living conditions. They are bound to the given economic paradigm of Growthism, which favours the highest growth of GDP for its own sake. It is likely that the cement-producing companies of the Global North and China will keep pushing into the markets of the Global South with disputable promises of improving living standards. It is also likely that they will keep pushing a green growth agenda in the Global North, by promoting high-efficiency concrete, its necessity for alternative energy power stations, and all kinds of CO_2-reduced products.

The 'Accumulation' section depicts the direct alignment of anthropogenic mass accumulation and GDP growth. Because green growth follows the same GDP-oriented logic, however, it is not a viable solution, since 'there is no evidence of long-term absolute decoupling of economic growth from resource use occurring either in historical data or in modeled projections, even under high-efficiency scenarios' (Hickel 2022: e347).

Promoting concrete as a sustainable material is hindering an urgently needed socio-ecological transformation. As described in the sections 'The Functional Time' and 'The Time of Human Intervention and Prevention', the time for successfully executing this transformation is getting scarcer, since the technosphere 'races ahead like a forest fire without much concern for its own longevity' (Haff 2014: 143). Meanwhile, local cultures and perspectives relating to what housing and living could look and feel like are diminishing. Humankind's task is not only to halt the technosphere but also to figure out how to reclaim a scope of action based on pluralistic mentalities.

During the *GC Conference*, Lukas Allner presented several contemporary ideas for creating a sustainable building culture that could be implemented right away. The ideas that directly relate to the use of concrete are *robust massive concrete construction*, to radically prolong the functional time, by increasing the thickness of all concrete elements; *skeleton construction*, to decrease the in-use material stocks per new building; *reuse and circular construction*, to implement reusable and prefabricated concrete elements; and *transformation*, of existing large concrete buildings. The two latter options both avoid demolition and reduce the pouring of virgin concrete.

We strongly advise against the first option of *robust massive concrete construction*. For the time being, and until the 2050 road maps are implemented, the use of concrete is still emitting drastic amounts of CO_2. It seems very wrong to distribute the high CO_2 emissions that are caused by construction today over an increased functional time — a diagnosed life cycle of 200 years, for example, when the goal should be to avoid unnecessary emissions right now.

We also assume that carbon pricing will exponentially rise, therefore the high levels of emissions today are not being correctly accounted for, especially in relation to such long future time spans.

Additionally, the mining of the necessary construction minerals is still seriously endangering thousands of species. In a near-future scenario after 2050 — when industry will supposedly have fixed the CO_2 problem and established a 'circular' economy of downcycling to avoid the mining of sand and gravel — the impacts of limestone rock quarrying, to produce cement, will still remain. Even if industry succeeds in implementing its road maps, this would not solve the problems of the sealing of soils, overheated cities, toxic dust, the diminishment of local building cultures, the impossibilities of individual adaptation and caring, and the accumulation of anthropogenic mass.

To overcome Growthism and short-sighted concepts of sustainability, degrowth and post-growth approaches need to be considered. Concepts of how to achieve a good life for everybody while staying within planetary boundaries need to be discussed not only by a small number of scientists and activists but also by whole societies. It might be necessary to define an ethical range within which concrete's use is legitimate.

Until this discourse leads to significant changes in the way societies and economies function, the Global North and China need to stop continuing 'business as usual' and instantly change the way they are building.

In order to accelerate this social process, we therefore propose:

STOP USING CONCRETE

Footnotes

[11] It is important to note that this does not include the accumulation of concrete in landfills but only concrete in use.↩

INDEX

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INDEX