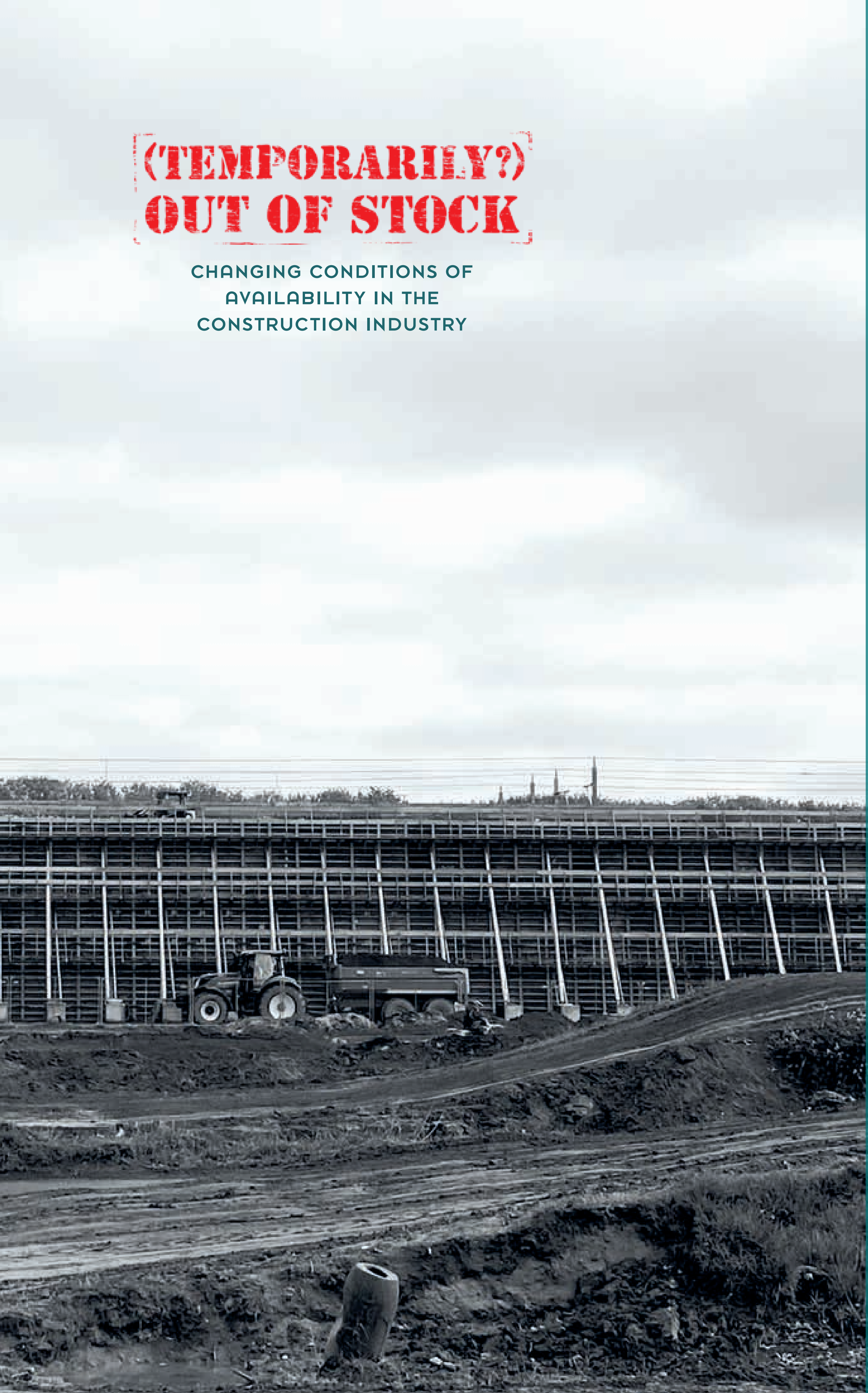
(TEMPORARILY?) OUT OF STOCK

CHANGING CONDITIONS OF AVAILABILITY IN THE CONSTRUCTION INDUSTRY



BULLETIN KNOB
KONINKLIJKE NEDERLANDSE OUDHEIDKUNDIGE BOND
2025
4

BULLETIN KNOB

VOLUME 124, 2025, ISSUE 4

KONINKLIJKE NEDERLANDSE OUDHEIDKUNDIGE BOND

FOUNDED ON 7 JANUARY 1899

BULLETIN KNOB
An independent, peer-reviewed scientific journal by KNOB and co-sponsored by the Faculty of Architecture and the Built Environment, Delft University of Technology. ISSN 0166-0470

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DESIGN Suzan Beijer, Amersfoort

CONTENT

Cover image
Construction of an earth wall along the perimeter of a soil bank in Utrecht (photo C. Pradel)

This issue is co-funded by
EOS THE EXCELLENCE OF SCIENCE

(TEMPORARILY?) OUT OF STOCK
CHANGING CONDITIONS OF AVAILABILITY IN THE CONSTRUCTION INDUSTRY

TOM BROES AND MICHIEL DEHAENE




This special issue is based on the simple idea that building our rapidly urbanizing world is not just a matter of erecting buildings, but also, and above all, of creating the specific conditions that make building possible in the first place. These conditions are not fixed, however, but require constant reassessment. 'Construction,' according to Heine and Rauhut, 'is a highly diverse process, which always has to adjust to social change and technical innovation, while it is also sitting on 'technological paths' and is constrained by the availability of resources, knowledge and experience'[1] and, by extension, the availability of skilled workers, materials, logistical capacity, and so on. Evolutions in the way we build are therefore never solely the result of technological innovation, but depend also on the way in which that technology and everything it entails is made socially available. The question, therefore, is which modalities of availability in the construction industry have been kept alive by society, and which have disappeared over time, and why.

In his contribution to this special issue, for instance, Jesse Foster Honsa convincingly demonstrates how efficient building systems for housing construction nevertheless fell out of use due to a lack of skilled workers to apply them properly. The usability of building materials therefore depends heavily on the availability of [suitably] trained labour(ers). It is precisely this notion of 'constructed availability'[2] that is central to this dossier: what forms of construction were proactively made possible in the twentieth century – based on what choices, and at what cost? These questions are very topical now that we are confronted with planetary boundaries that are constricting today's dominant construction practices.[3] After all, the construction sector's share in the anthropogenic disruption of global climate and ecosystems is considerable, as has been emphatically documented in recent years.[4]

The excessive consumption of energy and materials in the construction process is a particular focus of attention, which explains the increased interest in the availability of building materials and the growing number of publications on (global) material flows and related forms of 'extractivism' – both ecological and in terms of labour conditions.[5] In search of answers to the substantial

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environmental impact of construction, solutions are being sought in aspects of 'dematerialization', 'rematerialization' and circularity.[6] Despite the breadth and depth of ongoing research into these practices, it nevertheless contains several gaps and limitations.

For example, the editors of *Material Constraints* (2024), a special issue of *Abe Journal*, argue that contemporary discussions about alternative material use 'rarely really address the deeper historical contexts' in which new materials must become available.[7] The contribution by Arne Vande Capelle and Lionel Devlieger to this special issue of *Bulletin KNOB,* makes it clear that reuse only becomes economically feasible when new construction or renovation projects are able to formulate a specific demand for precisely those materials that are released during the demolition of particular historical heritage sites. It goes without saying that such symmetries do not arise automatically and are highly dependent on place and time. Like *Material Constraints*, the dossier (*Temporarily?) Out of Stock* explicitly aims to delve into the historical dynamics of construction and building materials during the course of the twentieth century. Not only with a view to enriching our historical knowledge, but above all as a necessary condition for better understanding the precise context in which what exactly can or must be made (un)available in order to enable more sustainable building practices. Tom Broes's article in this issue, for instance, shows how more sustainable alternatives will struggle to claim a credible place in the market as long as ready-mix concrete remains so abundantly and cheaply available. As this specific legacy of the Belgian context makes clear, availability and scarcity are not isolated, absolute or natural conditions, but are constructed within specific historical-contingent circumstances and are always related to situated – and therefore, by definition, relative – practices, needs and choices.

Another criticism of academic research into material consumption and the environmental impact of construction was explicitly developed by Jeremy Till in his 2011 essay 'Constructed Scarcity', in which he pointed out that much research focuses on the extraction of a single material in isolation, thereby threatening to reduce the notion of availability to the notion of a series of parallel natural reserves that will inevitably be depleted in the long term – which in turn reduces the idea of 'limits' to inescapable doomsday scenarios.[8] The typical response to this segmented approach is to continue producing (more) with less material – completely in line with the Brundtland definition of 'sustainable development'[9] – but this merely postpones the inevitable moment of unavailability, while resources continue to be depleted. Till concludes that 'instead of seeing actual scarcities [or availabilities] as ever-diminishing buckets of stuff, they have to be seen in relation to other networks and resource flows, and one's creative intervention is not in rearranging the contents of the bucket, but in designing new processes that divert and optimize the resource flows and change values and modes of behaviour, thereby understanding stuff in its social context'.[10] In his essay Till refers to the work of Dougald Hine, who, based on a similar analysis, argues that this reasoning 'is not to deny the force of material conditions, but it is to say that most of the time, there is social and cultural room for manoeuvre'.[11]

If we want to be more conscious of planetary boundaries in construction today, for example by producing in a more CO_2-neutral way or by focusing more on reuse and circularity, we will not only have to develop 'sustainable' material technology, but also consciously create the conditions in which opting for alternatives becomes structurally feasible. In concrete terms, this involves, for example, critically rethinking existing material flows and building the necessary infrastructure to enable certain local construction practices. Chiara Pradel's contribution exemplifies that circular construction will only really gain a foothold in the construction industry when an ecosystem of 'material gardens for reuse' can claim its rightful place in the urban network. The 'socio-cultural room for manoeuvre' referred to in the work of Till and Hind also invites us to develop a broader understanding of availability, beyond the dominant focus on natural resources. Building materials only become truly available when there is effective consumer interest,[12] when applicable standards and specifications can be met,[13] when there is a sufficient supply of skilled labour to process the materials,[14] and so on. It is therefore important to examine these different aspects in relation to one another, and to incorporate them into a multifaceted understanding of availability. It was precisely against this backdrop that the initiators of this special issue launched a broad call for articles explicitly examining how the 'constructed availability' of building materials, skilled workers and resources, among other things, conditioned construction in Belgium and the Netherlands in the twentieth century – and what lasting consequences this entailed.

In his article, Jesse Foster Honsa examines the availability of labour, essential to enabling certain construction practices. His research shows that organizing material flows to the

construction site makes little sense as long as there are insufficient skilled workers to effectively process those materials on site. The article looks in particular at how construction workers found their way to the garden suburbs in Great Britain and Belgium. In both countries, these garden suburbs were built outside the traditional urban labour markets in the first half of the twentieth century.[15] The article also asks whether these residential areas were accessible to the construction workers themselves and highlights the imbalance between affordable housing and the wages paid to the workers who built those homes.[16] The article further highlights how new technologies and materials challenged or even disrupted existing construction practices, and how the rising price of scarce materials had a direct impact on workers' wages in the overall cost structure of construction.[17]

Tom Broes shows how the cement industry in Belgium succeeded in turning concrete into an extremely accessible consumer product.[18] He recounts how the cement sector achieved the urbanization of concrete mainly through the roll-out of a logistics network of concrete plants across the whole of Belgium, at various moments supported by all kinds of government financial injections and interventions.[19] If large parts of the city are built with ready-mixed concrete today, this is partly because the (over)availability of the material was carefully orchestrated between 1960 and 1975 via a combination of economic and institutional interests. The introduction of the concrete plant led to a territorial rescaling and rationalization of dominant material flows (from 'in bags to construction sites' to 'in bulk to plants'), while also requiring the training of entirely new job profiles (from implementation-oriented laboratory researchers to mixer truck drivers). This deep-rooted ready-mixed concrete regime remains to this day one of the core driving forces of the persistent, almost irreversible cement addiction of Belgian construction culture.

Arne Vande Capelle and Lionel Devlieger outline how, on the margins of this rising concrete regime in Belgium, space emerged for alternative material flows and construction practices that in the event never gained structural acceptance. Drawing on the work of Marcel Raymaekers,[20] they outline which industrial waste streams (such as large river stones as a leftover product from dredging river gravel for the concrete industry) and demolition materials (for example from historical city buildings replaced en masse by concrete apartment blocks) were historically made available for reuse and by whom. Raymaekers's decidedly eclectic oeuvre of salvage architecture was highly dependent on a personal network of 'material miners' who were able to unlock ever-changing flows of recuperation materials. The systematic drying up of these material sources whenever a direct contact disappeared, ultimately drove his search for suitable material ever further afield. The article tellingly illustrates the many modalities of availability entailed by this supply-driven logic of varying materials in limited quantities. Raymaekers's approach depended on a dynamic and labour-intensive link between supply and demand. It required resourceful contractors who were willing to build without a plan,[21] sufficient clients who were open to an ad hoc aesthetic based on random material stocks,[22] and so on.

Chiara Pradel demonstrates that we must literally make space to physically and mentally anchor alternative material flows in urban society. Focusing on existing material banks (for the reuse of building materials, soil and trees), she explores how the spatial configuration and presentation of these materials create dynamic landscapes on an urban scale. The central question is how these landscapes might help us to reimagine, reconfigure and safeguard the value and potential uses of old materials – and what kind of design imagination is needed to achieve these goals.[23] The metaphor of the 'material garden' opens up a perspective of curating, caring for, maintaining (*main-tenir*) and revaluing what has recently been degraded to waste elsewhere.[24] The image of the garden as a grounded and demarcated staging post, where new cultures and mentalities of reuse can be cultivated, strips the concept of 'material flow' of all its abstraction. By treating very different 'material gardens' simultaneously, the article unlocks and reassembles a semi-invisible world that nestles in the cracks of dominant and consumptive construction practices as a complementary and ecosystemic landscape, bringing residual flows back into circulation.[25]
The juxtaposition of these historical studies in the context of the Low Countries invites the reader to effectively imagine 'availability' as a layered, historically contingent, and relational construct. No boulders for Raymaekers without aggregates for the concrete plants. No meaningful material flows without skilled construction workers. What can the 'material gardens' in Pradel's article learn from the way Raymaekers compiled and cultivated his personal Queen of the South material garden? And perhaps there will be opportunities in the future to transform a number of redundant concrete plants into fascinating material gardens for reuse – against the backdrop of monumental mixing silos that serve as industrial relics of the fossil fuel construction era.

ACKNOWLEDGEMENTS
The editors would like to thank all the authors involved for their submissions and for the committed way in which they engaged with the thematic approach throughout the process. Special thanks to Jesse Foster Honsa for bringing Jeremy Till's work on scarcity to our attention. The eight anonymous reviewers deserve our thanks for their efforts and critical comments, which helped refine the articles. Thanks also to all the editors of *Bulletin KNOB* for their openness to publishing a dossier on the theme of availability, for their careful editing of the final manuscripts, and for the attractive layout with many images that bring the issue to life. This special issue is rooted in the stimulating context of the Belgian EOS project 'Construction History, Above & Beyond: What History Can Do for Construction History'. A heartfelt thanks to all colleagues within the project, as well as to the many invited guests for the inspiring interactions during several international workshops and seminars. This project (40007559) received funding from the FWO and F.R.S.-FNRS under the Excellence of Science (EOS) program.

NOTES

1 E.C. Heine and C. Rauhut (eds.), *Producing non-simultaneity. Constru ction sites as places of progressiveness and continuity,* London/New York 2018, XXII.

2 On the notion of 'constructed scarcity', see: J. Till, 'Constructed Scarcity', *SCIBE (Scarcity and Creativity in the Built Environment)* working paper *1* (2011), online. See also: J. Till, 'Scarcity and agency', *Journal of Architectural Education* 68 (2014) 1, 9-11; J. Goodbun et al., *The design of scarcity,* London 2014.

3 J. Rockström et al., 'A safe operating space for humanity', *Nature* 461 (2009) 7263, 472–475.

4 M. Kuittinen, 'Building within planetary boundaries. Moving construction to stewardship', *Buildings & Cities 4* (2023) 1, 565-574; N. Francart et al., 'Building within planetary boundaries. Setting and assessing absolute sustainability targets at the building level', *Journal of Physics. Conference Series,* 2600 (2023) 152015, online. Conferences and symposiums on this theme are organized very frequently: 'The International Symposium Building within planetary boundaries – scales and practices of sustainable development', Osaka University, April 25-26, 2025; research seminar 'Designing in a finite world – urbanism, architecture and resource-consciousness', ULB Brussels, October 24, 2025.

5 J. Rowen, 'Pipes, provision, profits, privatization. The materials of water infrastructure in nineteenth-century Kingston, Jamaica, and London, England', *Aggregate* 11 (2023) May, online; J. Ore, 'Workers' bodies and plywood production. The pathological power of a hybrid material,' *Aggregate* 10 (2022) June, online; K. Förster (ed.), *Environmental histories of architecture,* Montreal 2022 (in particular: Hannah le Roux, 'Circulating asbestos. The international AC review, 1956–1985'); P.H. Christensen, *Precious metal. German steel, modernity, and ecology,* Pennsylvania 2022; R. Fivez, 'The rubble in the jungle. A fragmented biography of Lukala's cementscape, DR Congo', *Journal of Landscape Architecture* 15 (2020) 1, 78-87; K. Dawson, 'Geologising urban political ecology (UPE). The urbanisation of sand in Accra, Ghana', *Antipode* 53 (2021) 4, 995-1017; M.A. Miller, 'A transboundary political ecology of volcanic sand mining', *Annals of the American Association of Geographers* 112 (2022) 1, 78-96; V. Pivo, 'Shrouded in dust. The unseen labor of African American cement workers', *Journal of Architectural Education* 74 (2020) 2, 328-331.

6 I. Ruby and A. Ruby (eds.), *The materials book,* Berlin 2020; Space Caviar (ed.), *Non-extractive architecture, 1: On designing without depletion,* Berlin 2021.

7 M. Motylińska et al., 'Swimming in an ocean of materials', *ABE Journal (Dossier: Material Constraints)* 23 (2024), online.

8 According to thinkers such as Harvey, political movements should not simply accept the idea of 'natural limits' as apolitical facts. Instead, they should question and politicize how limits are calibrated, in whose interests, and then socially reconstruct them. D.W. Harvey, *Spaces of hope,* Edinburgh 2000.

9 According to the Brundtland Report, *Our Common Future* (1987), sustainable development meets the needs of the present generation without compromising the ability of future generations to meet their own needs. The criticism of this definition is that it does not sufficiently question the growth and production paradigm itself.

10 Till 2011 (note 2).

11 See also: D. Hine, 'Scarcity and Abundance', online (https://dougald.co.uk/scarcebooks.html).

12 R. Harris, *Building a market. The rise of the home improvement industry, 1914–1960,* Chicago 2021.

13 K.L. Thomas, *Building materials. Material theory and the architectural specification,* London 2021.

14 L. Clarke, *Building capitalism. Historical change andthe labor process in the production of the built environment,* London 1992.

15 J.L. Polasky, *Reforming urban labor. Routes to the city, roots in the country,* Ithaca 2011.

16 C. Wall et al., *Building a community. Construction workers in Stevenage 1950–1970,* London 2011.

17 J.R. Hicks, *The theory of wages,* London 1963 (2nd ed.).

18 On the relationship between industry, architecture and urbanization, see, for example: K.L. Thomas, T. Amhof, and N. Beech (eds.), *Industries of architecture,* London 2015; G. Meyers, 'Political ecology and urbanization. Zanzibar's construction materials industry,' *The Journal of Modern African Studies* 37 (1991) 1, 83–108; P. Mishra, 'Urbanisation through brick kilns. The interrelationship between appropriation of nature and labour regimes,' *Indian Institute for Human Settlements 5* (2020) 1, 17–36.

19 On the relationship between the realization politics of the cement industry and urbanization, see: D.W. Harvey, *Abstract from the concrete,* Berlin 2017.

20 A. Vande Capelle et al., *Ad hoc baroque. Marcel Raymaekers' salvage architecture in postwar Belgium,* Brussels 2023.

21 P. Lefebvre, J. Neeuwels, and J.-P. Possoz, *Thinking-making. When architects engage in construction,* Brussels 2021.

22 B. Sweeting, 'Re-use aesthetics and the architectural roots of ecological crisis', in: D. Baker-Brown and G. Brooker (eds.), *The pedagogies of re-use. The international school of re-construction,* London 2024, 43-55.

23 T. Armborst, D. D'Oca, and G. Theodore, 'Holding pattern,' *OASE* (*Social poetics. The architecture of use and appropriation)* 96 (2016), 19–24.

24 A. Kučan and M. Kurir, *Garden and metaphor. Essays on the essence of the garden,* Basel 2024. For the notion of maintenance as 'main-tenir' (as 'keeping in hand' or 'maintaining now'), see: P. Caye, *Durer.* Éléments pour la transformation du système productif, Paris 2020.

25 S. Massaro, 'Unblackboxing waste management in practice. A set of actions enabling circular city making', in: L. Arboritanza et al. (eds.), *The ecological turn. Design, architecture and aesthetics,* Bologna 2022, 349-364.

HOUSING FOR WORKERS, BY WORKERS

CONTRADICTIONS IN ENGLISH AND BELGIAN GARDEN CITIES

JESSE FOSTER HONSA

INTRODUCTION

The lack of sufficient housing has been, and continues to be, a driver of development. A difficult issue that arose during the industrial revolution was how to manage the teeming masses of workers who flocked to the centres of work. Housing for these masses has become part of an explicit political project.[1] Yet even when housing is understood as a necessary part of this productive system to ensure the supply of labour, it is itself viewed as a commodity; as if the solution to housing scarcity is to simply commission more houses. If their construction is problematized at all, it is often as a technical problem of materials and assembly, rather than a social problem of mobilizing labour.[2] The reality is that housing must be built by someone, and this labour must be sustained through training, care and more housing. For all the attention paid to the workers who were to *receive* housing, the workers who were to build that housing formed a blind spot.

How has housing scarcity intersected with the overlooked issue of labour scarcity? What do housing crises reveal about the fundamental contradictions in housing production, with regards to the figure of the construction worker? This article focuses on one type of housing solution where the crises and contradictions were more apparent than in others: garden cities and their variants in the early twentieth century. First of all, making cities and suburbs from scratch required the mobilization of many workers to remote sites where there was no nearby accommodation. For all the scholarship dedicated to the design and moral implications of garden cities, there is a paucity of studies considering the practical question of how they were built. One exception in this regard is the work of Christine Wall, Linda Clarke, Charlie McGuire and Michaela Brockmann, which reveals how Stevenage New Town was the product of intersecting needs: construction workers needed a place to live and a development corporation needed workers to build the new town.[3]

Secondly, houses were built in green environments with the aim of improving the lives of the working classes, but as they were expected to be built cheaply, this inevitably entailed hardships for those who built them. As Raj Patel and Jason W. Moore explain in *A History of the World in Seven Cheap Things*, capitalism makes things cheap by keeping the real costs of their production 'off the ledgers'.[4] Thus, the construction worker's invisibility in discourse is arguably by design.

1. Construction of the Belgian-owned Kryn factory and Lahy metalworks in Letchworth, circa 1916 (Garden City Collection, Letchworth Garden City Heritage Foundation)

Due to the social division of labour, those who build are excluded from what they build, often relegated to living in exactly the type of makeshift, poor-quality accommodation that housing programmes were supposedly meant to eradicate.[5]

This article focuses on England and Belgium, two countries that were early to industrialize and faced parallel crises of urban overcrowding. Their paths diverged, yet they often looked to one another for answers to their problems, and they arrived at suburban outcomes, fuelled by a shared hostility to urban tenements.[6] It is useful to look at the similarities between the two cases, to consider how English garden cities and their Belgian equivalent, the *tuinwijken/cités-jardins,* faced similar challenges in caring for construction labour. This was a peripheral, yet no less present issue for those who commissioned, designed and won the contracts to build housing – as evidenced in their records. Existing scholarship on garden cities and districts, which relies on such sources, tends to focus more on planning and policy, though some trace mentions of construction labour exist.[7] This article draws on these sources to consider if and how the hidden costs of construction labour forced themselves into the calculus of production. It also relies on the trade press and organized labour of the time, which were often more vocal about the problems in the building industry, to place such projects in the context of the labour crisis.

Below, a brief account of the historical background to the housing challenge in the two countries is followed by accounts of the development of the first garden cities in Letchworth and Gretna, the post-armistice housing programme in the UK, and the reconstruction programme in Belgium.

LABOUR AND THE EARLY TWENTIETH-CENTURY URBAN EXODUS

Working-class housing was not originally intended for workers in general, but specifically for industrial workers: those who concentrated around factories and mines, and who, in the words of Marx, were 'disciplined, united, organized by the very mechanism of the process of capitalist production itself'.[8] This was an imagined community, sharing similar struggles and with a pronounced presence in production centres.[9] Towards the end of the nineteenth century, in both London and Brussels, the urban overcrowding caused by industrialization prompted new experiments in working-class housing that involved relocating them to the green landscapes beyond city borders. The garden city movement was influential in both countries, promising to transform workers from rebellious slum dwellers into model citizens [simply] by changing their living environments.[10]

In Belgium, this was facilitated through the state-owned railway company, which began subsidizing workers' commuter passes in 1869 to encourage suburban living. Following a deadly riot in 1889, the state also helped workers to purchase land and build their own homes in the countryside – initiating a do-it-yourself movement and fragmenting land ownership patterns throughout the country. Across the Channel in the following year, the British parliament passed an act allowing the newly formed London County Council to acquire land by force in order to build rental housing for the working classes. It took the opposite approach to Belgium: housing was publicly organized on a large scale, whereas trains were operated by multiple private companies.[11]

In the aftermath of the Great War, both countries enacted landmark housing programmes as an antidote to turbulent conflicts and creeping Bolshevism. Belgium established the National Society for Cheap Housing (Nationale Maatschappij voor Goedkope Woningen, NMGW), which granted finance to local companies to build relatively small housing projects, often located in the countryside.[12] In Britain, the Addison Act granted large subsidies to municipalities to develop housing estates, which were often much larger than their Belgian equivalents.

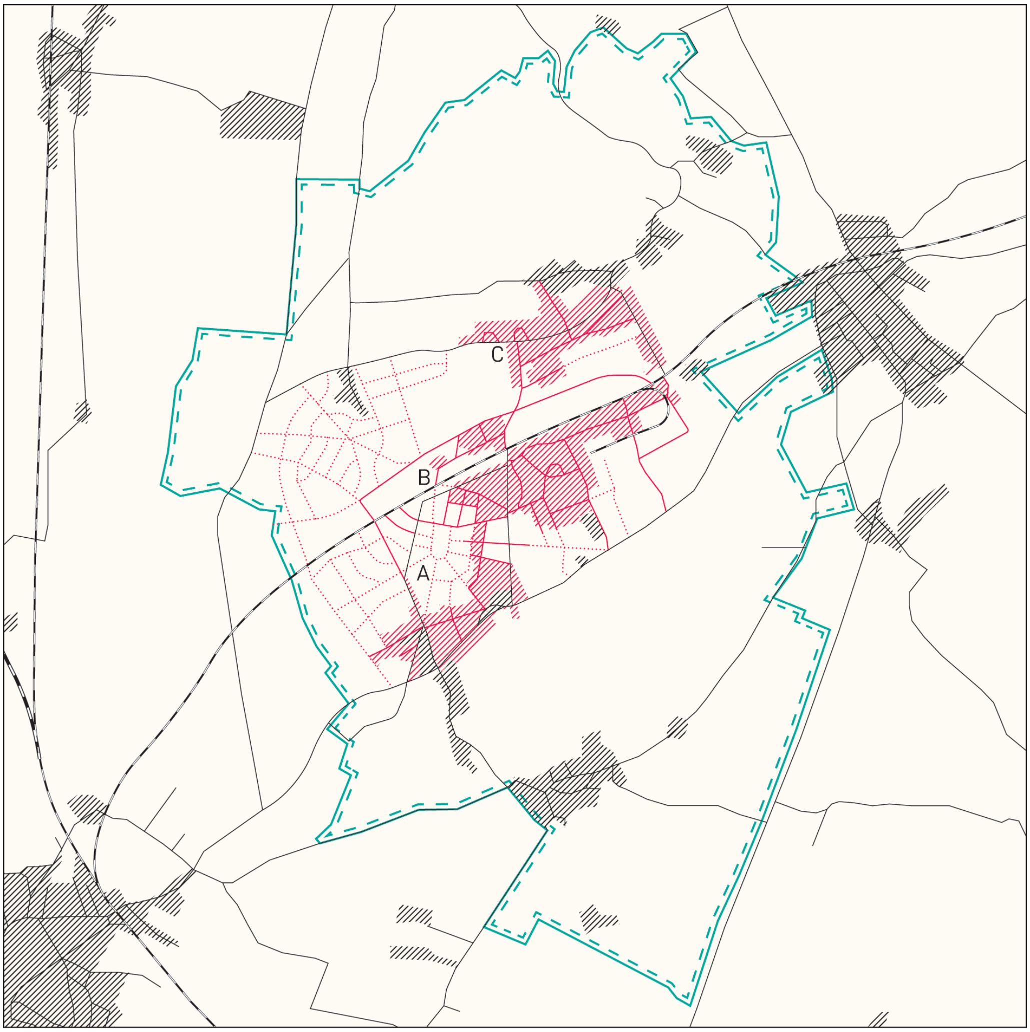
Post-armistice reconstruction was also a moment of change for the construction industry in both countries, given the great amount of work on the table.[13] Yet construction workers were rarely viewed as a threat to public order in the same way that industrial workers were. On the one hand, skilled tradespeople like carpenters and bricklayers were members of the 'labour aristocracy', enjoying somewhat better pay and a protected status. Unskilled construction workers, even when earning the same or less than factory workers, tended to organize themselves through these trades, rather than according to their socio-economic status.[14]

On the other hand, the sector was (and is) fragmented and precarious with a somewhat limited capacity to organize and disrupt. In 1910 the average size of a Belgian construction firm was a mere four people.[15] Even in England and Wales, with their tradition of 'master builders', the great majority (84%) of construction entities were self-employed, and the average firm size was also four people in 1881.[16] Every project was tied to a specific location, and the prospects of future work uncertain.[17] In both countries construction workers tended to travel long distances, as it was difficult to find housing nearby.[18] But their commute was often in the opposite direction from that of other workers: from the city to the countryside to work on new settlements, such as the first garden cities.

LETCHWORTH AND GRETNA: GARDEN CITIES 'ON A CLEAN SHEET'

Ebenezer Howard's 1898 *To-morrow: A Peaceful Path to Real Reform* outlines a financial and organizational plan to develop new cities free of slums. Limited-dividend companies would buy large, remote and [therefore] tracts of land, build the infrastructure, and then lease plots of land to developers or individuals. The companies would ensure that development complied with set standards for density and architectural quality.[19] Howard was a fervent supporter of competition and sought to overcome the conflict between socialism and capitalism through the ideology of industrialism: a belief in growth for the benefit of society.[20] Surplus income from land rents would be invested in further urban development, multiplying garden cities across the territory.

But Howard was more interested in the concept than its implementation, explaining that 'I passed in thought rapidly over all intervening stages, and sought



2. Map of Letchworth circa 1913. Development did not begin around the planned town centre, but rather adjacent to existing villages and the railway (Drawing by author)

to picture what would happen in England if such a city were built, rather than to trace the successive steps which would have to be taken to build it.'[21] He did, however, write one passage about building infrastructure: 'on a clean sheet it will be possible and feasible to use the very best appliances' such as steam-powered excavators. These machines 'would not make their appearance in the parts where people were living, but where they were coming to live after its work in preparing the way had been completed.'[22] That is, the city would be built by automated technology, seemingly with no need for a worker behind the wheel.

Likewise, the architects who joined his movement failed to address the question of construction. For example, Raymond Unwin's famous 1912 pamphlet *Nothing Gained by Overcrowding!* was a practical argument for garden cities addressed to housing developers. It made the economic case that large-scale, low-density settlements could be built at lower cost than high-density urban terrace housing.[23] Unwin focused on how agricultural land could be purchased at a lower cost than land in cities, but said nothing about the variable costs of building – as if the costs of materials and labour were the same everywhere.

Unwin was directly involved in the creation of the first garden city: Letchworth. In 1903, Howard's Garden City Association formed a limited company to develop a town for 30,000 people some 62 kilometres north of London. It bought 3,818 acres (1,545 hectares) of land from 15 different owners, composed of farms, scattered tenant cottages and small villages. The Association reached an agreement with the Great Northern Railroad to build a temporary stop on its branch track bisecting the estate, in order to bring in materials and people from London. It raised £300,000 to finance the construction of infrastructure and public facilities, with a masterplan by Unwin and Barry Parker. To the south of the station, the architects designed a main square hosting social facilities and surrounded by houses on roads radiating outwards from the centre. However, construction in the following year did not radiate from this planned centre, but instead was concentrated around existing villages on Association's land (fig. 2).[24] Howard's utopian diagram was not actually built 'on a clean sheet', but rather on top of the existing traces of settlement. The first roads in the new town were built by some 400 unemployed men sent by London labour bureaus, who were lodged in these villages as well as in temporary huts.[25]

In 1906, Howard acknowledged a shortcoming: while construction firms were quickly establishing themselves in Letchworth to take advantage of the many new contracts and speculative opportunities, their employees could not find accommodation in the town.[26] Houses were being built for middle-class garden city enthusiasts, but there was a dire need for 200 workers' cottages with cheap rents. 'This, besides being a serious inconvenience to the workpeople, is a loss to the Company and the community, and even casts a slur on the whole movement.' In response, Garden City Ltd. created a subsidiary company to raise capital from shareholders and to build affordable housing itself.[27]

This exposed a fundamental paradox. Howard confessed that it was difficult to build rental housing cheap enough for workers yet profitable for the limited company. 'Wages are higher, materials dearer, conditions altered entirely from those prevailing in the days when the rustic £3 or £4 a year cottage was built.' Some members of his association argued that workers' wages should be increased 'to meet the larger rent necessary to maintain a high class of architecture' expected in the Garden City. Yet Howard pointed out that higher wages in the construction sector would inflate building costs and thus cause even higher rents. This phenomenon is what economists today would call a 'wage-price spiral'. Intriguingly, Howard never suggested non-profit housing as a remedy to the problem. And he was quick to rule out any suggestion that the problem might be 'owing to increased profits going into the master builders' pockets.' His only conclusion was that the inflated costs of building were due to sluggish workers. What was needed was 'men who would put their hearts and backs into the work'.[28] Unsurprisingly, Howard did not find those men easily.

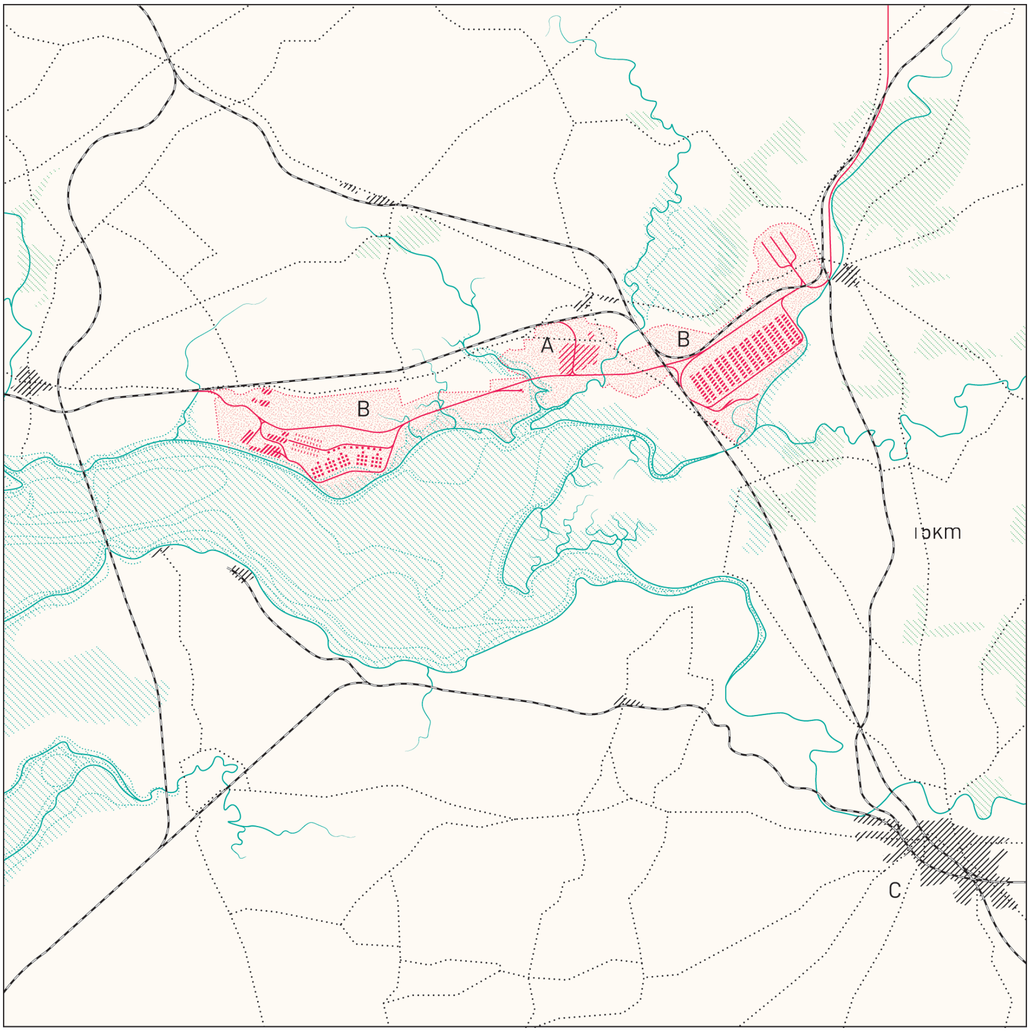
World War One brought even more construction projects to the Garden City. One of these was the 94,000 square foot (8,730 m²) Kryn & Lahy Metal Works, owned by two refugees from Antwerp who had re-established their business in Letchworth to supply the British army with munitions. So many other Belgians flocked to Letchworth to build and work that they made up a quarter of the population of Garden City by 1916.[29] A permanent train station had finally been built to welcome visitors to Letchworth, though their first sight upon exiting was a settlement of 'villainous' shacks for workers, 'one of the most serious blots on the whole garden city movement'.[30]

Letchworth was not the only explosion of building activity as part of the war effort, as the Ministry of Munitions created several purpose-built 'munition towns'. The largest and most challenging of these was Gretna, located at a remote, protected location on the border between England and Scotland (fig. 3). Designed in 1915 by Unwin together with three other garden city architects, Geoffrey Lucas, Courtney Crickmer and S.B. Russell, the Gretna Township was to host 30,000 factory workers (fig. 4). Its rapid construction demanded an additional 13,000 construction workers on-site at the same time, sourced from across the British Isles. At first, the ministry contracted various work to different firms, but chaos ensued: given the dire shortage of young men during the war, there was competition between employers to secure labour. It was then decided to hire one firm, S. Pearson, who oversaw all projects on a fixed cost-plus-profit contract with standardized wages.[31]

As reported by one government visitor to Gretna, the site conditions 'take the heart out of the men'. Strikes and walkouts were a constant threat. Morale was low. Travel from neighbouring villages to work sites could take several hours. And those who lived in huts on-site found that 'their clothes are wet early in the day, they have no change of their own, they take them off wet when they go to bed and they are still damp when they put them on the following morning.'[32] The original plan was to build more wooden barracks, but the shortage of timber and worker discontent prompted the ministry to instead invest in solid construction.[33] Lucas designed brick dormitories to house workers temporarily, in such a way that once the construction of the town was complete, these 'shells' could be subdivided into permanent single-family terrace houses (figs. 5–6).

MUNICIPAL HOUSING ESTATES AFTER THE GREAT WAR: THE WAGE-PRICE SPIRAL

After the war, the liberal government in the UK faced a shortage of half a million dwellings, a lack of private investment in new housebuilding and rising working-class unrest, for which subsidized municipal construction was [seen as] the solution. Gretna became the design template for the hundreds of projects that would be funded under the post-armistice government programme. In the quest for economy in production, the quaint arts-and-crafts dormers and gables of earlier garden-city architecture were substituted by simplified hipped roofs on brick boxes.[34] But who would build the 500,000 houses needed? One problem was that the UK was in the midst of a long-term decline in the construction workforce. The number of skilled construction workers had halved in the previous two decades, from 720,230 in 1901 to 365,000 in 1920, as stable factory jobs drew young men away from precarious careers in construction.[35] A more fundamental problem was that those who remained in the sector objected to working conditions in the housing programme. Strikes on large construction sites were commonplace.[36]



3. Map of the Gretna munitions factory and township on the River Esk, circa 1916 (Drawing by author)

5km
Existing villages
Existing Railways
Roads
New settlements
New railways
Military area
Water bodies
Forested areas

A. Gretna Township
B. Munitions production areas
C. Carlisle

4. Map of Gretna township by the Ministry of Munitions, 1916 (UK National Archives MUN 7/257)

5. Construction of permanent housing shells at Gretna, next to temporary wooden barracks for workers (UK National Archives MUN 5/159/1122/7/19)

The National Federation of Building Trades Operatives (NFBTO), a labour union umbrella organization, had several issues with the housing programme. Amid the triple-digit inflation of the post-armistice years, the Federation's primary concern was wages. But employers claimed that higher wages would lead to higher housing costs – echoing an argument previously made by Howard in Letchworth. The NFBTO responded by saying that inflated material prices were the real culprit behind high construction costs.[37]

A second impasse was over working conditions: long and arduous workdays were seemingly required to deliver urgently needed housing. To stimulate productivity, employers were beginning to return to 'piece work' – compensation based on output rather than time worked – at the very moment when organized labour across Europe was fighting to eradicate piece work and to put a cap on hours.[38] In 1920 the NFBTO successfully negotiated a shorter 44-hour working week.[39] In return, workers were criticized for their supposed slothfulness. *The Builder*, a British journal that often represented the position of employers, regularly compared statistics on the speed of bricklaying before and after the war to make this point. An article in *The Times* summarized the [perceived] paradox: the government was sponsoring 'houses for working men who won't work.'[40]

A third sticking point concerned 'dilution' and deskilling. Employers, housing reformers, architects and politicians attempted to bypass powerful unions, either by employing unskilled workers en masse or by adopting new building technologies.[41] Government-promoted systems such as the steel-clad timber 'Weir House' aroused the ire of the NFBTO's organ *The Operative Builder*, which argued that members should refuse to build it, not only because it threatened to dilute their power, but because its flimsy construction would quickly become a problem for the occupants.[42]

The wage-price spiral and its related discontents exposed seemingly intractable problems in the building

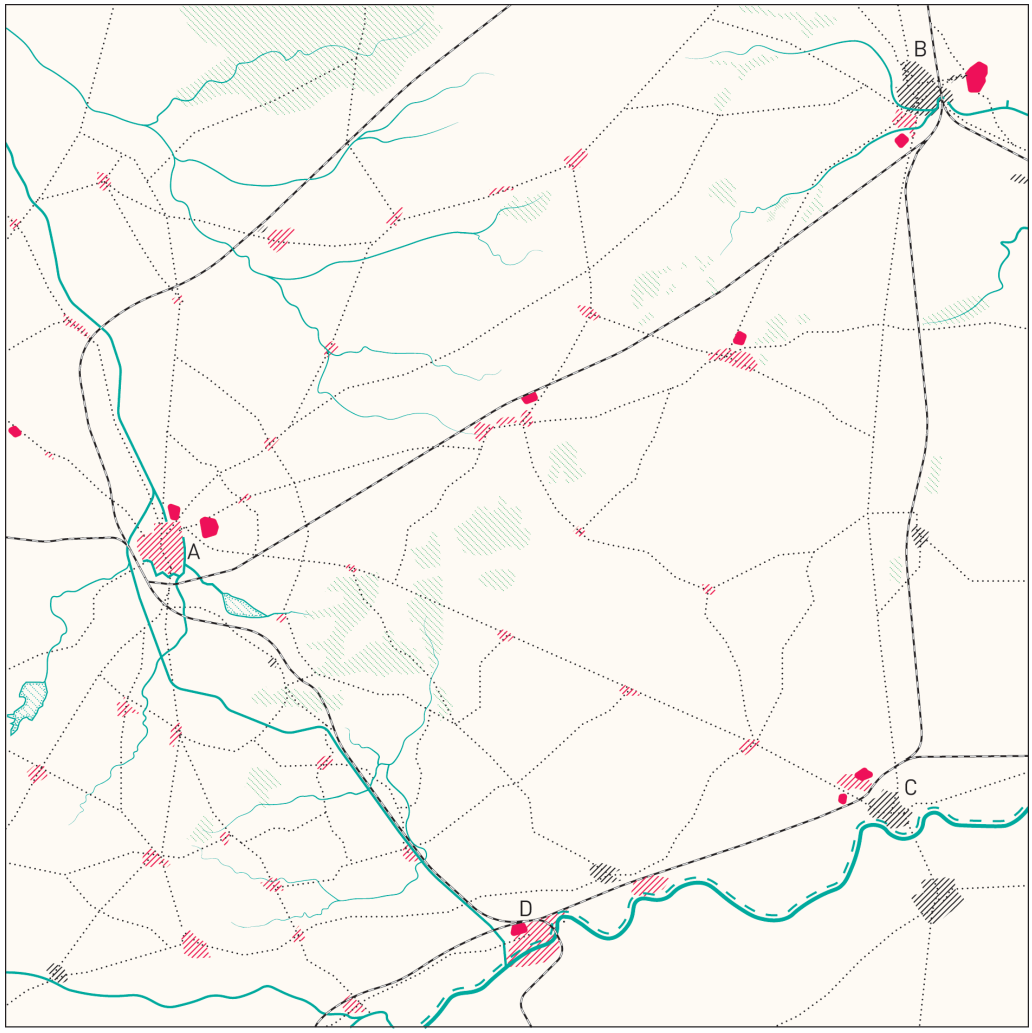
6. Housing at Gretna was designed to be used as dormitories for temporary workers (top) before being converted into single family houses for permanent families (bottom). Designed by Geoffrey Lucas, working under Raymond Unwin for the Ministry of Munitions in 1916 (UK National Archives MUN7/257)

industry, and threatened to undermine the entire housebuilding programme. But the stalemate ended once housing subsidies were axed in 1922. The decrease in projects coincided with a gradual rise in the supply of workers, effectively silencing the demands of construction labour.

BELGIAN RECONSTRUCTION: BUILD-IT-YOURSELF HOUSING, OR BUILDERS HOUSING THEMSELVES?

Many of the bombs manufactured in Letchworth and Gretna ended up on the front lines in Belgium. Conversely, garden city concepts were imported by Belgian architects who had spent the war in England, joining the Garden City Association and taking part in a 1915 Town Planning Conference in London on the reconstruction of Belgium's devastated regions. There was a widespread sentiment amongst participants that the destruction, as witnessed in Westhoek in Western Flanders and in other areas, was an opportunity to rebuild according to garden city principles. This was fuelled by a strong desire to escape the individualism that had previously engendered chaotic urban conditions.[43]

The architect Raphaël Verwilghen had spent the war in England, and upon his return to Belgium he became head of construction for the Ministry of the Interior's Department of Devastated Regions (Dienst der Verwoeste Gewesten, DVG) in 1919 (fig. 7). Verwilghen attempted to use his position to plan in a scientific way, but he was often left frustrated because the political urgency to rebuild 120,000 lost homes outweighed his desire for order. There was a lack of government support for centralized planning in Belgium, and there were widespread ideological disagreements over the best course for reconstruction.[44] There was even a shortage of temporary shelters for war victims. And the press was strongly of the opinion that emergency huts, such as those erected by the Koning Albertfonds, were flimsy and expensive reminders of trauma.[45] One Belgian participant at the 1915 London conference



7. Map of Westhoek circa 1920. New workers' settlements were often built adjacent to devastated towns. (Drawing by author)

5km

Surviving villages and towns
Railways
Roads
Devastated villages and towns
New workers' housing
French border
Water bodies

A. Ypres
B. Roeselare
C. Menen
D. Comines-Warneton

argued that instead of spending money building unsightly temporary camps, it would be better to begin immediately with the construction of permanent housing.[46]

But by 1919 there was some recognition that the workers who were to rebuild the devastated regions would themselves need housing. The Centrale Vereeniging der Bouw-, Hout- een Ameublementwerkers (CVBHA), the umbrella organization of unions for workers in construction and related fields, put it succinctly: 'provision must first be made for decent housing for those who hold the instrument of reconstruction in their hands'.[47] Even the vice chairman of the Belgian National Federation of Building and Public Works, representing the interests of employers, argued that the government's priority should be housing for workers to settle in the devastated regions.[48] The DVG duly embarked on a plan to itself build 2,000 houses for key workers, while the mechanisms governing the newly formed National Society for Cheap Housing (NMGW) to deliver social housing were still being developed.[49] Projects such as Bataviawijk in Roeselare, considered the first garden district in Belgium, were connected to the reconstruction of devastated regions.

While the UK had experienced a declining labour workforce for several decades, Belgium was witnessing a long-term trend in the opposite direction: the construction workforce increased from 100,000 in 1910 to 150,000 in 1937.[50] Nevertheless, Belgium faced a dire labour shortage immediately after the war because one third of its workers moved to neighbouring countries such as France, where reconstruction projects had been organized more rapidly. There were concerns that they might not return when Belgium finally had work for them.[51] The DVG housing estates therefore attempted to attract workers in two ways: by giving them houses, and by giving them jobs building houses.

However, in December 1919 government policy pivoted in the face of the protests of displaced residents waiting to be rehoused and because of the sluggish process of assembling land parcels.[52] The Ministry of the Interior sought to speed up reconstruction by invoking the myth of the independent Belgian *bricoleur*: that ordinary people were capable of rebuilding their own homes and did not need to wait for a coordinated, government-led response. The DVG offered subsidies to property owners to enable them to purchase build-

8 AND 9. Semi-permanent dwellings under construction in Ligywijk, Ypres in October 1921 (KU Leuven, Verwilghen Collection)

ing materials from a central government depot and rebuild their own homes.[53] Yet in reality, those who could afford to hire a contractor to build did so – creating competition for the scarce workforce in the region concerned. This drew the ire of organized labour, which at times refused to work on non-essential projects.[54]

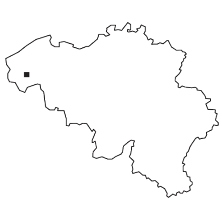
Verwilghen opposed this do-it-yourself policy, as it suggested a lack of architectural control. His office offered an alternative: 'semi-permanent' houses in the form of flat-packed timber frames, doors and windows, prefabricated by the DVG and ready to be assembled by residents (figs. 8-10). But this kit-of-parts proved too difficult for non-professionals to build, and most residents instead opted for the financial subsidy. Most of the 1,300 frames languished unused for a year.[55] In 1921 DVG decided to deploy the unused frames itself, as it had finally set up projects to build garden districts for workers. The first, Cité de Brabandere in Menen, was an estate of 100 houses, of which 28 were built using the experimental system. The second project comprised 139 houses in the Ligy district in Ypres (figs. 11). Further houses were built on estates in Roeselare, Nieuwpoort, Moorslede, Comines-Warneton, Zonnebeke, Diksmuide and Elverdinge. Workers were hired directly by the DVG, and the prefabricated system was assembled with speed and economy.[56] In theory, what began as a failed attempt to help everyday people build their own homes, turned into a successful method for allowing construction workers to rapidly build their own homes in order that they could then build homes for others.

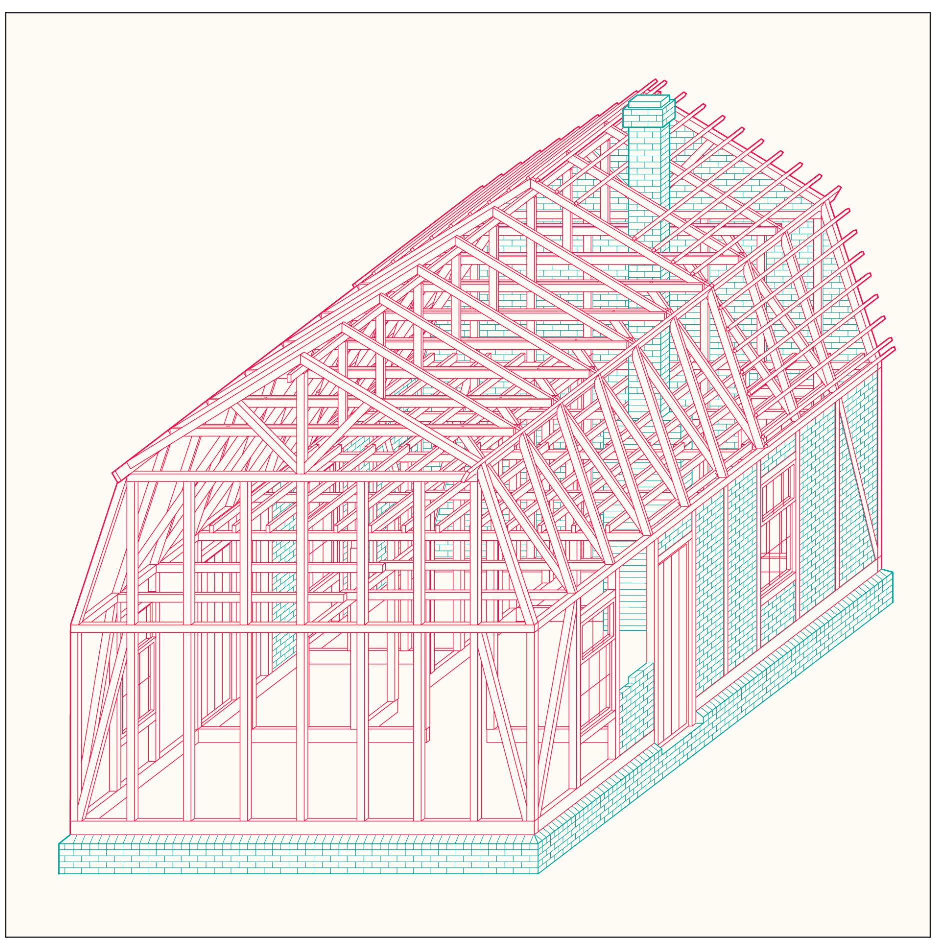
However, it is unclear if the DVG's garden districts were actually affordable for construction workers. A 1921 article in the socialist newspaper *Vooruit* pointed out that Bataviawijk's rents (at 46 francs a month) were far higher than an average textile worker earning 1.75 francs an hour could afford to pay.[57] Labourers in the construction sector made even less than this, and while skilled bricklayers and carpenters could make more, their typical wages do not appear to have been significantly higher.[58]

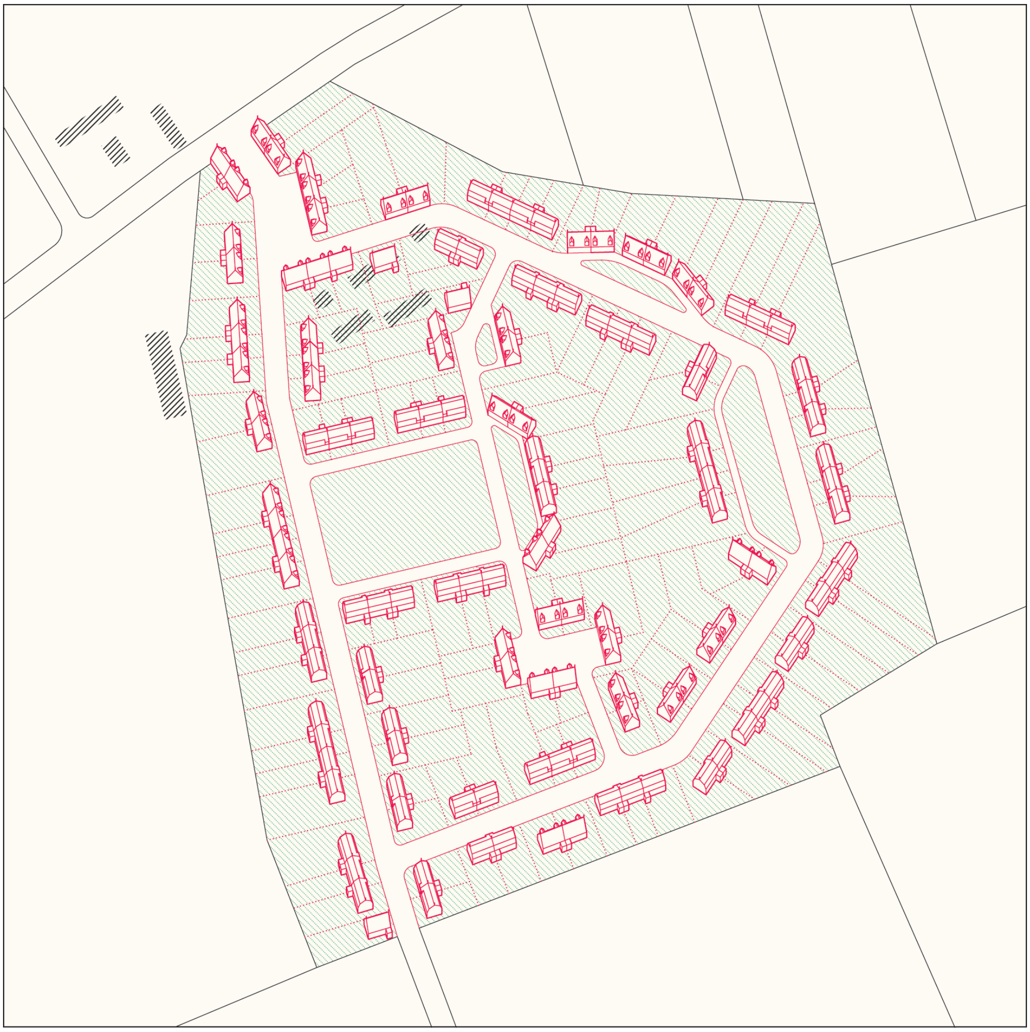
It is curious that the CVBHA did not protest against this injustice. Like its British comrades, it fought for decent wages and shorter working weeks and it defended its members against accusations of laziness in the press. Likewise, Belgian skilled workers were suspicious of new technology that could threaten their status.[59] But unlike in England, the Belgian CVBHA endorsed social housing wholeheartedly. For example, in 1921 its organ *De Ontvoogding* praised the social housing company *De Anderlechtse Haard* for organizing construction labour in-house, as proof that afford-

10. Framing of the semi-permanent 'Type Wilford' by Maurice Wilford, for the Dienst der Verwoeste Gewesten, 1920. (Drawing by author)

2m
— Prefabricated timber kit
— Masonry foundations, infill facade







11. Ligywijk, designed by, R. Verwilghen and H. De Bruyne, for the Dienst der Verwoeste Gewesten, 1920. (Drawing by author)

able housing for workers could be delivered without the profit mechanism.[60] Yet the monthly bulletin did not mention that the rent (40 francs a month) was likely to be out of reach for many of its readers. To make matters worse, the NMGW's magazine on social housing, *L'Habitation à Bon Marché*, revelled in the fact that contractors on housing projects had successfully quashed their workers' demands for wage increases in 1923, thanks to the growing reserve of unemployed.[61] Perhaps construction labour supported the social housing movement out of solidarity, even though it exploited construction workers.

CONCLUSION

Friedrich Engels once argued that the 'housing question' could never be answered by housing solutions alone: cheaper dwellings only lead to lower wages, thanks to reduced living costs.[62] And, as Howard and others in our story discovered, the reverse was also true: cheap construction labour was needed for cheap dwellings, and this led to a paradox when the producers (workers) were also the consumers (occupants). The underlying problem was that cheapness obscured actual costs.

The paradox tended to be more apparent in the British case because there, at least on paper, housing was intended for *all* workers. There was far more public debate when British workers felt that the housing drive was not benefitting them. In Belgium, with its mythical do-it-yourself approach, the connections were rarely so obvious. And Belgian social housing was more fragmented, facilitated through a great variety of promotors – niche groups with special interests and shared affinities.[63] Housing for construction workers was always a problem, but not necessarily *their* problem.

The 'villainous' shacks at Letchworth and the labour they represented were like temporary scaffolds, seemingly unworthy of attention because they would disappear once the actual buildings were erected. Nevertheless, the buildings articulated their construction, at both the technical and the social level. Innovations such as the convertible 'house shells' in Gretna, or the timber frames in Westhoek, were responses to labour shortages which required not only departures from normal techniques but also changes to the production-consumption cycle. The builder became an occupant, or vice versa.

Housing discourses today assume that we need to build our way out of shortages, renovate our way out of the climate crisis, or manage housing as a 'common good' to tackle inequality.[64] But those who are tasked with carrying out this work are affected by the very same housing problems. For example, it has been widely recognized that Western European countries like Britain and Belgium need more immigrants to fill gaps in the construction workforce.[65] Yet such newcomers are rarely able to access social or affordable housing, which is heavily restricted to citizens and long-term residents, so they must find accommodation in the often discriminatory and expensive private rental sector.[66] Connecting the dots between production and consumption might help not only to address bottlenecks in housing delivery, but also to ensure that those who participate in the city include those who build it.

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HOUSING FOR WORKERS, BY WORKERS

CONTRADICTIONS IN ENGLISH AND BELGIAN GARDEN CITIES

JESSE FOSTER HONSA

Housing programmes in the early twentieth century were meant to overcome shortages of dwellings for workers in many European industrial centres. Yet what was often overlooked was the fact that housing needed to be built by construction labour, and that labour also needed housing in order to be able to continue working. This article considers how housing scarcity intersected with the overlooked issue of labour scarcity: how the needs of construction workers were or were not addressed. It focuses on garden cities and related suburban settlements in England and Belgium – forms of development which, given their scale, required the mobilization of workers to remote sites, where workers often became the first occupants of what they were building.

The first section considers the earliest garden cities in the UK, designed by Raymond Unwin and his associates: Letchworth, founded in 1903 by Ebenezer Howard's Garden City Association; and Gretna, developed by the Ministry of Munitions during the First World War to support weapons production. The second section focuses on the post-armistice British housebuilding programme, when local municipalities were granted special subsidies to provide dwellings for workers on large suburban estates. The third section looks at reconstruction efforts in the devastated Westhoek region of Belgium, led by Raphaël Verwilghen and the Dienst der Verwoeste Gewesten (Department of Devastated Regions).

In the British context, the contradictions in housing programmes were clearly articulated: cheap construction labour was needed for cheap dwellings, and this led to a paradox when the producers (workers) were also the consumers (residents). The underlying problem was that cheapness obscured actual costs. In Belgium, the connections were not so obvious: housing was promoted as a do-it-yourself activity, and even social housing was facilitated through a variety of special-interest groups. Nevertheless, in both cases, the unprecedented need for housing in both contexts prompted innovative efforts to house those who build.

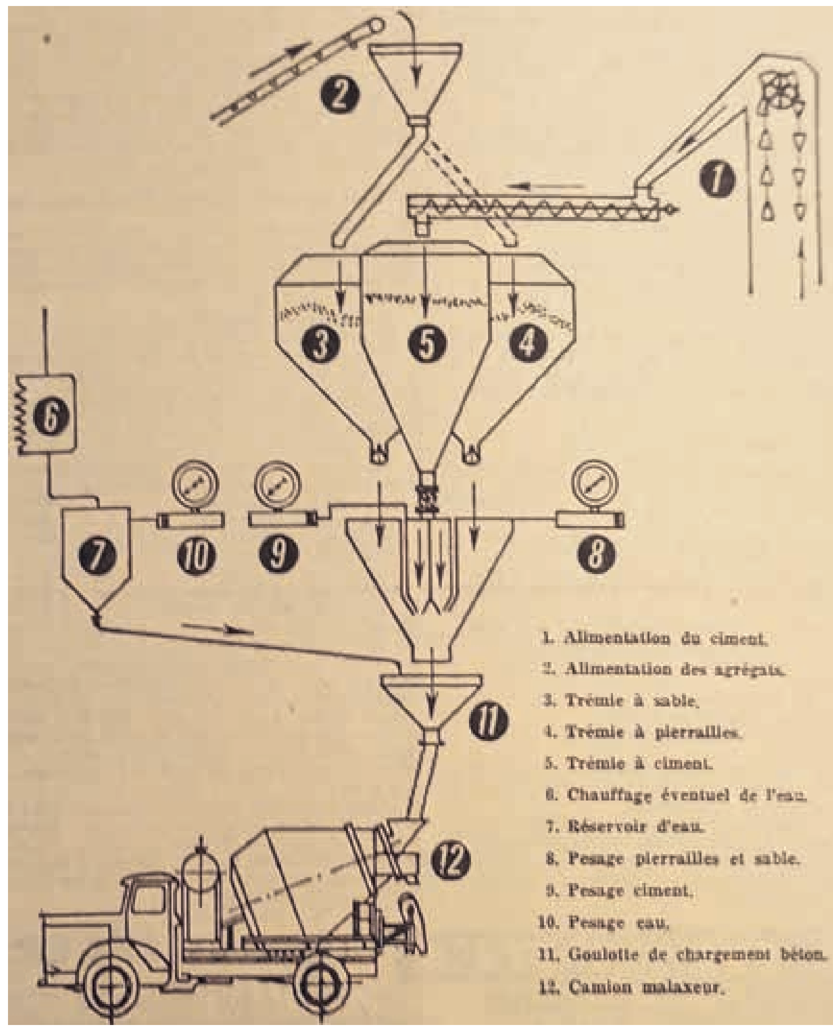
THE ‘URBANIZATION’ OF CEMENT AND CONCRETE

URBANIZATION THROUGH CONCRETE PLANTS AND THE ‘REALIZATION’ OF CEMENT AS A TERRAFORMING PRACTICE: THE BELGIAN CASE, 1955-85

PAGES 20-40

TOM BROES

1. Typical concrete plant in Charleroi operated by Ciments d'Obourg, c. 1967. Large quantities of cement, sand, gravel and water from the Sambre are processed into ready-mixed concrete and transported by mixer trucks. The diagram illustrates the various steps in the production process of ready-mixed concrete (Belgian State Archives, CBR Fund, folders 698 and 3567)



The claim that the growing scientific consensus on the anthropogenic contribution to the disruption of the Earth and its climate would substantially change general historiography,[1] has definitely made itself felt in the sub-discipline of construction history over the last decade. Topical notions like the Anthropocene and planetary urbanization recently even inspired Carl Nightingale to broadly reconceptualize the history of building as a historical process of *terraforming,* which he defines as the 'rearrangement of materials from the Earth's biosphere and geosphere for human purposes'.[2] The building material concrete, which has been described as 'the most abundant anthropogenic rock on earth',[3] seems to be the medium par excellence to illustrate this notion of *terraforming*. According to some, 80 per cent of all built-up volume in the average city worldwide today is constructed from concrete – a figure that even rises to 95 per cent in the context of the Paris periphery.[4] The ubiquity of this 'anthropogenic rock' has been remarked upon in numerous recent social, cultural and environmental histories that regard concrete as the vehicle of an extractive building culture with a substantial impact on humans, the planet and the climate[5] – in capitalist,[6] communist[7] and colonial contexts alike.[8]

Apart from water, sand and gravel, cement is the only basic component of concrete that cannot simply be extracted but must be produced through a capital-intensive process. This involves heating a mixture of mainly limestone, clay, sand and iron oxide in horizontal rotary kilns, which is subsequently ground into a fine powder after cooling. The success of the rotary kiln is often cited to explain the unstoppable rise of concrete. Temperatures of up to 1450°C prevent the kiln from being shut down at will,[9] which means that this 'mega-machine' must continuously produce enormous quantities of cement (fig. 2).[10] In *Abstract from the Concrete,* however, David Harvey argues that the success of concrete cannot be explained by the continuous production of cement alone. Based on the empirical observation that concrete is at the forefront of urbanization all over the world, Harvey suggests that we also need to better understand why the use of concrete catches on so readily. The continuous production of large quantities of cement, he argues, is pointless as long as they cannot be easily sold on the (global) market. For cement producers, it is therefore important not only to produce as efficiently as possible, but equally essential to pursue an incisive 'politics of realization' that ensures that uninterrupted cement production does not accumulate as unused surplus – and thus as anti-value.[11]

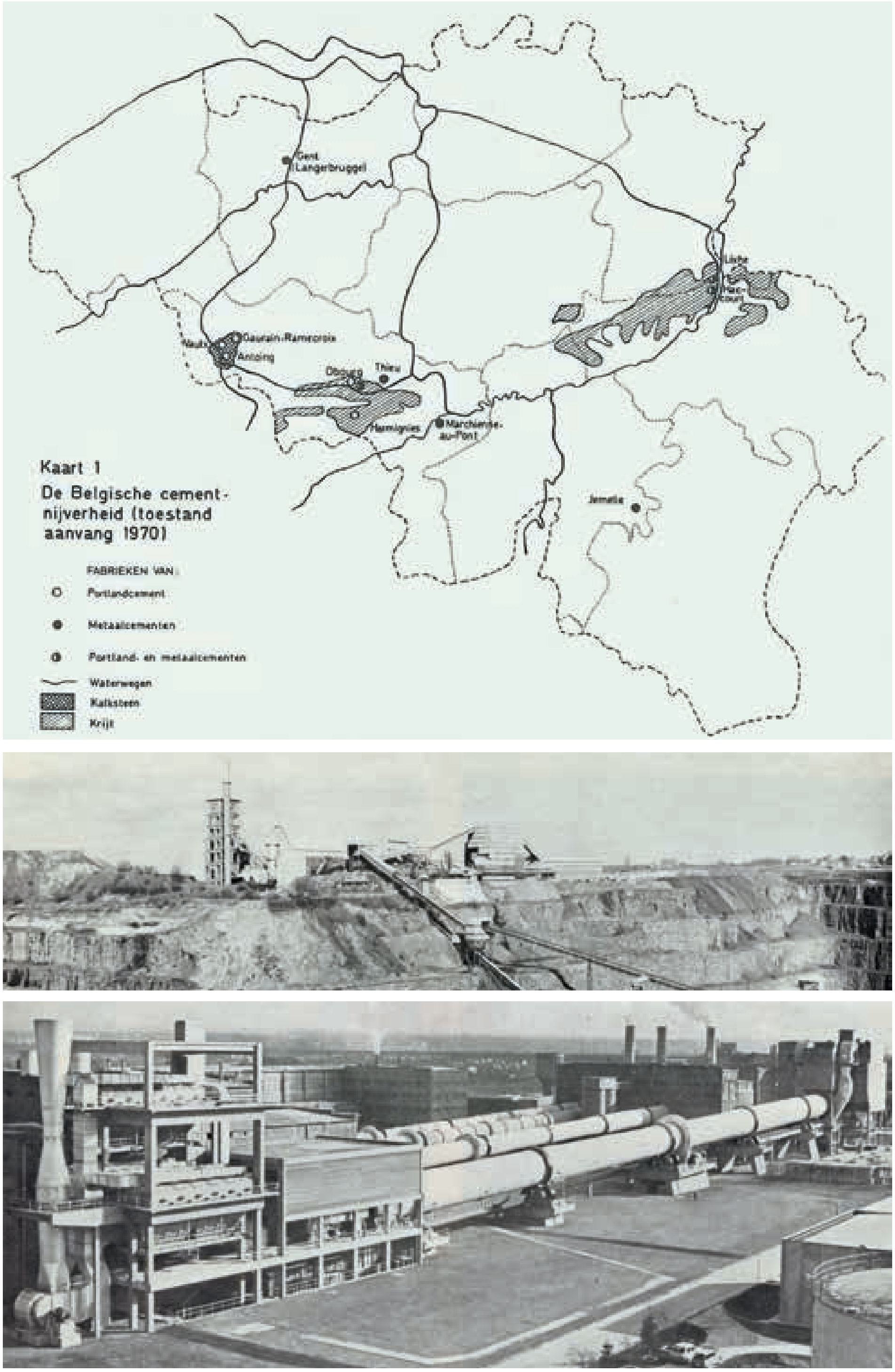
This article aims to examine in detail how the need to get cement circulating [quickly and efficiently] became one of the historical reasons for the continued success of concrete. It examines the deliberate policies and rationality with which large volumes of cement were 'realized' in the market in the form of ready-mixed concrete – thereby turning concrete into a readily available consumer product. The focus is on post-war Belgium, a country whose natural wealth of limestone, clay and sand made it an ideal breeding ground for the emergence of a strong cement industry. Throughout the twentieth century, Belgium was consistently among the world leaders in terms of annual per capita consumption of cement and concrete.[12] Belgium, then, is used as a paradigmatic case to study how the historical politics of realization of cement and concrete took shape in the context of the Western world and what that implied.

Specifically, the article reconstructs how the Belgian cement industry was forced to create an extremely dense network of ready-mix concrete plants in order to sell its continuous cement production on the domestic market (fig. 1). This research is largely based on original sources from the Cement Industry Association (VCN,[13] 1946), the Belgian Professional Association for Ready-Mix Concrete (BVSB,[14] 1962) and Inter-Beton (IB, 1967, a joint venture between the concrete divisions of the two largest cement producers in Belgium and a trendsetter in the ready-mixed concrete industry). The archival material shows how much the logistical landscape of concrete plants facilitated the distribution or 'urbanization' of concrete – an aspect that has so far been neglected in international research – and in so doing had an increasingly significant and irreversible impact on the 'cement addiction' of post-war building culture in Belgium.[15]

THE CONCRETE PLANT: SPEARHEAD OF THE CEMENT INDUSTRY'S POLITICS OF REALIZATION.

Although the number of cement-producing companies in Belgium declined from 62 in 1910 to 10 in 1970, total annual production capacity rose from 0.5 million tons to over 7.5 million tons during the same period. Thanks to far-reaching rationalization, concentration and (government) investment (including through the Marshall Plan), the three major players in Belgian cement production – Compagnie des Ciments Belges (CCB), Cimentières et Briquetières Réunies (CBR) and Ciments d'Obourg (CO) – became some of the 'most productive players in the world' (fig. 2).[16] Nevertheless, the sector's situation was initially economically uncertain. Infographics from the interwar period suggest the impossibility of effectively marketing increasing production capacities, resulting in large surpluses, losses and price drops. Especially after international markets collapsed following the 1929 crisis, which saw Belgium's export share shrink from 60 per cent of total cement production to barely 15 per cent, the (European) cement industry slipped into crisis.[17] After the Second World War, when it became clear that cement exports would never again reach previous levels, partly due to growing competition from overseas markets, it became clear that the sector would have no option but to sell the lion's share of its exponentially increasing production on the domestic market. The industry was fully aware that it needed to 'align its commercial and industrial policy with developments in cement consumption in this market'.[18]

This economic reality forced the cement industry to implement structural reforms and adopt a more coordinated domestic implementation policy. Together with the Société Générale de Belgique (SGB) – often referred to as a 'state within a state' – and the Union Financière d'Anvers (BUFA), the country's financial elite threw its weight behind the cement industry.[19] In 1949, spurred on by CCB chairman Jules Plaquet and riding the momentum of the 'Belgian Miracle',[20] the sector organized itself into La Cimentière Belge (Cimbel, 1949-1956), in 1956 succeeded by the more formal VCN (1956-1994). The explicit aim of this association was to avoid mutual price wars and to 'lay the foundations for industrial cooperation that



2. The industrial complex of the Belgian cement industry c. 1970. Top right: the limestone quarry. Bottomright: the horizontal rotary kiln (Map: W. Vlassenbroeck, *De Belgische Cementnijverheid*, 1970, 462; Photos: VCN, Cement, 1970, 11)

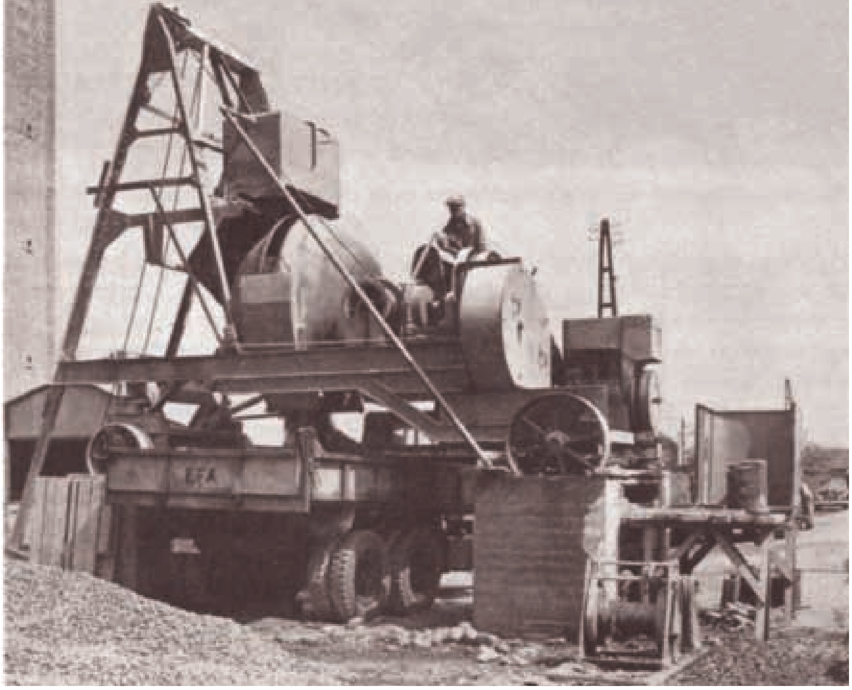
was necessary to meet the demands of the new era'.[21] Once federated, the sector explicitly sought rapprochement with the government, especially in view of the post-war 'revival of construction activity in the public works sector'.[22] In 1956, the newly founded VCN immediately became the main sponsor of the new [trade] magazine *La technique routière,* which grew into a platform for road contractors, research institutes, governments and the cement industry.[23] An advertisement in the very first issue of the magazine depicting a 'handshake' between the CO and the ministries of public works, industry and labour leaves little to the imagination (fig. 3).

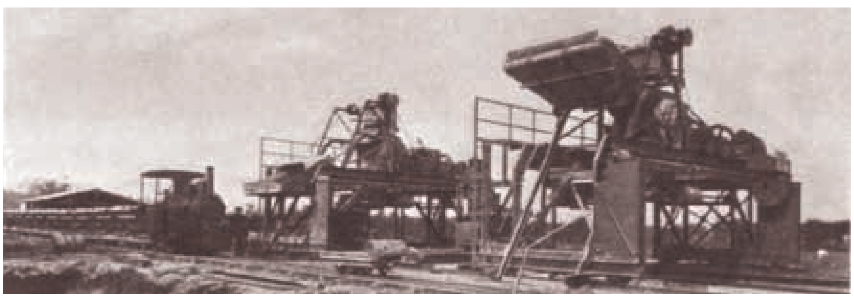
However, this firm handshake with the government did not immediately guarantee spectacular markets for cement: between 1950 and 1960, for example, no more than a meagre sixteen kilometres of motorway were built per year – considerably less than expected.[24] Early VCN brochures suggest that inadequate execution modalities, including the difficulties of getting

3. The handshake between the cement industry and the government 'as in 1948' with the Marshall Plan (*La Technique Routière* 1 (1956) 1, cover and back cover)

high-quality concrete to the construction site, prevented more efficient and rapid road construction (fig. 4). In addition, the cement industry concluded that contractors in regular construction were encountering similar efficiency problems 'due to the incessant relocation of heavy concrete mixing installations from construction site to construction site; due to the difficulty of recruiting competent workers to operate these installations; the lack of space when building in the city; the inaccuracy of volumetric dosing of the mortar mixture; difficulties in supply, and so on'.[25] Contractors had to find ways of getting sufficient small quantities of sand, gravel, cement and water to the construction site where they could be mixed as and when required. After all, lack of space on (urban) construction sites usually made large bulk deliveries impossible, so the use of inefficient bags of cement and sand remained the norm for a long time. The labour-intensive distribution of small bags and the slow processing of cement on site simply could not keep up with the ever-increasing production capacity of the rotary kilns (fig. 5).

In this context, it is not surprising that actual cement sales stagnated at 4.5 million tons a year during the 1950s, threatening to leave a large part of the accumulated production capacity of 7.5 million tons unused.[26] The response of the major cement producers was as simple as it was effective: from the 1960s onwards, they increasingly marketed 'ready-made' concrete in the form of all kinds of prefabricated products but also, and above all, as ready-mixed concrete – a strategy that has received little attention to date in the history of concrete, either in Belgium or abroad.[27] However, this seemingly banal innovation had an immense impact on the use of cement and concrete – and on the Belgian construction industry in general. From 1958 onwards, the cement giants CCB, CBR and CO all started building ready-mixed concrete plants, initially in large urban centres such as Brussels, Antwerp, Ghent and Liège, but before long in smaller provincial towns as well (fig. 6). In 1966, the VCN stated somewhat complacently that: 'The development of this industry has made it possible for contractors to obtain concrete of consistent quality and, in some cases, concrete with very special characteristics. The delivery of ready-mixed concrete in large quantities, according to pre-arranged schedules, has also enabled them to significantly increase the productivity of their sites'.[28]





4. Top: mobile mixing plants produce small quantities of concrete, transported in open-bed trucks (max. 4 km) or via Decauville rail (max. 3 km). Bottom: sliding concrete mixing plant above the formwork of the road surface, supplied with basic materials via Decauville rail (VCN, *De Cement-Betonweg*, 1954, 51 and 52)

5. CBR factory in Lot, where cement bags were for a long time sewn from jute. Right: paper bags did not predominate until after the Second World War, while cement distribution remained highly labour-intensive for a long time (CBR Echos (1981) 85, 9; VCN, *Cement*, 1970, 46)

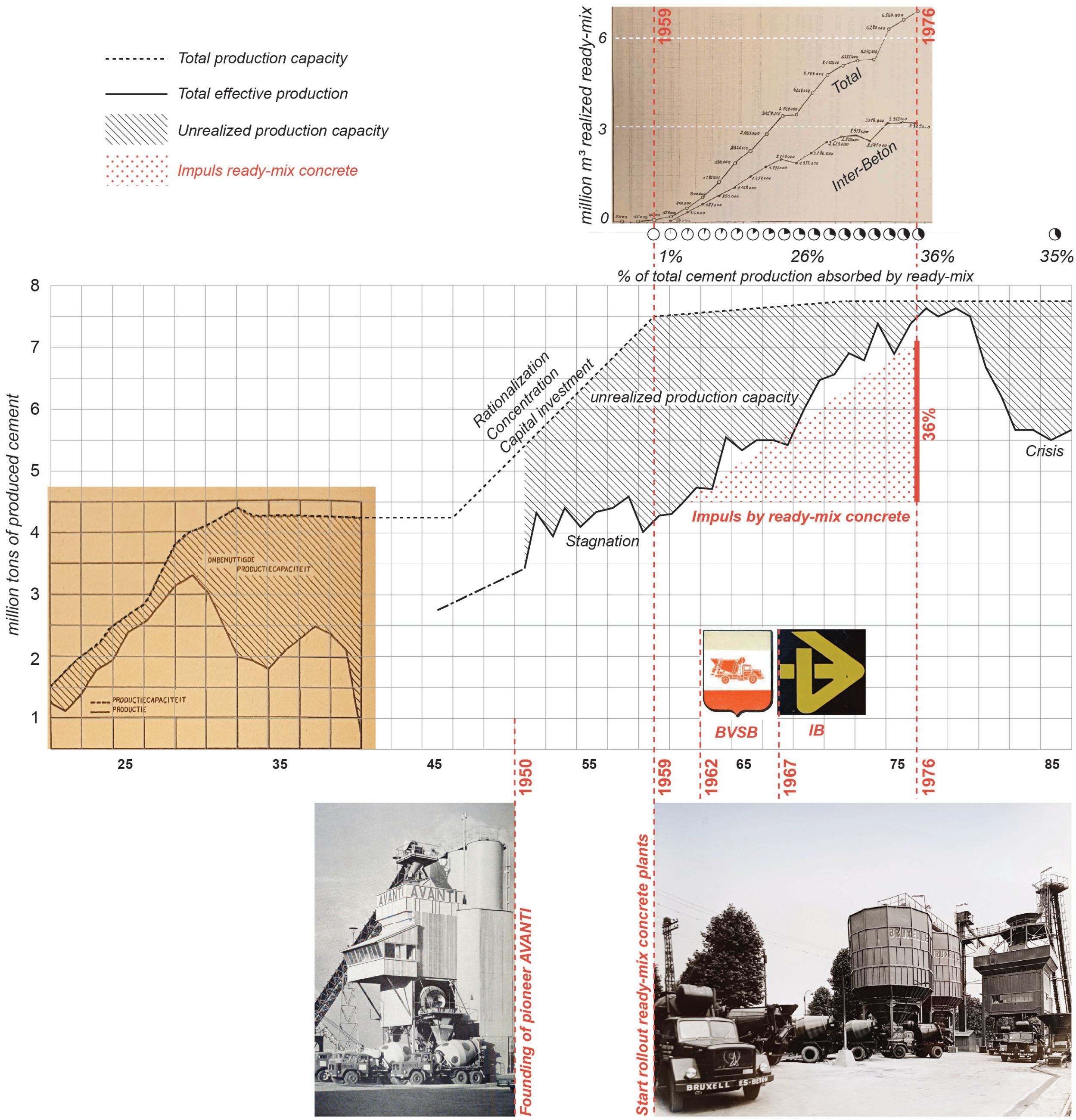
6. CO and CBR advertisements for ready-mixed concrete, first in major cities such as Brussels and Antwerp, later also in Ghent and Bruges (*De Algemene Aannemer* (1960) 10, 481; Belgian State Archives, CBR Fund, 3567)

Concrete plants proved to be so 'favourable in terms of quality, cost and productivity' that their efficiency 'prompted more and more contractors to change their construction methods'.[29] In 1970, the VCN was delighted to hear that the use of ready-mixed concrete had become so widespread that concrete production in plants accounted for 26 per cent of Belgium's total annual cement consumption.[30] Cement consumption by concrete plants rose from zero per cent in 1960 to 35 per cent in 1985, peaking at 65 per cent in 2020, while the share of cement delivered directly to construction sites fell from 80 to 9 per cent over the same period.[31] Concrete was decreasingly mixed by contractors on site. Major changes also took place beyond the construction site. Along with the rise of concrete plants, for instance, 'the transport of bulk cement by road exploded'.[32] Between 1959 and 1974, deliveries in cement bags dropped from 73 to 30 per cent, while deliveries by road rose from 33 to 84 per cent in the same period – at the expense of slower transport by rail and water. Sand and gravel were no longer distributed to countless small construction sites, but to a much smaller number of large concrete plants. Due to this rigorous rationalization and acceleration of the raw materials supply chain following the introduction of the concrete plant, cement consumption rose steadily after 1960 above the stagnant level of 4.5 million tons, approaching almost the entire production capacity of 7.5 million tons from 1975 onwards. Concrete plants thus became the undisputed spearhead of the Belgian cement industry's (necessarily domestic) politics of realization (fig. 7).

THE LOGISTICS NETWORK OF THE BELGIAN PROFESSIONAL ASSOCIATION FOR READY-MIX CONCRETE

In 1950, the Antwerp-based concrete company Avanti, with engineer H. De Vel as its driving force, established the very first Belgian concrete plant, which would remain the only pioneer for almost ten years (fig. 5). However, it was mainly the three large cement producers that 'definitively launched the ready-mixed concrete industry from 1959/1960 onwards,'[33] initially mainly in the context of larger cities such as Brussels, Antwerp, Liège and Ghent. It was also on the initiative of the cement industry that the BVSB was founded in 1962, with De Vel as its first president.[34] From 1965 onwards, the BVSB facilitated the introduction of the hydraulic piston pump on the Belgian market.[35] The pumping of ever-increasing volumes of ready-mixed concrete 'to distances of more than a hundred metres',[36] and over heights of 'minus thirty to plus sixty metres'[37] only increased the popularity of this technology. By 1970, there were already nearly a hundred concrete plants in operation, growing to around 175 in the mid-1980s.

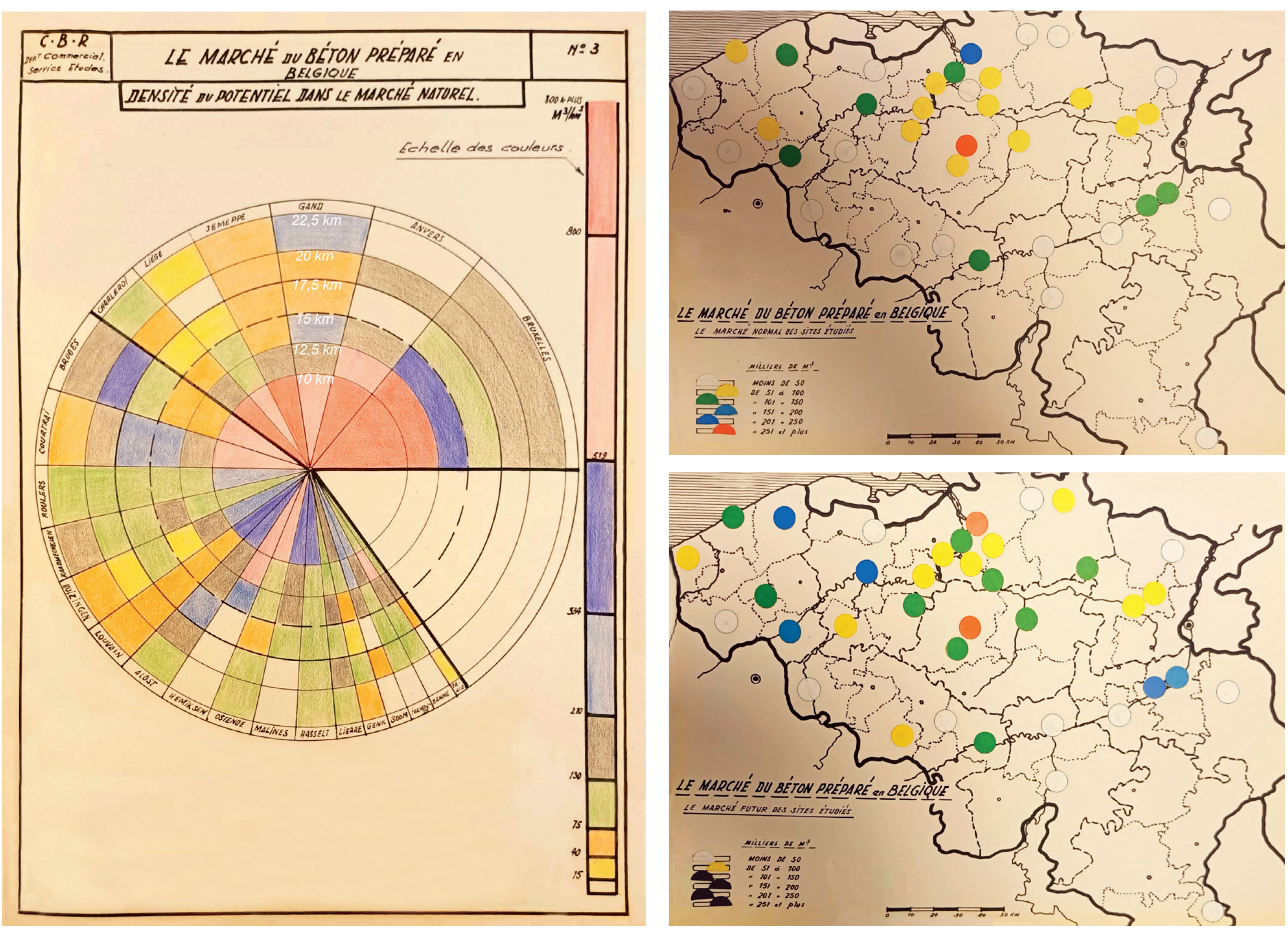
A 1962 study by CBR's *Béton Préparé* department shows



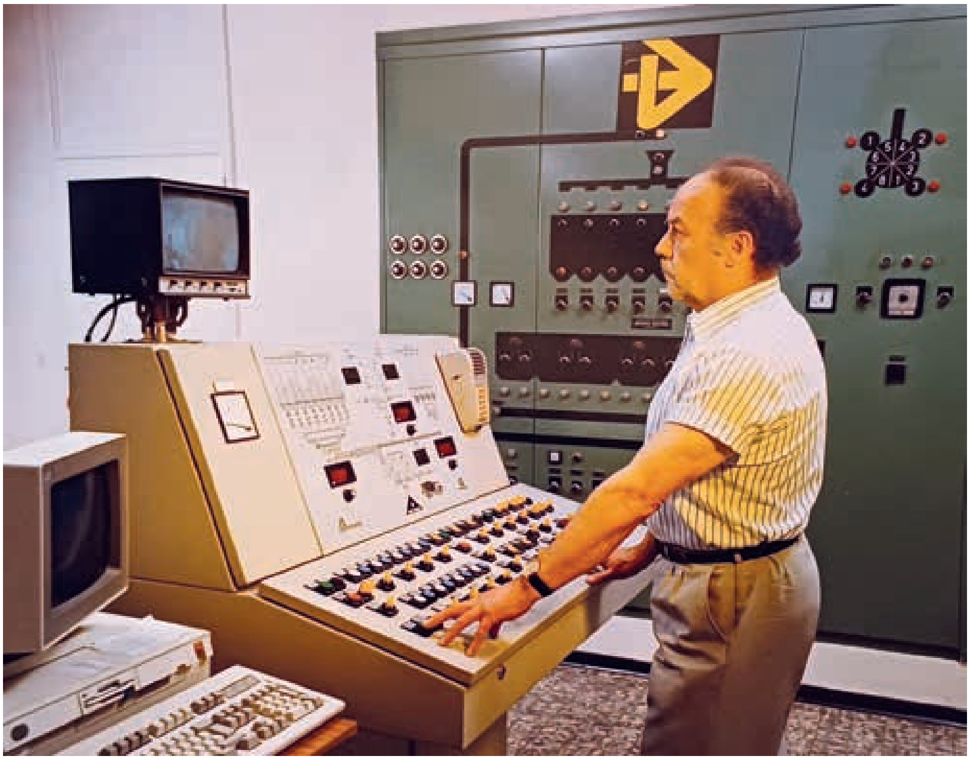
7. The emergence of concrete plants (especially from 1959), the founding of BVSB (1962) and the establishment of IB (1967) boosted the cement market: virtually the entire increase in production between 1960 and 1976 was absorbed by the growing ready-mixed concrete sector (Infographic created by the author based on a variety of source materials)

how the distribution of concrete plants was deliberately controlled by the cement industry. This control was based on various parameters, such as the potential market, but also the location-dependent costs of the supply of basic materials, workers' wages, the transport of fresh concrete, and so on.[38] The 'potential market' was calculated based on the assumption that 5.5 per cent of all built-up volume in the private sector within a radius of 20 kilometres around the plant could be realized from ready-mixed concrete – a number that was raised to 10 per cent to take into account the share of public works, for which no predictable data were available.[39] The radius was limited to 20 km because after mixing the concrete had to be poured quickly enough before it could harden. To simulate and detract the share of competing plants, only 35 per cent of the potential market within a radius of 15 to 20 km from the plant was included in the calculation of the 'normal market'. The 'future market' was determined on the basis of a (linear) extrapolation of the 'normal market' based on statistical data from between 1953-1960 and projected to 1970. Regional development plans, in full swing in the context of the 1962 urban development law, were explicitly not taken into account. In other words, the concrete plants were located where the path-dependent growth and construction potential was most promising. Yet, in the highly fragmented urban context of Belgium, the plants' action radiuses covered almost the entire territory – which was especially the case in Flanders. The plants thus helped perpetuate the generally dispersed urbanization model in Belgium, rather than effecting patterns of spatial differentiation. As a consequence, concrete became readily available throughout almost the entire country. In the early days, cement giants CBR and CO were the main pioneers in setting up new concrete plants, including a number of mobile plants for exceptional and flexible projects (fig. 8).

Not only the spatial distribution, but also the desired substance of the ready-mixed concrete itself was strongly influenced by the activities of the cement producers. The research capacity of a company such as CBR proved to be of great value in determining the optimal granulometry of the aggregates, the precise water/cement factor and the ideal mixing time (in the search for perfect fluidity, taking into account the time interval between mixing and pouring); the optimal ratios of kilos of cement per cubic metre of concrete (for maximum economy without loss of resistance), the optimization of the type of cement used (to limit equipment maintenance), experiments with warm cement (to facilitate concrete pouring throughout the winter and thus reduce seasonality to the maximum), etcetera.[40] The knowledge acquired was incorporated by the BVSB into numerous technical conditions for membership, including guidelines on dosing, mixing, transport and delivery, as well as the strict obligation to set up a test laboratory at each plant.[41] These guidelines formed the basis for the standardization of ready-mixed concrete, and only affiliated plants were allowed to display the BENOR/SECO quality label (Belgian Standards Mark & *Société Européenne de Controle)*.[42] The cement industry took the lead in turning the production of ready-mixed



8. Left: density of potential (ranging from 0 to 800+ m³ of concrete/km²) in relation to distance (from ten to 22.5 km) from the selected plants in 1962. Top right: normal market per plant in 1962. Bottom right: future market per plant in 1970 (Belgian State Archives, CBR Fund, 2496)

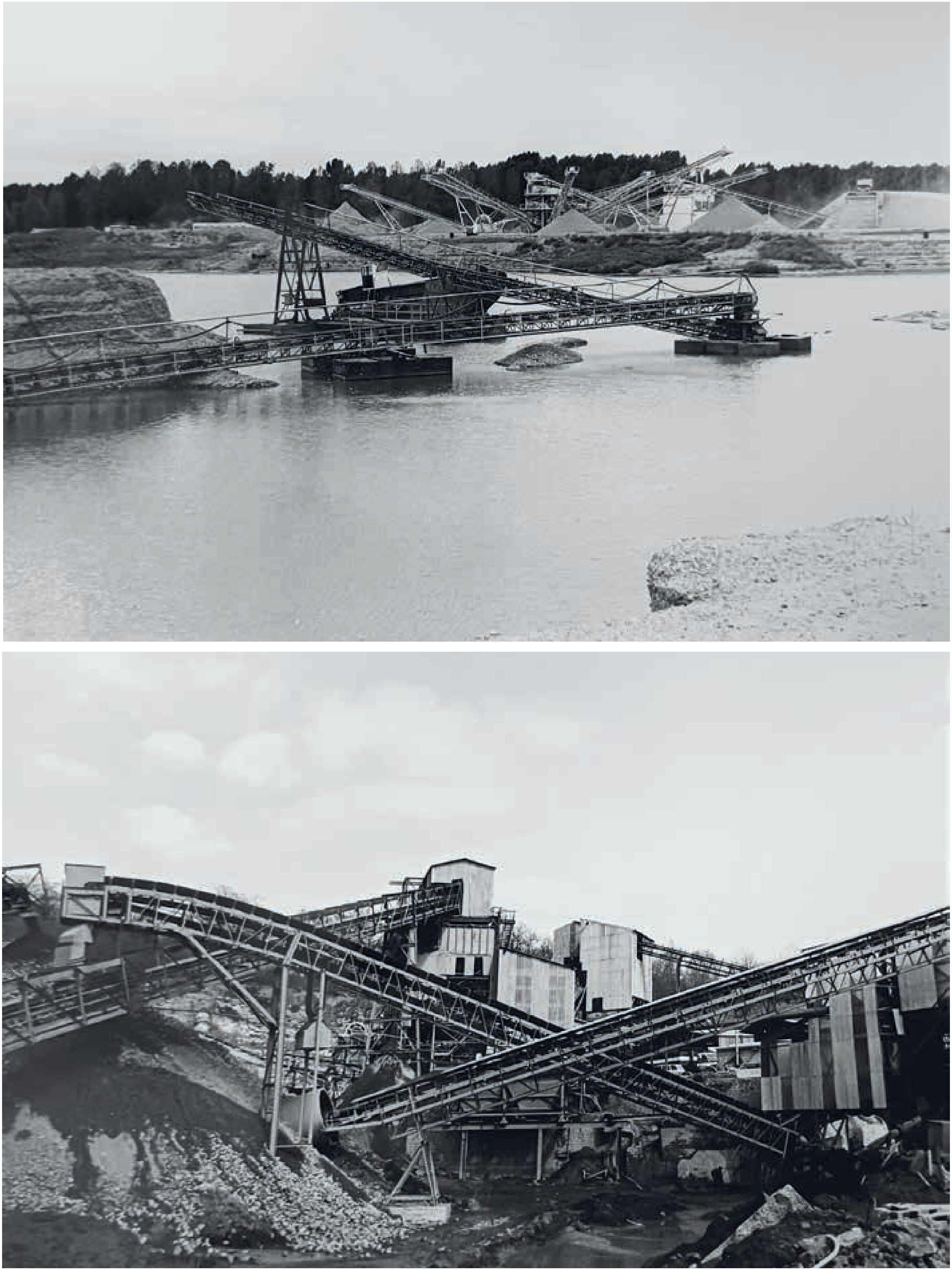


9. Growing scientific precision in the production of concrete mixes: note the graphical representation of various aggregate silos on the control panel. Research at Inter-Beton contributed to the standardization of ready-mixed concrete and the BENOR/SECO label (Belgian State Archives, CBR Fund, 3519)

concrete into an exact science, a trend that also manifested itself internationally through the organization of a series of specialized international congresses, in which the Belgian companies were well-represented (fig. 9).[43] One of the industry's explicit objectives was to monitor, guarantee and control the processing of its own cement into high-quality concrete.[44]

In 1966, the concrete companies CBR and CO, producing 1.1 million cubic metres and 675,000 cubic metres of ready-mixed concrete respectively, together accounted for around 80 per cent of the total Belgian market – followed at a considerable distance by CCB.[45] However, according to the companies, the low added sales value of ready-mixed concrete was difficult to reconcile with the very high and specific investments (in land, silos, mixer trucks, laboratories, personnel, etc.), especially in combination with their cost-intensive pioneering role in research. In 1967, CBR and CO therefore decided to set up the Inter-Beton joint venture. The aim of this organization was to optimize the return on investment, minimize total cement transport, achieve the greatest possible distribution without mutual competition.[46] This quasi-monopoly also prompted the joint venture to acquire control of the sand and gravel markets in Belgium. It did so by systematically absorbing companies such as Argex (Kruibeke), Inter-Silex (Dilsen), Sagrex (Beez) and Agral (Gourdinne) into a separate 'Aggregates' division and merging them at the end of the 1970s to form the Gralex company (fig. 10). The intention behind this expansive aggregates policy was clear: 'to maximize the difference in purchase prices between Inter-Beton and other customers (e.g. independent concrete plants, traders, contractors)'.[47] This power grab in the ready-mixed concrete industry was financially supported by the state in the form of favourable tax regimes under the Economic Expansion Laws of 1959 and 1966.[48] This allowed Inter-Beton not only to grow significantly (from 30 branches in 1970 to 55 in 1983), but also to control the market conditions within which private plants and other groups such as Ready-Mix or CCB could operate (fig. 11).[49]

When Inter-Beton was founded, CBR had set up a central research laboratory in Sint-Pieters-Leeuw. Its task was to optimize quality control procedures and to keep optimizing the manufacture and delivery procedures and modalities of ready-mixed concrete. There was a deliberate focus on implementation-oriented research, including simulation of practical site conditions, in addition to the fundamental research on concrete carried out in university laboratories. This knowledge-building exercise, developed in close collaboration with bodies such as CRIC-OCCN,[50] ENCI,[51] BBSP[52] and SECO, was intended to guarantee high-quality standards and hence the impeccable reputation of ready-mixed concrete.[53] CBR also made the laboratory in Sint-Pieters-Leeuw available to the BVSB to organize specialized training courses for all employees in the new sector, from management positions to mixer-truck drivers, all of whom were expected to have a thorough knowledge of everything from cement production to pouring concrete on the construction site.[54] Inter-Beton was a horizontally organized company, divided into six autonomously func-

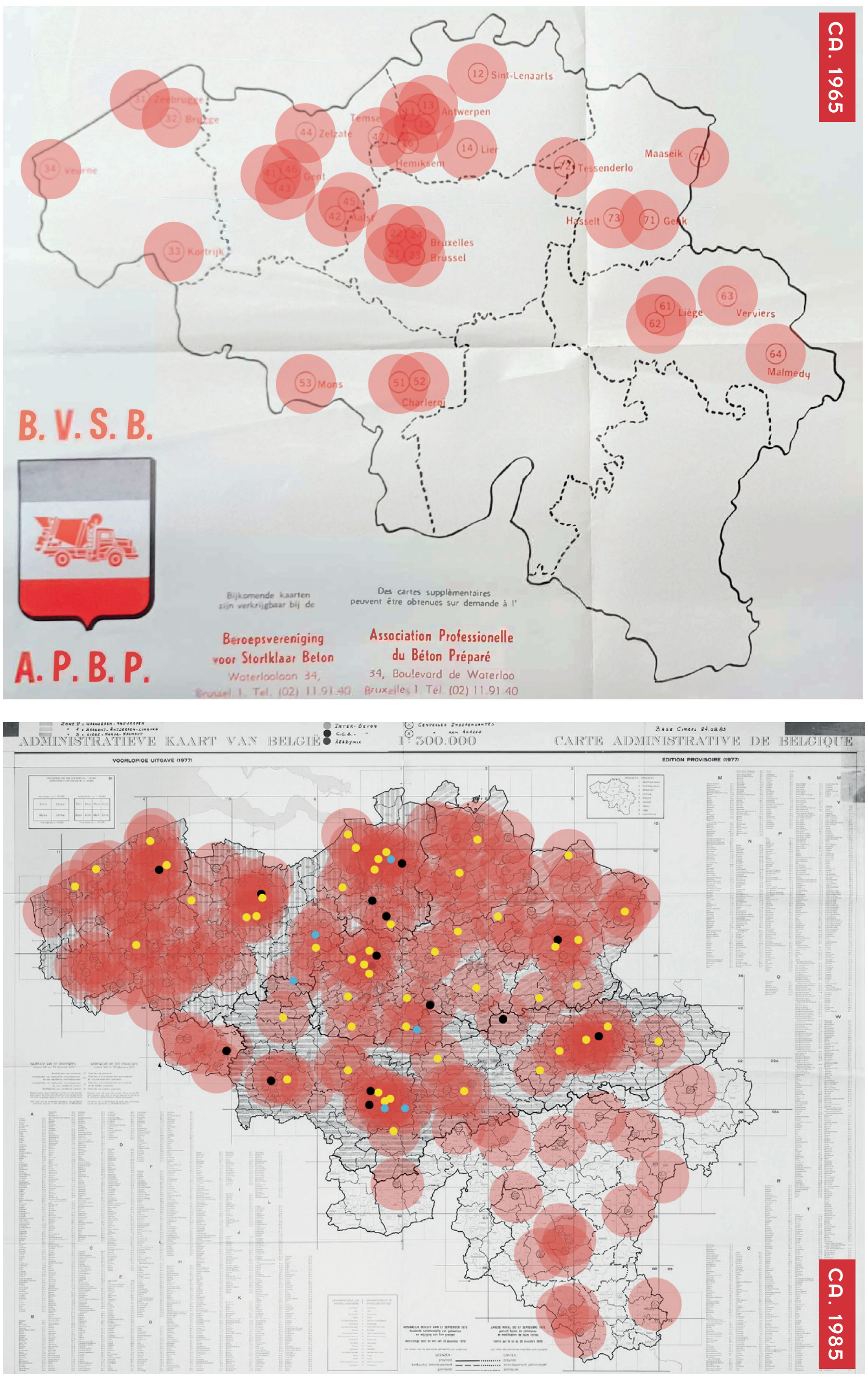


10. Gravel extraction by Inter-Beton in Dilsen and Beez in the 1970s (Belgian State Archives, CBR Fund, 3519)

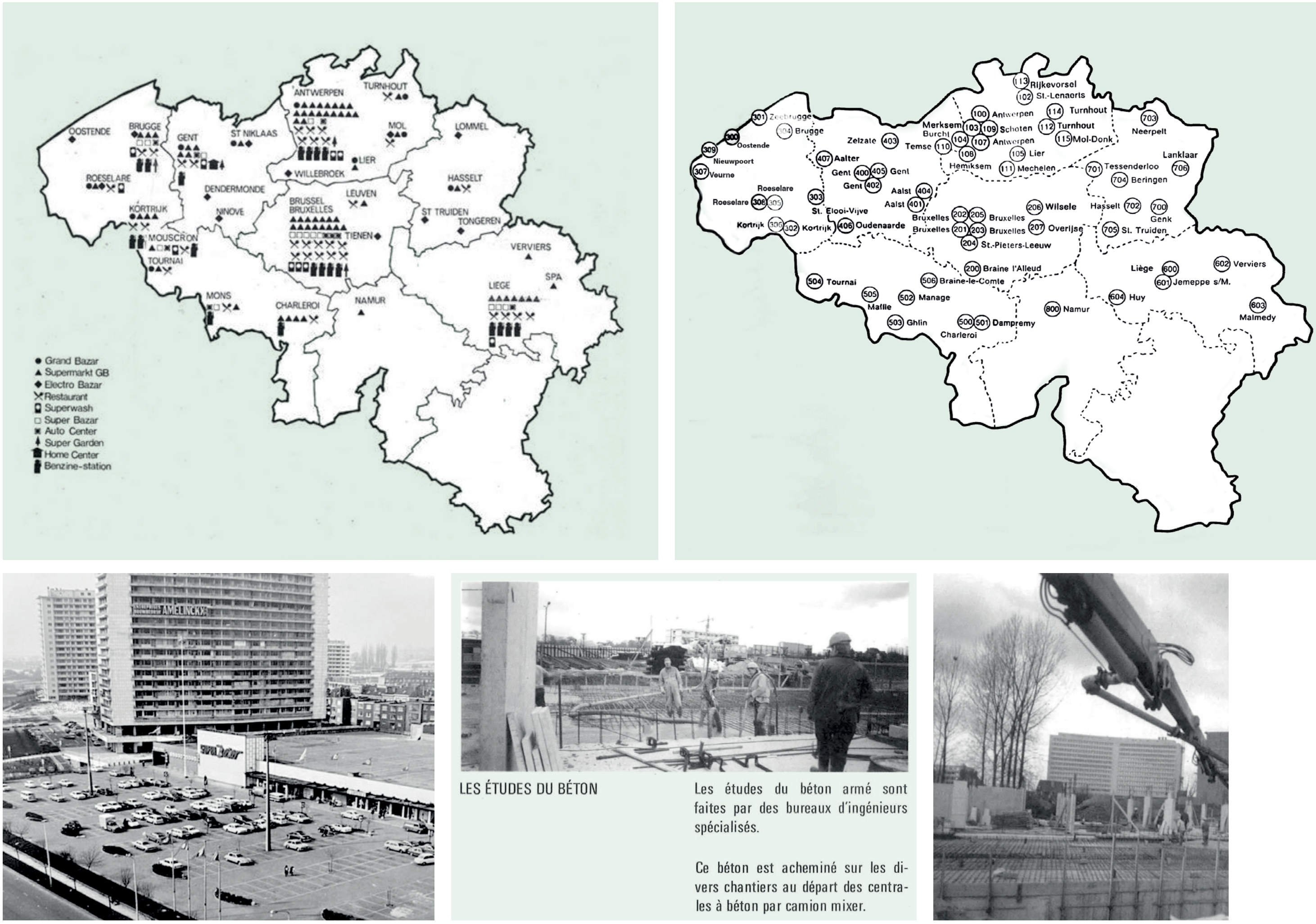
tioning departments, corresponding to six different zones, in which so-called ‘sales managers’ led a ‘prospecting department’ responsible for the permanent expansion of local markets.[55] In other words, Inter-Beton not only took the lead in developing a logistical landscape of concrete plants, but also in training a new kind of construction industry workforce and in the continuous development of practical knowledge. All these measures were aimed at bringing concrete into a state of flux – continuously, economically, qualitatively and professionally distributed across virtually the entire country (fig. 11).[56]

CONCRETE PLANTS: ‘TRIBUTARIES OF THE CRISIS, BUT THE CEMENT INDUSTRY’S MAIN CUSTOMERS’[57]

The launch of this new concrete regime was not without effect. It coincided, for example, with the heyday of Belgian highway construction between 1965 and 1973. The annual averages of constructed road far exceeded the initial sixteen kilometres, reaching an absolute peak of 275 kilometres in 1972 alone.[58] In that very year, Inter-Beton acquired three new mobile plants to supply the E40 and E5 construction sites with fresh ready-mixed concrete.[59] However, even in that peak year, only 35 per cent of the total amount of cement



11. Growth of the logistical network of concrete plants between 1965 and 1985: from metropolitan regions to national coverage. Around 1985, Inter-Beton (yellow), CCB (blue), and Ready-Mix (black) operated as major players among a great many private companies (Map by author, based on sources from Belgian State Archives, CBR Fund, 2496; Nationale Confederatie van het Bouwbedrijf, *Officieel Jaarboek* 1965-1966, 1966, n.p.)



12. Top: the roll-out of concrete plants and GB supermarkets followed a very similar trajectory between 1960 and 1970. Bottom: the juxtaposition of construction activities of GB supermarkets and Amelinckx housing blocks which were built entirely from ready-mixed concrete (Plans: Archives ULB, GIB Fund, AAB/010/E/45; Nationale Confederatie van het Bouwbedrijf, *Officieel Jaarboek*, 1971, n.p. Pictures: Archives ULB, GIB Fund, LOC/050/U/670; Amelinckx, *Bien vivre dans son appartement*, undated, n.p.)

went into infrastructural works; the rest ended up in 'residential and non-residential' buildings.[60] We know that a major real estate player like François Amelinckx, who built more than 50,000 apartments for the Belgian market and even achieved an average of more than 4,000 completed residential units per year in the early 1970s, had all his concrete delivered directly from concrete plants and poured on site.[61] The logic of the concrete plant fitted in perfectly with Amelinckx's thorough Taylorization of construction labour, which was essentially structured around the formwork of floors.[62] Concrete plants became a *conditio sine qua non* for the company's incredible production pace, and Amelinckx only built where ready-mixed concrete was available. An identical pattern characterizes the feverish construction activities of Maurice Cauwe, who, as head of GB-Entreprises from 1960 onwards, built up a veritable empire in the commercial distribution industry in next to no time. The roll-out of his supermarket chains coincided almost entirely with the rise of the concrete plants, and in that light it seems no accident that Cauwe appointed CCB director and VCN chairman Jules Plaquet as managing director of his company from the outset.[63] Important 'captains of industry' like Cauwe and Amelinckx are symbolic of how the newly established ready-mixed concrete regime enabled the construction industries to rapidly transform the Belgian urban landscape into a rational cement city of major roads and adjacent boxes in concrete – or *voiries et constructions* in the terminology of urban planner Victor Bure (fig. 12).[64]

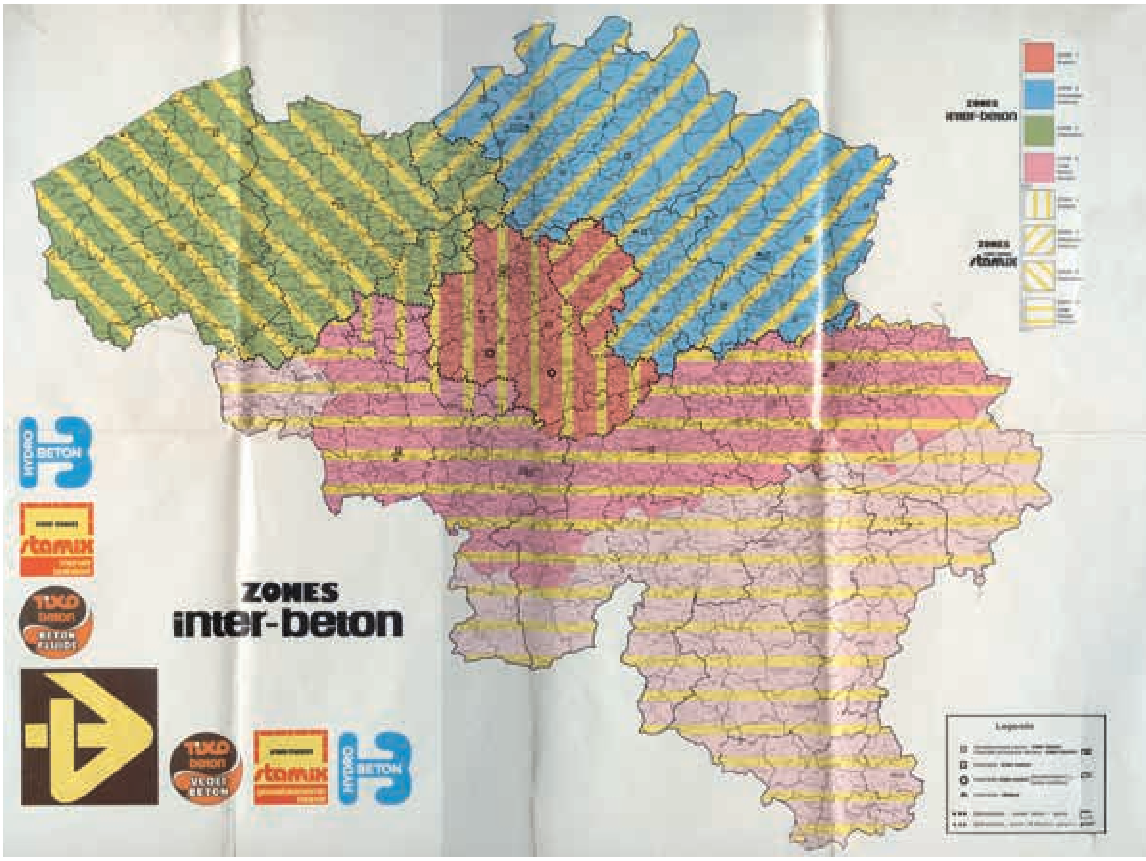
However, the copious consumption of concrete was not limited to these major players alone. The prospecting department at Inter-Beton employed 'delegates' whose task was to 'deal with small sites and make routine visits to every potential customer'.[65] The company pioneered 'pump systems tailored to small quantities' that very accurately pumped small volumes of ready-mixed concrete into housing projects throughout the country. In other words, the growth strategy did not focus solely on large construction players, but also actively targeted the bulk of small construction projects and activities (fig. 13). Moreover, it is well known that, as long as their activity was only monitored by tachograph, mixer truck drivers were able to gain a fair amount of extra income by secretly selling leftovers from large deliveries at a bargain price to acquaintances, farmers, or anyone who could use a bit of concrete.[66] Flowing concrete is perhaps a more apt metaphor to describe post-war urbanization in Belgium than the commonly used oil stain analogy. In conditions of steep market growth, the 'potential market' seemed inexhaustible, causing more and more plants to start operating within each other's radius of action – without immediately leading to price wars, thanks in part to the regulatory role of Inter-Beton and the BVSB.

This controlled growth and revenue model worked outstandingly well until the late 1970s, when it ran up against the iron law dictating that any over-accumulating production regime will sooner or later face stagnation and recession.[67] During the major construction crisis of the 1980s, only fifty per cent of the total 'production capacity of the ready-mixed concrete industry, spread across a large number of companies, was being utilized'.[68] The very dense network of concrete plants quickly led to 'cut-throat competition' and initiated 'a ruthless price war in which everyone ended up losing'.[69] Belgian concrete prices fell to more than 20 per cent below the rates sustained in neighbouring countries, plunging the entire industry into a deep crisis.[70] Large countercyclical government investments in urban infrastructure – such as the construction of port infrastructure and the (pre)metro lines in Antwerp and Brussels – provided a lifeline that proved crucial to the sector's survival.[71]

Nevertheless, the crisis also forced the concrete and cement industry into serious introspection. CBR, for example, was fully aware of the strange paradox that, on the one hand, while the ready-mixed concrete industry had contributed to the severity of the crisis, it had also become the cement sector's largest customer. Nevertheless, the company did not hesitate for a second in implementing a 'policy for the future', which was 'to maintain this market, be present everywhere, and above all to restore prices to previous levels'.[72] Confidential company documents reveal the multiple measures Inter-Beton took to try to turn the tide. In addition to standard economizing procedures for business organizations in times of crisis (such as reducing the number of zones from six to three with fewer middle managers, introducing modern information systems, increasing job rotation, reducing seniority, phasing out fringe benefits, etc.), one recommendation stands out: improving the market position by launching 'special types of concrete' (fig. 14).[73]

13. The logistical landscape of concrete plants as an operational device for large and small terraforming processes in concrete: commercial centre of GB Entreprises along the highway in Ruisbroek and a private project in an anonymous subdivision (*GB Eigen Leven*, (1973) 7, 2; Sint-Pieters-Leeuw concrete plant archive, not inventoried)

As early as the mid-1970s, Inter-Beton had started a programme in its laboratory in Sint-Pieters-Leeuw to develop specific 'mixes' for special concrete applications. Early achievements included TIXO-mix (for extremely fluid concrete with high resistance), Hydro-mix (for applications under or around water), CEL-mix (for light insulating applications) and STA-mix (a ready-to-use 36-hour workable stabilized mortar).[74] These inventions transformed concrete – and cement mixtures more generally – from a generic material into a specialized consumer product. Advertisements for all these 'inventions' made great play of the fact that they would make work on the construction site considerably easier. However, internal documents show that these new products were primarily intended to stimulate 'the processing of concrete [*la mise en oeuvre*



14. Special types of concrete – which make life on the construction site significantly more convenient for workers compared with 'regular' concrete – became available across nearly all of Belgium (Belgian State Archives, CBR Fund, 712)

15. Overview of various Inter-Beton mixes specially developed for every conceivable use. Samples of MAR-mix in all possible shapes and colours (Sint-Pieters-Leeuw concrete plant archive, not inventoried)

du béton]' and that their exclusivity mainly served as 'an additional selling point'.[75] From the 1980s onwards, the crisis accelerated this research programme and within a very short time, some 30 'groundbreaking mixes' came onto the market. These even included a number of concrete mixes geared specifically to aesthetic aspects, such as coloured concrete (COLOR-mix), patterned concrete (PRINT-mix), fair-faced concrete (VIEW-mix) and even marble concrete (MAR-mix) (fig. 15). Thus, the ready-mixed concrete industry itself was one of the driving forces behind the postmodern rebirth of concrete in Belgium.[76] Backed by the economic clout of global cement producers such as CBR and CO, Inter-Beton was able to invest in new strategies in the midst of a recession. In this way, the position of the ready-mixed concrete industry was not only consolidated after the crisis but even strengthened. This circular logic anchored the logistical landscape of concrete plants ever more deeply into the territory as an inevitable terraforming device for Belgian urbanization: in 2023, approximately 270 plants distributed twelve million cubic metres of ready-mixed concrete in Belgium – more than double the annual peak production in the golden Sixties.[77] The fact that the cement and concrete sector itself initially counted on a market share of ten per cent of all built volume in the early 1960s, but that the average city today consists of about eighty per cent concrete, shows the extent to which the sector's politics of realization succeeded in making concrete an (almost) inevitable and essentially over-consumed commodity.

CONCLUSION AND PROSPECTS: BROADENING THE POLITICAL ECOLOGY OF CONCRETE?

This article has shown that the politics of realization of the Belgian cement industry was largely determined by the need to gain control over the 'final consumption' of concrete in all kinds of urbanization practices. Capitalism's market-driven economy forced the cement industry to take action to make concrete widely available as a ready-made consumer product. In a context of rapidly increasing productivity and reduced export opportunities, it became necessary to develop strategies to effectively 'realize' the millions of tons of cement that were being continuously and rapidly produced by the rotary kilns on the domestic market. The development of a dense logistics network of hundreds of concrete plants, the training of workers, implementation-oriented concrete research, the development of new products, and so on, were all crucial pillars in the Belgian cement industry's realization policy.

The growing network of concrete plants became a pertinent circuit board for all kinds of *terraforming* practices at the national level. Significant material flows of sand, gravel and cement were optimized in order to build the Belgian welfare state in all its forms (residential, commercial, infrastructural, etc.) as quickly, efficiently and cheaply as possible. In a country rich in easily mined limestone deposits, making cheap concrete 'over-available' became an almost self-evident act of political geology to ensure the country's economic development.[78] In Belgium, for example, the density of concrete plants is about twice as high as in the Netherlands – and also its per capita cement consumption has been significantly higher than that of their Northern neighbours throughout the post-war era.[79] Such an interpretation is important in order to gain a clearer understanding of how certain construction industries were able to assume the position they did; how they helped determine the methods and conditions under which construction took place; or how they managed to embed the overconsumption of a particular material in society. A good understanding of these historically embedded dynamics and practices also seems crucial for reflecting on ways to make urban construction practices substantially more sustainable, less extractive and more inclusive. After all, this article shows how great the impact of the (overly) dense network of concrete plants has been on Belgian construction culture. It suggests that, to a certain extent, we should perhaps take the figurative 'concrete ban' in Flanders literally in order to pave the way for other, more post-fossil construction cultures where desirable.[80]

The realization strategy of the concrete and cement industry undoubtedly helped shape the Belgian urbanization pattern. Conversely, that same urbanization pattern also co-determined the options open to the concrete industry. The highly fragmented spatial structure in Belgium – and particularly in Flanders – meant that plants that had to supply concrete to urban centres also had sufficient reach to cover virtually the entire country. After the initial expansion phase, the development strategy of the cement industry can also be interpreted as a continuous adaptation to the contingent circumstances in which concrete could be used within the spatially differentiated pattern of the urbanizing landscape. Further growth was achieved through increasingly far-reaching specialization in various niches, with a simultaneous focus on both large-scale applications such as road construction and small-scale customization down to the level of the family house. Moreover, research into the development of different concrete mixes and applications shows how availability was increasingly orchestrated for the benefit of specific forms of use that arose (but were also actively promoted) in an increasingly urbanizing society.

Finally, the concrete plant provides a new arena for further research into the political ecology of concrete.[81] In line with the renewed interest in the origins of materials, much political-ecological research into concrete has so far focused mainly on the extraction and production of basic components such as sand, gravel and cement.[82] Particular attention is paid, for example, to the devastating impact of certain extraction practices on the environment,[83] or to the CO_2 emissions of horizontal cement kilns, which are currently estimated to be responsible for around eight per cent of annual global emissions.[84] Recently, urban and environmental geographer Matthew Gandy proposed looking beyond the extraction of materials to the everyday reality of the city itself in order to imagine and write an 'urban' political ecology of concrete. The focus here would be on the link between the abundant use of concrete and the urban heat island effect, the accelerating effect of concrete in the spread of certain viruses, etcetera.[85] However, the concrete plant presents a particularly intriguing place between the extraction landscape (where the raw materials are mined) and the (urban) construction site (where concrete is applied) to broaden and deepen the political-ecological historiography of concrete.

For example, what was the contribution of the very heavy cement transports, which after the introduction of concrete plants were largely carried out by truck, to the accelerated degradation of the road surface?[86] How serious were dust emissions from the delivery of aggregates and cement to the plants, especially when they were located near residential areas (fig. 1)? Where did the considerable residual flow of rinse water containing aggregate and cement residues

16. Large quantities of leftover cement and aggregate are flushed out when cleaning the mixing machine between different batches at the concrete plant in Sint-Pieters-Leeuw. Today, they are recovered in sedimentation basins, in compliance with environmental regulations. What previously happened to these leftovers, and with what environmental impact, remains unclear (Photo Tom Broes)

go in between the various concrete mixes before environmental legislation required settling basins to be created to collect it from the late 1980s onwards (fig. 16)?[87] How should we understand the accumulated traffic impact on the urban environment of the decades-long stream of energy-intensive mixer trucks, which are not yet ready for electric propulsion and suffer from a serious blind spot problem?[88] These are just a few questions that invite us to include the logistics hub of the concrete plant in the political-ecological historiography of concrete.

ACKNOWLEDGEMENTS

The author would like to thank the anonymous reviewers for their suggestions and comments on an earlier version of this article, which greatly contributed to sharpening the argumentation. Thanks to Michiel Dehaene and Rika Devos for the ongoing conversation about the politics of realization of material industries as an urbanization practice in general, and for their critical reading of various preliminary versions of this article. Thanks also to Lionel Devlieger for the invitation to organize a joint research seminar at Ghent

University on cement production in Belgium. This article was developed as part of the project Construction History: Above & Beyond. What History can do for Construction History. This project (40007559) has received funding from the FWO and the F.R.S.-FNRS as part of the Excellence of Science (EOS) programme.

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THE CONCRETE PLANT AS A TERRAFORMING MACHINE

URBANIZATION THROUGH CONCRETE PLANTS OR THE MARKETIZATION OF CEMENT AS TERRAFORMING PRACTICE: THE BELGIAN CASE, 1955-85

TOM BROES

This article reconstructs how the development of a dense network of concrete plants was crucial in making concrete the basic material of an urbanizing construction culture. Belgium is treated as a paradigmatic case to argue that one – perhaps the main – reason why concrete became the most dominant building material in the world was due to the intensive way in which it was distributed and made available as a self-evident consumer product. The article describes how the relentless output of horizontal rotary kilns compelled the cement industry to adopt a bold 'politics of realization' – ensuring that massive cement volumes being produced actually found their way to the market. The solution lie in the development of a dense logistics network of concrete plants that efficiently produced and delivered ready-mix concrete directly to construction sites – actively shaping urbanization regimes capable of absorbing large volumes of concrete. Spurred on by cement giants CBR (Cimenteries et Briqueteries Réunies), CO (Ciments d'Obourg) and CCB (Compagnie des Ciments Belges), together with the establishment of the BVSB (Belgian Professional Association for Ready-Mix Concrete, 1962) and the IB joint venture (Inter-Beton, 1967), this strategy was increasingly formalized.

In the fragmented Belgian urban landscape, concrete plants spread rapidly across the entire country. During the 1960s and '70s, this new concrete regime put a veritable form of 'terraforming' into practice. Important material flows of sand, water and gravel were rationalized and distributed in bulk to the concrete plants in the network. From there, concrete spread across the country, driving a surge in construction —from major infrastructure to everyday urban practices—that transformed the Belgian landscape.

As Belgium's construction recession in the late 1970s deepened into a full-blown crisis in the early 1980s, the ready-mix concrete sector was sustained through major public contracts and a strategic pivot toward specialized concrete mixes that unlocked new niche markets. In this way, the concrete plant became increasingly entrenched as an indisputable cause of Belgian urbanization's 'cement addiction'. By focusing on the concrete plant, the article provides a new spatial perspective on the political ecology of concrete and raises questions about the sustainability of a building culture in which the overproduction and overconsumption of this extractive material is a structural component.

TEMPORARILY IN STOCK

THE OEUVRE OF SALVAGE ARCHITECT MARCEL RAYMAEKERS AS A MIRROR OF DEMOLITION AND DISPOSAL PRACTICES IN POST-WAR BELGIUM

ARNE VANDE CAPELLE AND LIONEL DEVLIEGER

Since the Second World War the construction sector has been increasingly characterized by the sustained availability of cheap, standardized building materials, industrially produced from raw materials extracted on an ever-larger scale.[1] Given the enormous environmental impact and social harm associated with this extractivist model, it is increasingly being called into question.[2] An alternative to this high consumption of raw materials and energy is the reuse of materials and components.[3] However, the 'Urban Mine' cannot be mined like a traditional mine. It consists of a wide variety of materials with diverse technical properties, which become available in an unpredictable and scattered way and in small quantities.[4] An architectural practice that focuses on the extensive reuse of elements will inevitably be characterized by a different notion of 'availability' than is common in the contemporary construction sector.

To better understand how such a practice functions

▲ 1. Fighter jet cockpit cupolas serve as skylights in the Kelchtermans House. The roof is clad with reclaimed roof tiles. (Photo Anja Hellebaut and Anthony De Meyere)

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2. The projecting entrance to Huis Witters, clad with copper sheeting recovered from dismantled ships (Photo Jan Mees)

and the parameters that influence it, we examine a little-known case study in this article. The Belgian outsider architect Marcel Raymaekers (b. 1933) focused on salvaged (and other non-standardized) building elements as the starting point for his design practice and was responsible for the construction of dozens of new houses and a multitude of renovations and interior projects between 1962 and 2014, which were carried out almost exclusively with reclaimed elements. Raymaekers is not the only salvage architect in Belgium, but he is by far the most expressive.[5]

This article builds on an oral history research project by Rotor vzw/asbl and Ghent University, led by the authors.[6] Between March 2022 and January 2023, 45 interviews were conducted with Marcel Raymaekers himself, his clients, present and former employees, and family members. Photographs, plans and newspaper articles were collected from their private archives wherever possible.[7] In addition, Anja Hellebaut and Anthony De Meyere produced photographic reports on 25 projects. The information gathered through these channels has already been incorporated into a book that includes a biography and an overview of Raymaekers' oeuvre.[8] In the book, we took a closer look at his background and motivation, his ad hoc design and construction methods, and the role that employees played in his practice. However, these topics are beyond the scope of this article. In this piece we provide a chronological overview of the different types of materials and components Raymaekers worked, the actors who made his practice possible, the socio-economic context in which he operated, and the influence of all these parameters on his architecture.

But we begin by discussing a few points that are important for understanding Raymaekers' personality and practice. In the early 1950s, he settled in Belgian Limburg after dropping out of the Sint-Lucas architecture school in Brussels, in his own words out of boredom.[9] The real starting point of his practice did not come until 1962, after he discovered the principles of assemblage art during an art course at the Teacher Training College in Hasselt. Working with existing components and their specific characteristics generated more creativity in Raymaekers than starting from a blank sheet and using industrially produced materials with their generic characteristics.[10] In the process, he also developed a narrative of architectural-cultural impoverishment.[11] For Raymaekers, living had nothing to do with radical functionality, but was guided by sensory experiences that existing materials could evoke much better than their new equivalents. Reclaimed materials were therefore both a vehicle of creativity and an instrument of countercultural resistance to the aesthetics of post-war industrialized material and housing production.[12] In order to develop a practice based on this premise, Raymaekers found himself obliged to become a material collector and dealer in addition to being an architect. In 1972, he founded Queen of the South (QotS), his headquarters and a two-hectare salvage stock yard located between Genk and Hasselt. The roles of material dealer and architect were always closely intertwined. Until QotS went bankrupt in 2014, a design was free of cost with the purchase of a minimum quantity of elements.

SALVAGE YARDS AND INDUSTRIAL WASTE STREAMS

The first material Raymaekers experimented with was reclaimed metal sheeting sourced from shipbreaker Jef De Smedt, who had been operating in Antwerp since the late 1930s.[13] Initially, the sheeting was used for residential front doors or garage doors. But soon it was being prominently featured as interior wall cladding or facade material (Witters House, fig. 2). Raymaekers also incorporated the steel into eccentric fireplaces, using portholes as windows. Ship timber was another recurring element. He obtained this mainly through Salembien, a private individual who acted as an intermediary between Belgian and Dutch shipbreakers and interested buyers. Ship timber planks reappeared as flooring, wall and ceiling cladding, or in furniture or staircases.

At the same time, Raymaekers worked with river stones known as *maaskeien* or 'Meuse/Maas boulders'. Unearthed during sand and gravel extraction in the riverbed of the Middle Meuse/Maas in Limburg, the boulders were economically worthless and were simply piled up as waste next to the quarries. Raymaekers used them mainly for garden and other external walls. But in the Nijsen House, they served as the anchor point for the entire design: the fireplace and chimney were integrated into a two-storey sculpture that also served as a central structural element (fig. 3).

Raymaekers' modus operandi in the first decade of his career was that of a hunter-gatherer. He was forever driving around the country in search of interesting materials. A typical product of these intensive hunting expeditions were the 23 Lockheed T-33 fighter jet turrets used in the Kelchtermans House (fig. 1). Raymaekers found them in a scrapyard in West Flanders, on the other side of the country. A once-in-a-lifetime opportunity, as the Belgian army had only 39 of these jet fighters, which ceased production in 1959.[14] Raymaekers' other finds were in keeping with Belgium's economic development in the 1960s. The residual waste flow of *maaskeien* was a consequence of the increasing sand and gravel extraction along the Maas, linked to the breakthrough of concrete as a versatile building material with applications in residential and infrastructure construction.[15] The scrap metal at Jef De Smedt was available because of a phenomenon that was already emerging in the 1960s and a contributor to the crisis of the 1970s. An overproduction of steel and metal products in Europe in response to rising global competition, resulted in fluctuating prices.[16] Since De Smedt's largest customer was the steel and metal processing industry, he was forced to speculate more and more during the 1960s

3. The Nijsen House. The central, double-height maaskeien sculpture has just been completed. The rest of the house will be built around it (Photo Familie Nijsen)

4. The recovered arches, window frames and porticos in the Moffroid House came from the Anglican Church in Spa (Marcel Raymaekers archive)

by hoarding scrap on his site until he could get a good price for it. These industrial waste streams were an important early source of materials for Raymaekers.

THE DEMOLITION SITES OF MODERNIZATION

Reclaimed building materials were also already present in his projects in the 1960s. Interior and exterior facades were constructed from reclaimed brick, sometimes with white stone accents suggestive of historical brick and sandstone architecture. Floors and roofs were supported by reclaimed oak joists. Roofs were covered with reclaimed tiles. These materials were so widely available at the time that Raymaekers did not need to waste time sourcing them himself. Instead he tasked his clients to negotiate their purchase and transport directly with local demolition contractors. In addition to their pre-war charm, they also had the advantage of often being cheaper than their new equivalents.[17]

Raymaekers himself provided his clients with more unusual elements. Reclaimed oak beams inspired bold design gestures with their enormous dimensions. The floating living space of the Nijsen House was supported by just two beams used as columns. In the Kelchtermans House, they formed the ribs of a pyramid-shaped house. The structure of Queen of the South was formed around a pair of beams used as columns, which were visible over two floors. Other types of wooden beams, such as pitch pine, were also used, but were more commonly processed into planks for staircases, for example. At the end of the 1960s, Raymaekers also started using elements of sculpted natural stone. A first batch of porticos, windows and arches came entirely from the neo-Gothic Anglican church in Spa and were used in QotS and the Moffroid House (figs. 4, 5), among others. A subsequent series of elements came from a mansion on Avenue Brugmann in Brussels, from which Raymaekers used the bluestone plinth, window frames and two bay windows in various projects.

A look at economic trends in the 1960s quickly reveals the origins of this diverse range of materials. Investments in buildings and infrastructure carried out in the name of modernization meant that obsolete buildings were rapidly demolished and replaced.[18] The area of land used for agriculture shrank, while the sec-

5. The Anglican Church in Spa, completed in 1877, demolished in 1966 (Ghent University Library)

tor [as a whole] mechanized and scaled up.[19] Several builders mentioned small, local farms as the source of their bricks and roof tiles.[20] The large oak beams came from ancestral farmsteads. Pitch pine beams came from obsolete production infrastructure, such as factories in the port of Antwerp,[21] or the drying sheds in the Boom region, which were demolished following the collapse of the ceramics industry.[22] The oak beams for QotS came from Fort 1 in Antwerp, which had to make way for the straightening of the Turnhoutsebaan and the construction of the Wijnegem shopping centre as part of major infrastructure works in 1959.[23] Raymaekers also obtained materials from inner-city modernization operations, as evidenced by the mansion on Avenue Brugmann in Brussels.

During the 1960s, Raymaekers began to develop a system. Unlike with ship steel and *maaskeien*, it was not always necessary for him to track down potential sources (in this case demolition sites) himself and be present there. Various intermediaries organized a structured supply of materials by stockpiling them or contacting Raymaekers directly from their yards. In addition to the aforementioned Salembien, Raymaekers was a regular customer of a Yugoslav demolition contractor (name unknown); Scheerlinck, a demolition contractor based in Roosdaal with a large and diverse stock of materials; Spinois, a Brussels-based salvage wholesaler who stored materials dismantled by various Brussels demolition contractors in his Molenbeek yard; and a string of small antique dealers in the Sablon (the Brussels antique district).

In the first decade of his career, Raymaekers drew on three different material flows. *maaskeien* and ship steel were available thanks to industrial extraction and production processes. In addition, the demolition of buildings led to the availability of materials such as bricks, roof tiles, cobblestones and so on, which were still regularly recovered at the time. These materials were traditional and standardized, reclaimed and processed in bulk, and newly produced equivalents were also available. On the other hand, many high-quality, unique building components became available, which were finely crafted and ornamented, such as natural stone bay windows, or for which no new equivalent existed, such as large oak beams.

QUEEN OF THE SOUTH: FOCUS ON A SINGLE MATERIAL STREAM

Raymaekers founded Queen of the South in 1972, one year before the start of the oil crisis that marked the end of the *Trente Glorieuses.*[24] As a result, the socio-economic playing field in which Raymaekers operated started to change. Sky-high inflation led to rising labour costs which, combined with increasing competition from low-wage countries, caused industrial employment in Belgium to fall by a fifth between 1974 and 1979. This marked the definitive transition from an industrial to a post-industrial economy.[25] One of the casualties was the shipbreaking industry. All but one Belgian shipbreaking company had to close its doors in the 1970s.[26] De Smedt ceased trading in 1975,[27] and Salembien's activity too came to a standstill. Ship materials disappeared from Raymaekers' oeuvre. The last time he used ship materials was in QotS itself. The company took its name from the ship whose starboard paddle box fascia adorns the facade (fig. 6).

When building his headquarters, (local) architectural antiques definitely prevailed. In the interior, Raymaekers integrated porticos and arches from the Anglican church in Spa, lion statues from a castle estate in Bomal and the Ottignies train station, a bay window from the mansion on Avenue Brugmann, along with other blue stone window surrounds.[28] The fence around the Queen contained columns from a bridge over the Elbe. The interior featured wooden panelling from church interiors, an enormous chandelier from a Brussels hotel, marble floors, and so on.[29] (fig. 7). The building was clearly conceived as a calling card and persuasion machine for the power of his

6. Facade of Queen of the South with top left the starboard paddle box fascia from the ship of the same name (Photo Anja Hellebaut and Anthony De Meyere)

7. Interior of the Queen of the South restaurant (Photo Anja Hellebaut and Anthony De Meyere)

architecture, complete with restaurant and starred chefs. From then on, he focused exclusively on buying and selling architectural antiques, which were supplied to him through his network of demolition contractors and wholesalers. The combination of their exclusivity (which Raymaekers emphasized) and their ready availability made it possible to achieve generous margins.

QotS was open every day but Tuesday, when Raymaekers visited the stocks and demolition sites of his aforementioned contacts. Hunting and gathering non-architectural waste was no longer part of his business model.

A WELL-OILED MACHINE, NEW SOURCES OF MATERIAL

Once established, Queen of the South quickly made a name for itself. Raymaekers advertised extensively in domestic and foreign magazines and was well known in the demolition world because, according to himself, he always offered the highest price for architectural antiques.[30] An important new contact in the early years of QotS was the Liège-based demolition contractor Leunen, which quickly became Raymaekers' most important source of supply. It was quite a cosy setup as Leunen dined weekly at the QotS together with the relevant Liège councillors. The modernist demolition and modernization frenzy of the 1960s continued longer in Liège than elsewhere. In response to the crisis of 1973, the socialist city council decided to invest even more in public works to alleviate the effects of the economic depression. For example, demolition around the central Place Saint-Lambert started in 1975, while major infrastructure works continued throughout the 1970s.[31] Liège buildings demolished in the 1970s and 1980s, elements of which ended up at QotS, included a castle on Boulevard de la Sauvenière, the Saint-Léonard Prison, several smaller churches, and the Church of St. François de Sales.[32]

At the same time, Raymaekers' supply from Brussels came to a partial standstill After Spinois' death in 1975, his successors were unable to maintain his wholesale salvage business on the same scale. A new source of supply for Raymaekers in the 1970s were other dealers specializing in architectural antiques who had their own network of suppliers. Two important contacts were Vanhaelemeesch and Antiek Delaere, family businesses located in West Flanders.[33] Through the latter, for example, he was able to acquire elements from Gustave Eiffel's Swiss summer house, which was demolished in 1978.[34] Raymaekers integrated the staircase and balustrade into House D. (figs. 8 & 9).

◄ 8. The balustrade and staircase from House D. came from Gustave Eiffel's villa in Switzerland (Photo Anja Hellebaut and Anthony De Meyere)

▲ 9. Interior of Villa Claire, Gustave Eiffel's summer house in Switzerland, demolished 1978 (Musée d'Orsay, RMN-Grand Palais/Alexis Brandt)

10. Raymaekers' apartment on the first floor of Queen of the South (Photo Anja Hellebaut and Anthony De Meyere)

Raymaekers' intense focus on architectural antiques in the 1970s and 1980s led to an architecture that, for all its exuberance, became more homogeneous. Facades consisted of brickwork with bluestone or sandstone porticos, window surrounds, and corbels. The interiors featured marble floors, natural stone mantelpieces and columns, wooden panelling or natural stone bas-reliefs, wooden or marble balustrades, wooden or cast iron (spiral) staircases, oak doors and stained glass domes. Interior walls were plastered, complemented with plaster mouldings and antique or plaster replicas of statues. This range of materials is best illustrated by the interior of his own apartment, which he built on top of QotS in 1979 (fig. 10).

In addition to the antique building materials purchased from Raymaekers, reclaimed bricks and roof tiles continued to appear in many projects as facade and roof materials. Clients were still responsible for purchasing these themselves. Second-hand bricks for load-bearing walls were replaced by new ceramic

masonry units, while experimental support structures made from old oak beams disappeared. One observation we make in the book is that Raymaekers' architecture was made possible not only by his suppliers but also by the many skilled contractors trained in the pre-war Limburg tradition. These individuals, who were active on his construction sites in the early years, had no problem with verbal communication, flexible thinking and visually assessing the qualities of materials. But their way of working began to come under pressure due to increased regulation and mechanization and rising labour costs in the post-war construction sector.[35]

FRENCH CASTLES, NEGLECTED HERITAGE AND WEALTHY CLIENTS

In 1980, Raymaekers already foresaw a decline in the supply of high-quality architectural antiques. He was quoted in an American newspaper as saying: 'This is a time of harvesting. These are the fat years that will have to carry me through the lean ones that are coming.'[36] The supply of materials from Scheerlinck and Leunen began to dwindle. Around 1980, Raymaekers got to know demolition contractor Vander Elst. Founded in 1966, the company had largely shifted its focus to France in the 1970s.[37] There, Vander Elst was interested in one type of property: the chateaux of the impoverished bourgeoisie and nobility who could no longer afford the maintenance costs or wanted to sell the land. A 1979 article in *Le Monde* described how Vander Elst was dismantling a 19th-century castle in Anjou and how so many other similar French castles unfortunate enough to lack heritage protection were suffering the same fate.[38] The French 'castle surplus' became an important source for Raymaekers.[39] A similar dynamic of impoverished castle owners was also at play in Belgium. A 1980 BRT television report showed Raymaekers, probably together with Vander Elst, at work on a demolition site in Remouchamps in Wallonia.[40] Several builders have also mentioned that their marble and parquet floors, doors, stairs, balustrades, panelling and even an entire tower came from these sources.

The decline in available architectural antiques was due to a combination of factors. Hourly wages continued to rise during the crisis of the 1970s and into the 1980s, outpacing the wage index.[41] The demolition sector became mechanized.[42] Labour-intensive recovery became more expensive. Raymaekers had to pay more for his elements, which came from an increasingly limited supply. In addition, a functioning heritage protection system finally got off the ground in Belgium.[43] Two source buildings from the 1980s were the home of Art Nouveau architect Jos Bascourt in Antwerp from 1904, and the Saint-François de Sales church by Joris Helleputte in Liège from 1889. The Bascourt house was acquired by the Sint-Vincentius hospital in Antwerp in 1975. After ten years of neglect, it was demolished in 1986 to make way for the expansion of their parking lot.[44] The Saint-François de Sales church was damaged in the 1983 Liège earthquake and was demolished in 1988 due to the risk of collapse. In both cases, the Koninklijke Commissie voor Monumenten en Landschappen (Royal Commission for Monuments and Landscapes) considered protecting them but decided against it owing to the high renovation costs.[45] As

11. The ribs of the dome above the Alders swimming pool came from the Saint-François de Sales church (Photo Anja Hellebaut and Anthony De Meyere)

12. The Saint-François de Sales church in Liège designed by architect Joris Helleputte, completed in 1894, demolished in 1988 (CC BY 4.0 KIK-IRPA, Brussels, negative B178258)

these projects demonstrate, the demolition of valuable pre-war buildings still took place, but not as recklessly as in previous decades. In both cases, budgetary force majeure was invoked – whether or not initiated by the owners themselves. Elements from the Bascourt facade were rearranged by Raymaekers in a new facade for the Valentijn Flower Shop. The steel columns and trusses and the natural stone columns and arches were integrated by Raymaekers in various projects, the standout being the roof of the Alders swimming pool (fig. 11,12).

Raymaekers managed to maintain his stock levels by finding new supply lines. However, he did start looking for increasingly wealthy customers. In the 1990s, 80 per cent of the items went to wealthy buyers abroad, mainly in Germany and the Netherlands.[46] Raymaekers never designed a new construction project outside Belgium but instead developed a new revenue model by sending construction kits full of architectural antiques to hotels, restaurants and corporate lobbies. In Belgium, he also managed to appeal to the nouveaux riches on several occasions.[47] For example, the Mols House was built for the famous road construction contractor family in 2000. The Peeters House, for a family of antique dealers, was Raymaekers' largest construction project. Elements from several French castles, rare Balegem natural stone, a natural stone staircase and balustrades from a Parisian mansion and stained glass windows were combined in the facade (fig. 13). In the interior, he used dozens of types of marble floors and columns, a staircase, chandeliers, decorative fireplaces, doors, an entirely marble bathroom and a solid cast-iron portico that required its own foundation. The construction process took all of ten years, from 2000 to 2010.

However, Raymaekers never closed the door on middle-class clients. For less affluent clients, he encouraged self-building and a long construction period in order to reduce and spread the costs. The construction of the Boncher House ran from 1978 to 1984, that of the Philippaerts House from 1986 to 1995, and that of the G&B House, which started in 2013, is still ongoing. The Boncher and Philippaerts families also reclaimed materials themselves from an obsolete slaughterhouse in Tienen (fig. 14) and a dilapidated barn in Kinrooi. In both cases, they were interested in the roof tiles and bricks, materials that had been very cheap to find at demolition sites in previous decades, but which became scarcer and more expensive from the 1980s onwards.

During the 1990s, Raymaekers' last three major materials suppliers – Scheerlinck, Leunen and Vander

13. Facade of the Peeters House. Balegem natural stone combined with fragments from dismantled castles (Marcel Raymaekers archive)

14. Dismantling of the former slaughterhouse in Tienen by the Boncher family to reclaim bricks and roof tiles (Photo Familie Boncher)

Elst – ceased their activities. Vander Elst and Leunen were taken over, but the new managers were unable to provide Raymaekers with the same flow of materials. In order to continue finding materials, Raymaekers expanded the Queen's hunting grounds even further to Italy, Russia and even India. From the stocks of demolition contractors he visited, he shipped the most interesting elements to Genk. But ensuring a stable supply of materials ultimately proved too difficult and too expensive, as did selling his materials. Customers drifted away after 2000.[48] Although the income from a few projects, such as the Peeters House, kept QotS going for a while after the year 2000,[49] a dwindling clientele eventually forced Raymaekers' company into bankruptcy in 2014.

CONCLUSION: DYNAMIC FLOW MANAGEMENT

A chronological overview of the components Raymaekers worked with shows that his company and architectural practice were deeply dependent on various chance factors. In the first phase of Raymaekers' career, from 1962 to 1972, his projects directly mirrored material flows or the unique lots that he encountered as a hunter-gatherer. His practice in those years was entirely supply-driven. It was up to Raymaekers to convince his clients of the architectural added value of the elements he knew were available at a given moment. The existence of a network of demolition contractors and wholesalers in building materials, which he systematically managed to work his way into, prompted him to focus entirely on architectural antiques from the moment Queen of the South was founded. Raymaekers consolidated his role as a designer-salesman and left the actual search for and reclamation of materials to this network.

It is striking that his practice remained highly dependent on the individual actors in that network, and that the disappearance of, for example, Salembien and Spinois in the 1970s had an appreciable impact on Raymaekers' range of materials. Interestingly, all the players in this system operated within a limited territory (Spinois in Brussels, Leunen in Liège) and/or specialized in niche sources such as chateaux (Vander Elst). This made Raymaekers' reuse ecosystem[50] radically different in nature from industrial supply chains, which pursued economic optimization through scalability based on the extraction of natural resources, and cover an almost unlimited territory.

The Raymaekers case clearly shows that a circular construction economy is bound to function differently from its extractivist equivalent. It depends on locally embedded recovery practices, reverse supply chains (from demolition site to storage), centralization by intermediaries and a second commodification cycle with its own unique logic.

Throughout the 1970s, the network of demolition contractors and wholesalers proved to be sufficiently large and stable for Raymaekers to easily absorb disruptions, but the fact that, from the 1980s onwards, materials increasingly had to be sourced from France, and after 2000 from all over the world, is indicative of an evolution that his company underwent. Owing to the architecture of Queen of the South and the successful marketing of his company as a niche supplier of architectural antiques, Raymaekers' practice became increasingly demand-driven. He became entangled in the commodification logic that he himself had set up. When, from the 1980s onwards, supply struggled to keep up with demand, Raymaekers had no option but to cast his net wider. At the same time, higher hourly wages and the growing gap between the price of new and reclaimed materials meant that Raymaekers had to increasingly play the exclusivity card in order to appeal to wealthy customers. Paradoxically, the relative scarcity of architectural antiques and the increasingly difficult socio-economic context gave rise to the Peeters House, the most extravagant project in Raymaekers' oeuvre.

When demand also began to decline after 2000, this heralded the end of Queen of the South. Its business model was entirely linked to a specific phase in the modernization and urbanization process that had been curtailed by heritage protection, cultural shifts and the decline of the ideology of progress: that of the unbridled demolition and replacement of pre-war buildings. Raymaekers' case thus shows that a sustainable calibration of the connection between supply and demand in second-hand materials will (of necessity) always be dynamic.

NOTES

1 K. Somer and R. Stenvert (eds.), *Bouwmaterialen 1940 – 1990:* Rotterdam 2024.

2 K. Moe, *Unless: The Seagram Building Construction Ecology,* New York 2020. J. Hutton, *Reciprocal Landscapes: Stories in Material Movement,* New York 2020.

3 M. Ghyoot et al., *Déconstruction et réemploi: comment faire circuler les éléments de construction,* Lausanne 2018.

4 A. Vande Capelle and M. Garcia Cortes, 'Urban Mine Inc.', in: F. Heisel and D. Hebel (eds.), *Urban Mining und kreislaufgerechtes Bauen: Die Stadt als Rohstofflager,* Stuttgart 2021, 79–89.

5 Post-war salvage architects are largely overlooked in Belgian architectural historiography. A few cases, such as Frank Delaere, came to light during Rotor's Opalis project, which mapped the contemporary network of reuse traders (see opalis.eu). Another example is Raymond Rombouts, whose work has been documented in: W. Pauwels, *Hommage Raymond Rombouts,* Lausanne 2003; and in a recent student thesis: F. De Meester, *De Belgische naoorlogse hergebruiksector: De samenwerking Rik Storms - Raymond Rombouts,* Ghent 2025.

6 The research and publication project was made possible with the support of a project grant from the Department of Culture, Youth & Media of the Flemish Government, and the Special Research Fund of Ghent University, Starting Grant from Lionel Devlieger as associate professor. Two student theses were instrumental in its launch: P. Matthijnssens, *Mijn Bunker, mijn bunker, mijn burcht, mijn bordeel: Onderzoek naar een genuanceerde lezing van de praktijk van Marcel Raymaekers,* Ghent 2021; and: R. Van der Mynsbrugge, *Een catalogus van fragmenten: Het gebruik van historische bouwrelicten in het architecturale oeuvre van Marcel Raymaekers*, Ghent 2023.

7 The newspaper articles appeared in the popular press between 1973 and 2006. The collected archival material of photos, plans and articles has been scanned and archived by the Flemish Architecture Institute (VAi) and can be consulted on request.

8 A. Vande Capelle et al., *Ad hoc baroque: Marcel Raymaekers' Salvage Architecture in Postwar Belgium,* Brussels 2023.

9 Interview with M. Raymaekers by A. Vande Capelle and S. Colon, Genk, March 17, 2022.

10 Raymaekers repeatedly expressed his disapproval of drawing boards and the associated design methodology to journalists. He is quoted as saying: 'To me, a drawing board is a torture device.' in: 'Ik ben kleuter gebleven, spelend met mijn blokkendoos', *Week/uit:* weekly supplement to the daily newspaper *Cobouw,* April 24, 1981. Translation by the authors.

11 See, for example: 'But a one-sided geometric design language leads to dead architecture, to inhumanity. Characteristic of the post-war period is the constant concern for functionality and mechanisation. This has inevitably led to the "impoverishment" of architecture. The use of old materials and fragments (yes, even neo-styles) compensates for this disadvantage in my opinion. That is why I work with it, yes, I live with it.' In: 'Wohnen wie Ludwig XIV', *Top of the tops,* n.d. Translation by the authors.

12 Regarding the interaction between aesthetics and industrial production in the Belgian post-war construction world, see: E. De Vos, *Hoe zouden we graag wonen? Woonvertogen in Vlaanderen tijdens de jaren zestig en zeventig.* Leuven/Louvain 2012.

13 Louis De Smedt founded the company in 1925, but it was not until his son Jef De Smedt took over that important ships were dismantled. See: C. Vander Straeten, Foto van de Maand: September 2017 (Scheepssloperij De Smedt)' at: www.heemkundezb.be/index.php/publicaties/37-portretjes/193-foto-van-de-maand-september-2017-scheepssloperij-de-smedt (accessed June 11, 2025).

14 'Lockheed T-33 T-Bird' at: aviationsmilitaires.net/v3/kb/aircraft/show/1307/lockheed-t-33-t-bird (accessed June 11, 2025).

15 S. Van de Voorde, *Bouwen in beton in België (1890-1975): Samenspel van kennis, experiment en innovatie,* Ghent 2011.

16 'Memorandum on the general objectives of the Community's iron and steel industry for the years 1975 to 1980', *Official Journal of the European Communities,* 14 (1971) C 96. And: R. Vandeputte, *Economische Geschiedenis van België 1944-1984,* Tielt 1985.

17 Interview with M. Raymaekers by A. Vande Capelle and S. Colon, Genk, September 22, 2022.

18 Vandeputte 1985 (note 16).

19 M. De Keyzer, T. Soens, and C. Verbruggen (eds.), *Mens en natuur. Een geschiedenis,* Ghent 2024. And:

Vandeputte 1985 (note 16).
20 For example, general practitioner M. Kelchtermans collected roof tiles from patients whose farms were demolished for land parcelling or modernization. Interview with M. Kelchtermans by A. Vande Capelle and S. Colon, Heusden, 29 March 2022.
21 Interview with H. Nijsen by A. Vande Capelle and S. Colon, Houthalen-Helchteren, April 26, 2022.
22 Interview with M. Raymaekers by A. Vande Capelle and S. Colon, Genk, May 18, 2022.
23 Raymaekers found the beams after they had been stored for more than ten years at the demolition contractor's site and used them for the load-bearing structure of the Queen of the South. Van der Mynsbrugge 2023 (note 6), 27.
24 The period of unprecedented rapid economic growth that began in 1946 and ended with the oil crisis. See: J. Fourastié, *Les trente glorieuses: ou la révolution invisible de 1946 à 1975,* Paris 1979.
25 S. Kristof and E. Buyst. *Het gestolde land: Een economische geschiedenis van België (The Solidified Land: An Economic History of Belgium),* Kalmthout 2016.
26 Alfred Nijkerk, 'Shipbreaking Thrives Again in Belgium', *Recycling International,* (2007) 7, 36-37.
27 Vander Straeten 2017 (note 13).
28 Van der Mynsbrugge 2023 (note 6), 206.
29 Raymaekers 2022 (note 22)
30 Raymaekers 2022 (note 22).
31 Architectural historians have pointed to the indelible and unfortunate mark that Jean Lejeune, historian, university professor, alderman for public works, and undaunted modernist, left on the urban fabric of Liège. The exceptional length of his term as alderman (1959-1976) partly explains why the demolition mentality lingered longer in Liège than elsewhere. See, among others: L. Gardier, *La rénovation urbaine à Liège sous l'échevinat de Jean Lejeune 1959-1976 : Le cas du quartier Hors-Château – Féronstrée,* Liège 2018.
32 Raymaekers 2022 (note 22).
33 Raymaekers 2022 (note 22). See also: interview with J. Vanhaelemeesch by A. Vande Capelle, Oostkamp, March 14, 2025; interview with F. Delaere by A. Vande Capelle, Kuurne, May 11, 2025. The supply streams of both traders are the subject of further research.
34 Delaere 2025 (note 33).
35 Vande Capelle et al., 2023 (note 8), Chapter 4. This observation is based entirely on information obtained through oral history. The trend towards specialization and professionalization is described in: J. Dobbels, *Building a profession: A history of general contractors in Belgium (1870-1970),* Brussels 2022.
36 R. Wielaard, 'Architect Recycles Castle Treasures', *The Arizona Republic,* 1980.
37 F. André, 'Châteaux à vendre', *Le Monde,* August 11, 1979.
38 André 1979 (note 37).
39 Raymaekers 2022 (note 22).
40 'Kastelen voor morgen', *Terloops,* BRT, July 12, 1980.
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42 On the history of the mechanization of the demolition sector in the American context, but extrapolatable to Europe, see: F. Ammon, *Bulldozer: Demolition and Clearance of the Postwar Landscape,* New Haven, London 2016.
43 H. Stynen, 'Paradise Lost? De verloren eer van de monumentenzorg in België' in: E. Buyst (ed.), *De beschikbare ruimte: reflecties over bouwen,* Tielt 1990, 95-112.
44 'Bouwmeesterswoning Joseph Bascourt tegen de vlakte', *Gazet van Antwerpen,* May 27, 1986.
45 Regarding Bascourt, see 'Bouwmeesterswoning Joseph Bascourt tegen de vlakte' 1986 (note 44). Regarding Helleputte, see the letter: 'Demande d'autorisation concernant les mesures conservatoires de protection des orgues de l'Eglise Saint-François de Sales à Liège suite aux dommages causés par le séisme du 8 novembre 1983.' by R. Guiaux and J. Debatty, October 25, 1985. Archives of the Commission royale des Monuments, Sites et Fouilles (CRMSF).
46 T. Kay, 'An Interview without Marcel Raymaekers', *Salvo News,* March *4,* 1993.
47 Vande Capelle e.a. 2023 (note 8). In the book, we observe how Raymaekers focuses specifically on families who owed their climb up the social ladder to the expansion of the post-war welfare state. His approach resonates most with families with 'new money', looking for an unprecedented architectural style to highlight their new status.
48 Interview with F. Lemmens by A. Vande Capelle and S. Colon, Brussels, December 10, 2022.
49 Interview with E. Raymaekers by A. Vande Capelle and S. Colon, Genk, January 17, 2023.
50 By analogy with the concept of 'industrial ecosystem'. See: T. Burström et al. 'Industrial Ecosystems: A Systematic Review, Framework and Research Agenda', *Technological Forecasting and Social Change* 208 (2024): 123656.

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TEMPORARILY IN STOCK

THE OEUVRE OF REUSE ARCHITECT MARCEL RAYMAEKERS AS A REFLECTION OF DEMOLITION AND DISPOSAL PRACTICES IN POST-WAR BELGIUM

ARNE VANDE CAPELLE EN LIONEL DEVLIEGER

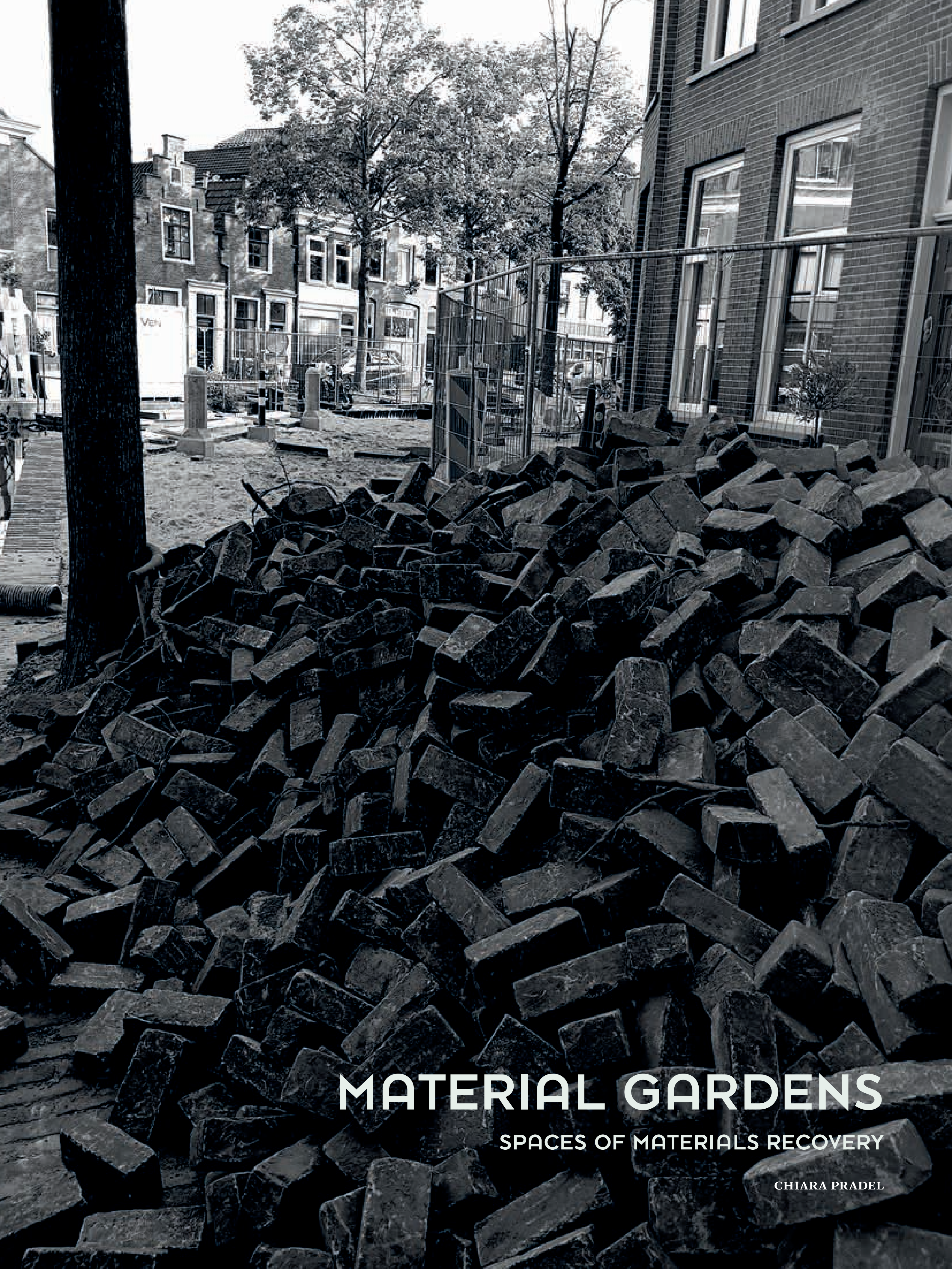
In order to gain insight into the specifics of circular architecture as a necessary alternative to contemporary extractive building practices, this article examines the work of Marcel Raymaekers. Between 1962 and 2014, the Belgian architect and trader developed a practice in the reuse of building materials. In the post-war context, in which the construction sector began to rely increasingly on cheap, standardised, industrially produced materials, Raymaekers made a radical choice for alternative elements. His aversion to mass-produced elements stemmed from aesthetic preferences. A preference for sensory experiences as a guideline for living, and a great affinity with Assemblage Art, in which a design process starts from existing materials. His way of working was thus characterised by a totally different notion of 'availability' than is common today.

Raymaekers started out as a hunter-gatherer, criss-crossing the country in search of material graveyards and demolition sites. For the first ten years, he worked extensively with materials from industrial waste streams, such as mesh stones (a residual product of sand and gravel extraction) and ship steel (recovered from obsolete ships for the steel processing industry). The immense demolition frenzy of 'Les Trente Glorieuses' also ensured the availability of materials such as bricks and roof tiles, which were recovered and processed in bulk. In addition, many high-quality, unique building components were released, which were finely crafted and ornamented and for which there was no longer any new equivalent on the materials market.

In 1972, he founded Queen of the South (QotS), his materials stock and headquarters in Genk. From then on, Raymaekers became a permanent trader-designer. His established network of demolition contractors and wholesalers was crucial in this regard. During his career, he developed close partnerships with players such as reuse wholesaler Spinois and demolition contractors Scheerlinck, Leunen and Vander Elst, each active in their own geographical area and building niche. Raymaekers' architecture became increasingly baroque, but also more homogeneous due to his focus on architectural antiques. QotS was set up as a veritable machine for convincing people of the power of these elements.

From the 1980s onwards, the supply of building antiques declined due to the mechanisation of the demolition sector, rising labour costs and the increasing clout of heritage protection. His supply chains came to a standstill. Raymaekers began importing more materials from abroad. His practice became increasingly exclusive, targeting wealthy clients, although he also continued to build for middle-class clients through self-build and long-term construction projects. Eventually, Raymaekers had to go as far as India to find building materials. After 2000, the influx of materials became too expensive and too difficult, and clients began to stay away. In 2014, QotS went bankrupt.

Raymaekers' work shows how circular architecture depends on locally anchored supply networks, which are difficult to scale up due to the nature of the urban mine, where a wide variety of materials are released unpredictably, scattered and in small quantities. His practice was also strongly linked to a specific phase in the urbanisation and modernisation process: the period of unbridled demolition of pre-war buildings. Raymaekers' identity as a designer-trader was so intertwined with this period that his business inevitably ceased to exist with the demise of the ideology of progress that had given rise to it. This case study shows that the sustainable matching of supply and demand in second-hand materials will always have to be dynamic.



MATERIAL GARDENS

SPACES OF MATERIALS RECOVERY

CHIARA PRADEL

◀ 1. Construction site in Delft (photo C. Pradel)

▲ 2. Spanish Pavilion at the 55th Venice Biennale, Lara Almarcegui, 2013 (Photo by J. P. Dalbéra licensed under CC BY 2.0)

Recently, Amsterdamsestraatweg in Utrecht was repeatedly punctuated by piles and pallets of bricks and tiles and mounds of excavated soil due to road resurfacing works. Such interruptions to the streetscape are not a rare occurrence in Dutch cities. When traversing the urban landscape one often encounters piles of materials stacked on the periphery of roads and building sites (fig. 1). Although these are clearly temporary structures, they nonetheless capture the attention, whether due to their autopoietic, informal character, the contrast with their surroundings, or the shift in meaning they imply.[1]

Recalling the obsessive repetition of materials portrayed in Iain Baxter's *Portfolio of Piles* (1968), contemporary piles constitute a kind of 'weak monument' to everyday construction and demolition flows (fig. 2), positioning themselves within the spectrum of what is no longer, what is still, and what is not yet architecture.[2] The stark and minimal appearance of these deposits calls into question the act of building, as well as the foundations of industrial culture, by referring to the primary units of a pre-architectural lexicon rather than to an intentional composition.[3]

On the one hand, this type of material accumulation exhibits a hybrid character, determined either by the properties of individual objects or by the object plus the human or mechanical piler's imagination or lack thereof.[4] On the other hand, when observing these piles, one is immediately prompted to question how waste resources are stored, sorted and maintained to ensure that they can become accessible again and acquire a new life.

To follow the movements of huge stacks of paving bricks and to acknowledge their host places, or 'reciprocal landscapes', implies the necessity to move beyond an abstract concept of material flows and the macro-economic mapping of produced and reused goods.[5] The focus turns towards physical sites where re-used components are kept accessible for potential reintegration into cycles of use and reuse. Situated as an intermediate step within fluctuating and transformative processes – between construction and deconstruction, between scarcity and redundancy – material deposits, along with their operational logic and configuration, are often-overlooked spaces that fundamentally embody a paradigm shift: various types of matter deriving from demolitions, renovations or surpluses on construction sites – which would otherwise be destined for waste and obsolescence – are saved to retain or regain both significance and utility. Their presence (or absence) is made visible not only physically, thanks to their storage, but also conceptually, as enduring products of human labour that challenge narratives of unconscious waste and decay and reshape (architectural) imaginaries.

Transitioning from conditions of material shortage to those of renewed availability requires specific spatial organization and enabling conditions, as well as new practices of care and interaction: piles of construction materials and architectural artefacts must necessarily claim space and appropriate positioning within urban landscapes. Networks of hubs dedicated to material recovery and repair may thus be understood as networks of 'banks': sites where the notion of availability is concretely translated into the allocation and management of (material) reserves, that remain potentially accessible while retaining their value and staying connected to the flows of supply and demand.

PUBLIC DEPOSITS AS BANKS

In the Netherlands, deposits known as *Grondstoffendepots*, or 'material banks', are sites where surpluses and shortages are managed, and where everyday construction elements and materials are eventually repaired and stockpiled. According to the Cambridge Dictionary, the verb 'to pile' refers specifically to the accumulation of a supply of something, especially during a shortage or an emergency, to keep it available for future use. One or more 'material brokers' then match the specific characteristics of the recovered materials with public works under construction and with their designers, assisting with organizing deconstruction, dismantling and reclassification.

The role of these increasingly widespread banks has become more relevant over the past decade in the Netherlands. During recent energy crises, energy supply shortages have raised both the direct and indirect production costs of essential materials such as bricks and concrete. For example, the cost (input price) of new housing building materials in the Netherlands has risen steeply over the past five years, impacting bricks and concrete in particular.[6] Across Europe construction costs have risen significantly, with most countries, especially since 2021, experiencing a double-digit increase in construction prices according to Eurostat (2024).[7] These conditions clearly favour the reuse of materials and practices of recovery and restoration.

In 2016, the Netherlands set itself the goal of achieving a fully circular economy by 2050. This ambition needs to be underpinned by a new design agenda for availability, oriented towards the rethinking and repurposing of existing resources, rather than the continued extraction and consumption of new ones. In response to this objective, within the private sector, a network of dealers in reclaimed building materials and construction fragments, supported by well-known digital platforms such as Salvo or Material Reuse Portal, has expanded and gained prominence.[8]

Research projects like Interreg FCRBE, or Assemble's and ROTOR's practice and research, serve as key references in this context.[9] In addition, a number of Dutch municipalities and provinces have produced municipal or regional strategic visions and programmes. However, these programmes tend to focus on urban governance, discussing policy analysis and management directives rather than focusing on the spatial requirements and landscape impact within the urban context.

My aim here is to expand and diversify the abstract idea of 'materials' by analysing the first step in the reuse trajectory of three different typologies, namely *bricks and tiles*, *soil* and *trees*.

Bricks and tiles are materials that often have 'standard' characteristics and widespread use. Furthermore, their reuse is more easily linked to an economic benefit. Soil reuse is an overlooked issue that has a large and complex impact on both construction and landscape. Finally, trees are an important material from the perspective of increasing urban greenery and mitigating urban heat, managing maintenance costs and increasing biodiversity.[10] In this regard, the article briefly examines three types of spaces that host these materials, comparing their characteristics and the interpretations of 'availability' they entail.

MATERIAL BANK

As part of the European-funded Preuse project, the city of Utrecht recently opened a pilot public depot.[11] In 2023, the city decided to acquire a plot of land of approximately four and a half hectares for the storage of materials salvaged from demolitions or from public

3. Material bank, view from the Amsterdam-Rijnkanaal, Utrecht (photo C. Pradel)

works, with the aim of facilitating their repair and cleaning, and making them available for subsequent projects.[12] The depot site, located in the Lage Weide district on the industrial periphery of the city, provides both covered and uncovered space for the storage of street furniture and materials salvaged from public projects, particularly road renewal works: paving bricks, stones and concrete tiles.[13] The municipality has currently singled out six standard types of paving material (commonly used materials are easier to reuse in new city projects) along with several less frequently occurring types. Overall, the materials are organized into around twenty different categories. For example, piles of paving bricks from the aforementioned Amsterdamsestraatweg have been stored ready to be reused in future road projects. The Preuse project report notes that the city of Utrecht has seven million square metres of pavements.

Road access to the depot is flanked by a railway embankment, which isolates the strip of land close to the canal from the rest of the industrial area to the west. This embankment, along with high fences and a gate, helps limit and control access. Looking east from the bank of the Amsterdam-Rijnkanaal – which offers an important dock for materials transported by barge and is bordered by orderly rows of regular freestanding and semi-detached houses with well-maintained gardens – the storage space is clearly visible (fig. 3). It is precisely this side that effectively reveals the actual connection with the urban realm, making for a dynamic horizon that is close to the water as well as to the residential area. Artificial mounds of materials give form to a kind of 'jumbled museum' of stones, bricks, tiles and small-sized furniture, choreographing a landscape of 'heaps of rubble tossed down in confusion'.[14]

4. Material bank and changing landscape, Utrecht (photo C. Pradel)

Unlike a bank institution, where accumulation of funds reflects the health of an account, a certain ambivalence is evident in depot sites: surface deposits convey the idea of a material reservoir for the city, but are also suggestive of a misalignment between the supply and demand for reusable materials, as well as overproduction and obsolescence. Conversely, an empty space might signify an active, rapid alignment of material exchange between deconstruction and construction projects, an effective urban metabolic dynamic and high transformity of architectural objects and processes.[15] The perception of space lends itself to another dichotomy: it is difficult to disassociate piles of extraction-based materials from the depletion, dispossession, mining and energy consumption they entail. Yet, in this instance, accumulation isn't strictly about profit, since the materials aren't sold externally, and are instead managed within the city. In fact, these depots represent a radically different distribution of materials, one that is closer to a cooperative bank. Moreover, one might almost see these material landscapes as a 'naturalization' of the view, as if the mine dump had always been there, undergoing continual modulations.[16] 'Materials shape-shift as they move in and out of human controlled systems, challenging us to think of them as both formed through human action and also as having lives of their own' (fig. 4).[17]

The interstitial depot in Utrecht starts to reveal a spatial potential, somewhere between the ordinary and the extraordinary, that falls outside the scope of standard planning and diverges from urban design principles.[18] This becomes even more apparent when considering soil deposits. If one extends one's gaze beyond the Utrecht Public Material Bank, immediately behind the embankment an even more variable horizon opens up. Delineated by mounds of earth in various colours is another materials bank, in this case one that specializes in the recovery of polluted soil (fig. 5).

SOIL BANK

In the Netherlands, a *grondbank* is a physical site and an organization that regulates the logistics of soil flows released during excavation works. It receives and classifies parcels of soil in line with environmental regulations such as those laid down in the Soil Quality Decree (Besluit bodemkwaliteit). The site can be regarded as a temporal archive where diverse typologies of soil (from costly, different-sized gravels, to more common and less expensive sand) are collected and stored. In these banks, partitions made of recycled concrete blocks are frequently used to temporarily organize piles of earth, thereby creating distinct 'materials rooms'. At the perimeter of the deposit area, 'monumental walls' made of lower-quality and industrial soils mixed with cement are constructed.[19] They serve as both visual and noise barriers, especially on sites adjacent to residential areas or infrastructure (figs. 6, 7). These deposits are connected by land and water to a large network that extends well beyond national boundaries. As such, they are tied to a complex constellation of landscapes that are continuously being excavated (construction sites and quarries, for example) and filled (renaturalized areas, dams or agricultural land), involving substantial movements, transactions and flows, backflows and reflows of materials.

Unlike the publicly managed Utrecht materials bank, many well-known *grondbanks* are private enterprises. A medium-sized private *grondbank* company such as Grondbank GMG, which currently operates some 25 bank sites, provides services for the collection, temporary storage and reuse of soil.[20] It is linked to several West-European extraction landscapes and construction sites that generate excavated soil and recyclable materials. Because the demand for natural raw materials surpasses domestic availability, recycled aggregates represent a huge and expanding market opportunity, which currently represents roughly 20-35 per cent of newly extracted raw materials.[21] This huge movement of soil is largely overlooked. For example, a recent study of the demolition process in Antwerp, conducted by the Testaccio Collective of TU Delft University, showed how approximately ten thousand tons of soil produced by the excavations for the demolition and reconstruction of a school, were directly transported by ship to two different Grondbank sites.[22]

5. Soil bank in Utrecht (photo C. Pradel)

6 AND 7.
Construction of an earth wall along the perimeter of a soil bank in Utrecht (photo C. Pradel)

8 AND 9.
Kesselse Waard, renaturalization and deposition of soil, Maren-Kessel (photo C. Pradel)

In particular, more than half of this material was used to fill a former clay quarry on the river Maas, as part of the renaturalization of the river basin and its shorelines, as part of a Natuurmonumenten strategic project (figs. 8, 9). Supported by renaturalization plans, these regular soil disposal activities aim to offset environmental impacts. However, despite the compensatory intent, the global scale of soil and sand flows presents significant challenges with respect to reliable traceability, without which the reuse and deposition of materials in natural environments may well introduce ecological risks, including potential inaccuracies in the mapping of sand flux and sediment flows, and the flawed quality control of materials used for filling.

Because of the public interest involved, municipalities are also taking the initiative here. For example, since 2008 the municipality of Apeldoorn has established a series of public soil banks with the express aim of reducing expensive movements of soils, controlling their quality, facilitating their reuse in a circular economy, and more effectively managing the exchange between demand and supply. Such local soil and sand depots are 'able to operate as a node in the logistic system of the soil and sand market, where supply and demand can converge, facilitating inspection procedures and the immediate availability of this resource, which is not easily worn out'.[23]

The first depot, established concurrently with a housing block development in the Zuidbroek district, occupied about 14,000 square metres, and on average handled a material flow of up to about 23,000 cubic metres a year.[24] Following the closure of this initial site, the municipal 'bank' was relocated to its current open-air site, which is also situated on the periphery of the town and is easily visible from the nearby highway, serving as a changing landmark for those approaching Apeldoorn from the north.[25] Indeed, depending on the time of year and the scarcity or abundance of soils, different cones and landforms created by earth-moving machines present a kind of geo-accelerated morphology. Heaps are perpetually changing over time, subsiding in accordance with the inherent physical and structural characteristics of each material, increasing and decreasing based on supply and demand. The presence of piles of various soil types on which vegetation can spontaneously grow, lends itself to the proliferation of an ecological mélange: these 'unintentional landscapes' are indeed 'typified by an array of so-called pioneer species, specially adapted for the colonization of new substrates, which can engender rapid and unexpected changes in the appearance of urban landscapes.'[26]

In shape and dimension of composition, it recalls the Chris Reed's Stock-Pile garden (Boston, 2011), in which different materials used in the making of urban landscapes, such as soil, sand and gravel, were stacked in an urban yard, planted with ancient ferns and allowed to progressively settle, to test their adaptability over time.[27] Similarly, the installations and projects of Landing Studio, such as Time Lapse Capture (Boston, 2011) and Piles (New York, 2016) works that explore the spatial impact and temporality of sand and road salt stockpiles, interpreting them as temporary choreographies and form-making structures within the urban environment. What makes these examples particularly interesting is that they engage with active and functioning storage and distribution sites, simultaneously soliciting the collective engagement of citizens, making the sites accessible, inviting them to acknowledge, through critical participation, the physical manifestation of the city's global material availability.

TREE BANK

The material bank managed by the city of Utrecht and the soil bank managed by the city of Apeldoorn, do not permit actual interaction with the community, nor are they freely accessible under current regulations. In contrast, another type of bank that is starting to catch on in the Netherlands involves a more proactive role on the part of non-conventional local actors. Temporary tree repositories, or Tree Hubs, are based on the active participation, at various levels, of volunteers and ordinary citizens. These kinds of storages may be conceived as 'tree banks' that facilitate the distribution of excess trees.[28] Indeed, they are in many ways similar to material banks. Instead of construction materials, however, these banks host 'surplus' plants that may have been removed (mainly from November to March), for instance, from a development site, a mound or railway embankment, a construction site, or from an urban park or forest.

These storage hubs can be located on private land, but also on farms or in semi-public community gardens, where unwanted trees can be freely stored after being carefully removed by volunteers (mainly organized by community-led organizations, such as MEERGroen or Meer Bomen Nu) to be distributed later free of charge to anyone who requests them (figs. 10). Meer Bomen Nu, in particular, provides a detailed online instruction kit for setting up a tree bank, as ideally any ordinary residual open space of ten square metres or more can be used for tree storage purpose. For example, a community garden on the northern periphery of Utrecht, which is open to the public on week days, periodically hosts a hundred small trees deposited in small heaps scattered across the five-hundred square metres of set-aside land and fallow fields. Trees (typically native species with a small diameter and from 0.5 to 2 metres high) can be temporarily stored for short periods on the open ground, or they can be dug in and later replanted elsewhere. This process of collection and re-distribution facilitates the maintenan-

10. Harvesting of trees for the tree bank (photo John van Loon, courtesy of Meer Bomen Nu)

ce of existing green public and private spaces, and also supports the processes implemented by various other nature-based solutions. The specimens are freely distributed during open days, preferably as a mix of both trees and shrubs, thereby establishing diverse planting palettes to ensure that ecological resilience is maintained.

The tree banks are not necessarily aesthetically pleasant natural landscapes. Rather, they are spaces that remain open and accessible to (episodic) care protocols, have a necessarily frugal design, and a dirty and 'unfinished' character that distinguishes them from the manicured context of the neighboring countryside. They represent a space linked to repeated gestures and unstated activities, showing 'the path to perceiving the maintenance of nature as a revolutionary practice', involving 'economy and repair in terms of materiality and attention to human and nonhuman living organism'.[29] A reconfigured system of resource exchange, based on reuse, reciprocity and circularity redefines the principles and logic of 'giving and taking', of sharing practical-poietic knowledge, and taking care of the environment, challenging the dominant 'take-make-waste' paradigm (fig. 11).

REFLECTIONS

Beyond highlighting the relevance of practices linked to material reuse and clarifying how different typologies of materials collection and storage occupy spaces and shape ever-changing landscapes, the three cases examined above can be interpreted as different articulations of spatial practices that might be termed 'designing for availability'.

Although these 'banks' are often both physically and conceptually linked to marginal zones, situated on the edges of industrial areas or located on residual lots between urban and rural contexts, they are anything but marginal. On the contrary, they are embedded within the very core of the constructive systems (processes) that shape urban and landscape transformations, providing a ground for rethinking the value of materials – whether mineral or natural – beyond the economic one, and beyond normativity and standard judgements. Spaces of availability are characterized, in particular, by:

LAYERED VALUES

In the three types of public 'banks' examined here, we see an emerging material value that is not exclusively monetary.[30] Significant ethical and ecological components often occur, together with a tacit but powerful invitation to (re)formulate a creative design approach to the resources' accessibility and readiness for reuse.[31] Designers, for example, might make experimental, or at least unpredictable, decisions based on the available materials and therefore shift the value from

11. Storage space close to the tree hub in Utrecht (photo C. Pradel)

the specific, final object to its design process. At the very least the materials may embody an historical, even geological, or emotional value connected to the place, the work, or the building from which they were recovered, and a sense of latent potentiality, which connotes available components and refers to their possible future transformations.[32]

In summary, the material banks stage the uncoupling of 'heaps' from their exclusive monetary/accumulative value and quantitative meanings, and open up broader and more stratified implications.

AVAILABILITY OF SPACE

In each of the examples discussed above the issue of availability and, conversely, scarcity, does not seem to relate exclusively to the materials themselves, but also to the space for their management.

Normally, materials are stockpiled on less valuable land for a limited time (around one to three years on average for the material banks, about three years for the soil bank, and one season for the tree bank). However, the need for additional spaces for recycling and storage is also urgent and not yet regulated. Some recent studies hypothesize the distances that would allow the optimal functioning of these storage deposits, minimizing transport and making the sorting of resources more efficient.[33] More radical reflections invite us to rethink the role of public space and to reappropriate the public realm, laying the foundations for a precise and responsive project based on a constellation of micro public depots, or micro technical places.[34] According to Hans Frei and Marc Böhlen, the authors of the 'Micro Public Places' manifesto, free and interstitial urban spaces can be rethought as areas (temporarily) dedicated to material storage, evolving collaboratively through the actions of many different actors.[35]

A NETWORKED ECOSYSTEM

Numerous areas dedicated to the storage of rocks, marble and stone flourished along the Tiber River between the first century BC and the ninth century AD. Their purpose was to collect, re-work and adapt materials before they were reused, thereby complicating the identity of the resulting constructions. In the history of ancient and medieval Rome, we encounter many such spaces, which were often open-air yards, for like the depots near the port of Ostia or the small open-air depots adjacent to the Temple of Portuno or to the Forum Pacis. They were called 'gardens of rocks' or, transposing the words, we might call them 'material gardens' (fig. 12).

This concept effectively conveys the proliferation of spaces, of varying size and scope, that together constitute a structural network for material accumulation, strategic disposal and collection of architectural frag-

12. Forum Pacis in Rome (photo C. Pradel)

ments, reuse inventories, places for both official and unofficial exchange, sites where new social behaviours can take place and 'landscapes are made public'.[36] Moreover, the notion of gardens suggests spaces that are bounded and local, and, in times of scarcity, it carries inflections of minimalism, frugality or, vice versa, availability and sustainability.[37]

As Kiel Moe explains, 'architecture is an instantiation of building that inherently involves more resources – be it of matter, energy, information, wealth, ambition, desire, or labor...the constitutive resources necessary for building puts architecture in a nontrivial position in the metabolic economy of terrestrial material and energy systems'.[38] In the approaching era when reuse becomes the dominant paradigm, 'architectural design should not merely focus on an object, but on its terrestrial basis, and develop mutually reinforcing terrestrial systems. [Architecture should] design the object and the system, the log cabin and the forest.'[39]

Material gardens thus become places for exploring how operational characteristics of materials availability can expand the conventional realm of design.

I would like to thank Sonja Dijkman-Elskamp, Leon van Elzakker, and Noortje Voulon for sharing information and data on Apeldoorn and Utrecht material banks and on the soil banks of GMG company.

NOTEN

1 'Assemblages are ad hoc groupings of diverse elements, of vibrant materials of all sorts. Assemblages are living, informal, throbbing confederations that are able to function despite the persistent presence of energies that confound them from within.' In J. Bennett, *Vibrant Matter: A Political Ecology of Things*, Durham/London 2010, 24.
2 The *Weak Monuments* research presents a collection of seemingly insignificant architectures and public spaces, whose political, social and architectural relevance is brought into relief through contrast. T. Říha, L. Linsi and R. Reema (eds.), *Weak Monument: Architecture Beyond the Plinth*, Zürich 2018.
3 S. Franceschini, N. Hirsch and S. Papapetros (eds.), *Pre-Architectures*, Leipzig 2024.
4 L.R. Lippard, *Six years: The dematerialization of the art object from 1966 to 1972*, Berkeley/London 1997.
5 J. Hutton, *Reciprocal Landscapes: Stories of Material Movements*, London and New York 2020.
6 According to Statistics Netherlands (CBS), the cost of building materials for new dwellings increased by nearly fifteen per cent in 2021 alone. The 'Material intensity database for the Dutch building stock' shows that the material intensity (which measures the quantity of materials used to produce a good) in ordinary constructions – in particular in most demolished categories of buildings such as utility buildings, offices built after the 1970s and post-war residential buildings – mostly consists of concrete and clays.

B. Sprecher et al., 'Material intensity database for the Dutch building stock: Towards Big Data in material stock analysis', *Journal of Industrial Ecology* 26 (2022) 1, 272-280.

7 ec.europa.eu/eurostat/statistics-explained/index.php?title=Construction_producer_price_and_construction_cost_indices_overview.

8 See the Opalis map on professional dealers: opalis.eu/en/dealers/map

9 See, in particular, vb.nweurope.eu/projects/project-search/fcrbe-facilitating-the-circulation-of-reclaimed-building-elements-in-northwestern-europe/.

10 See, for instance, the EU Forest Strategy and commitment to planting three billion trees by 2030: eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021DC0572.

11 The project, under the leadership of Rotor, aims to develop an effective and replicable strategy for the development of reuse centres for construction materials. Two pilot projects are in France, one is in the Netherlands, in Utrecht. See preuse.nweurope.eu/.

12 According to Noortje Voulon, strategic adviser to the municipality of Utrecht, part of the plot is currently rented to another company (interview with the author, 29 August 2025). This helps to cover the expenses, as the project required several interventions to renovate existing buildings and adapt the site to its new function.

13 Banks often emerge in response to specific projects, like the development of new residential neighbourhoods and housing, with storage sites chosen from undervalued, nearby spaces.

14 'Excavations form shapeless mounds of debris, miniature landslides of dust, mud, sand and gravel. Dump trucks spill soil into an infinity of heaps. The dipper of the giant mining power shovel is 25 feet high and digs 140 cu. yds. (250 tons) in one bite. These processes of heavy construction have a devastating kind of primordial grandeur and are in many ways more astonishing than the finished project —be it a road or a building. The actual disruption of the earth's crust is at times very compelling, and seems to confirm Heraclitus's *Fragment 124*, 'The most beautiful world is like a heap of rubble tossed down in confusion.' R. Smithson, *Earthworks*, New York 1968, 45.

15 Justus von Liebig used the term 'metabolism' to describe the exchanges of consumption and feedback that characterize biological systems. See J. von Liebig, *The Natural Laws of Husbandry*, New York 1863. Marx identified a fundamental disruption in the ecological relations between people and the material systems that support them, looking at the increasing divide between town and country. For a deeper understanding of the many implications of this idea in the urban context, see also: D. Peleman, B. Notteboom and M. Dehaene, 'Fragments of a Changing Natural History of Urbanisation', *OASE* 104 (2019), 1-11.

16 'This adaptability is more than the flexibility to accept a new situation. It is stronger than mere acceptance… as these landscapes finally…become an object lesson in provisionality, undergoing continual modulation as they host transformative earthworks, mounds of debris, inert waste' W. Kentridge, *Six Drawing Lessons*, London 2014, 88.

17 J. Hutton 2020 (note 5), 7.

18 For example, J. Hwang, 'Generatinve Zoning: Mining the City Toward Novel Ecologies', in N. Bouchard, *Waste Matters: Adaptive Reuse for Productive Landscapes*, Oxon 2021, 169-179.

19 The research project 'Monumental Ground' (2022), exhibited at the 19th International Architecture Biennale in Venice, maps the dislocation of millions of cubic meters of excavated inert material during the construction of the AlpTransit railway (1992–2020), and identifies, among others, the construction of 'monumental walls': artificial partitions or dykes made with excavated soil that have been displaced within the landscape.

20 According to Leon van Elzakker, project leader of the Grondbank GMG company, the operating radius of each bank for the collection and distribution of soil should not exceed about forty kilometers (interview with the author, 26 June 2025).

21 'The primary raw materials used in construction, particularly coarse and fine sands, face challenges in terms of supply. The total extraction of regularly used primary raw materials ranges from 55 to 80 million tons, with backfilling sand accounting for approximately 66% of this activity. The supply of coarse aggregates, mainly sourced from Limburg in the southeastern part of the country, constitutes only 7% of the total supply, resulting in a significant demand-supply gap for coarse aggregates. To meet this demand, around 70% of coarse aggregates are imported from countries such as Germany, Belgium (Wallonia), Norway, Scotland, and the UK, often requiring transportation over distances exceeding 100 kilometers.' See J. Hubert, F. Michel and L. Courard, 'Sand resources in North West Europe', in *INTERREG NWE CirMAP* (2024), 36.

22 The Testaccio Collective's research project is entitled 'De-Molire' and is led by Eireen Schreurs, Chiara Pradel, Peng Lee. See: www.tudelft.nl/bk/onderzoek/projecten/material-culture-collective. The research, alongside other insights, underlines how transporting soil by boat to deposit sites offers significant economic and environmental savings. A single boat can carry over three thousand tons of soil, while a truck normally carries a maximum of twenty cubic metres.

23 A.G. Entrop, 'Developments to come to a circular construction economy: Experiences in facilitating a local soil and sand depot', in *Earth and Environmental Science* 855 (2021), 5.

24 Entrop 2021 (note 25), 7.

25 According to Sonja Dijkman-Elskamp, project supervisor with the municipality of Apeldoorn and responsible for the city's circular banks, a new relocation of the soil bank is planned soon (interview with the author, 1 July 2025). The value of the municipal land hosting a *grondbank* may in fact increase over time making it economically disadvantageous to use it as a depot, or it may conflict with nearby urbanization projects. Furthermore, the space requirement for storing material tends to grow over time.

26 M. Gandy, *Natura Urbana: Ecological Constellations in Urban Space*, Cambridge MA 2022, 91-92.

27 The spontenous growth of vegetation on the mounds evockes Gilles Clément's concept of the Third Landscape, in which abandoned parcels of land, that have been altered by human activity, evolve without deliberate human intervention. See J.D. Hunt, *A World of Gardens*, London 2012, 432-433.

28 See C. Pradel, 'Tree Hubs: The city as a sustainable scenario of circular gardens and forests: The case of the Dutch Region', *Techne 29* (2025), 61-68.

29 C. Malterre-Barthes, 'Maintenance as a Political Act', in V. Grossman and C. Miguel, *Everyday Matters*, Berlin 2022, 197-198.

30 'From a cost-saving perspective, you don't always have to opt for reuse,' says Matthijs Haveman, director of the Utrecht-based road construction company D. Van der Steen. 'Economically, a new tile is cheaper, for example. It might cost 50 cents to make such a tile, and in that case, you don't have costs for an intermediate storage site or transport to and from that location.' However, Haveman emphasizes, 'the depot is certainly more sustainable.' K. Marée, 'In the Utrecht raw materials depot, piles of stones and seesaw stand ready for reuse', *NRC*, 19 March 2025, www.nrc.nl/nieuws/2025/03/19/in-het-utrechtse-grondstoffendepot-staan-stapels-stenen-en-een-wipkip-klaar-voor-hergebruik-a4886913.

31 'Ethics bears on what, qualitatively, a process can do, and in what direction that capacitation leads. It evaluates the singular how of "an immanent power's" mode of operation, as it consequentially unfolds. The project of a revaluation of values to give value its qualitative due takes the path of a processual ethics. Processual ethics is thoroughly relational. The immanently self-powering modes of existence it concerns come in multiples

and mutually inflect. This qualifies it as an ecology, in the broadest sense' B. Massumi, *99 Theses on the Revaluation of Value: A Postcapitalist Manifesto*, Minneapolis 2018, 4.

32 'Tracing materials back to the land can reveal how certain properties (the durability of certain wood or the shininess of a stone, for example) are not merely 'useful' attributes, but how they are physically related to unique, local biophysical conditions'. Hutton 2020 (note 5), 7.

33 See, for example, the research by Tanya Tsui, Cecilia Furlan, Alexander Wandl and Arjan van Timmeren, which defines spatial parameters for locating circular construction hubs in the Netherlands. T. Tsui et al., 'Spatial Parameters for Circular Construction Hubs: Location Criteria for a Circular Built Environment', *Circular Economy and Sustainability* (2024) 4, 317-338.

34 See H. Frei and M. Böhlen, *Situated Technologies Pamphlets 6: MicroPublicPlaces*, New York 2009, and the research by Tomas Ooms and by Studio Tuin en Wereld, Mike Viktor Viktor architects on Micro Public Material Depots: studio-tuin-en-wereld.tumblr.com/post/673898190114832384/mp-md-2043-awarded-bwmstr-label-027-the-micro.

35 Among other examples, it is worth mention here the 'Holding Pattern' installation by Tobias Armborst, Daniel D'Oca, Georgeen Theodore at MoMA PS1 in Queens, New York. See T. Armborst, D. D'Oca and G. Theodore, 'Holding Pattern', *OASE 96* (2016), 19-23.

36 To make landscape public means to convey 'the imagination of a new public, the assembling of new groups around specific spatial projects'. In this way, 'landscape makes social developments tangible, and has the capacity to appeal to and make demands on the public'. M. Dehaene, B. Notteboom and H. Teers, 'Making Landscape Public/Making Public Landscapes', *OASE 93* (2014), 7.

37 N. Milthorpe (ed.), *The Poetics and Politics of Gardening in Hard Times (Ecocritical Theory and Practice)*, London 2019, 8.

38 K. Moe, 'Metabolic Rift, Gift, and Shift', in N. Axel et al. 'Accumulation: The Art, Architecture, and Media of Climate Change', Minneapolis 2022, 306.

39 K. Moe, 2022 (note 40), 308.

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MATERIAL GARDENS

SPACES OF MATERIALS RECOVERY

CHIARA PRADEL

Recently, the notion of material harvesting, collection, and reworking has gained significant attention as a crucial step in understanding essential aspects of building culture, particularly in relation to reuse, material scarcity, or, conversely, material availability. The 'Recycling Beauty' exhibition (Fondazione Prada, Milan 2022), which displayed Greek and Roman spolia, marble fragments, and pieces of sculptures placed alongside one other, alluded to practices of appropriation and possession, to the relationship between craftsmen and found resources, and to the need to store and preserve material in times of scarcity or political uncertainty. Similar questions have emerged in Dutch and Belgian contexts, for example, from research into the work of designer Marcel Raymaekers and his way of organizing salvaged materials (Marcel Raymaekers, pioneer in circular architecture, Vai, Antwerp 2023). Besides highlighting the relevance of practices linked to material reuse, exhibitions and installations also make clear by their very organization, how material collections take space and, at the same time, sculpt ever-changing landscapes.

Building on these premises, and shifting the focus towards contemporary and less curated cases, this article critically examines the purpose, spatial qualities and configurations of three material storage typologies in the Dutch context – bricks and tiles, soil, and trees – highlighting their pivotal role in relation to material accessibility and availability. These sites, termed 'material gardens', are understood as experimental laboratories or 'banks', where the notion of availability is translated into the allocation and management of (material) reserves.

Though often overlooked and considered marginal, such open spaces are in fact key sites where design and other creative processes are crucially tied to resource allocation and disposal, and impact collective imagination and practices. They are increasingly being positioned at the core of construction and deconstruction processes, raising relevant ecological questions and helping to shape tacit knowledge on material reuse.

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