THE 'URBANIZATION' OF CEMENT AND CONCRETE

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

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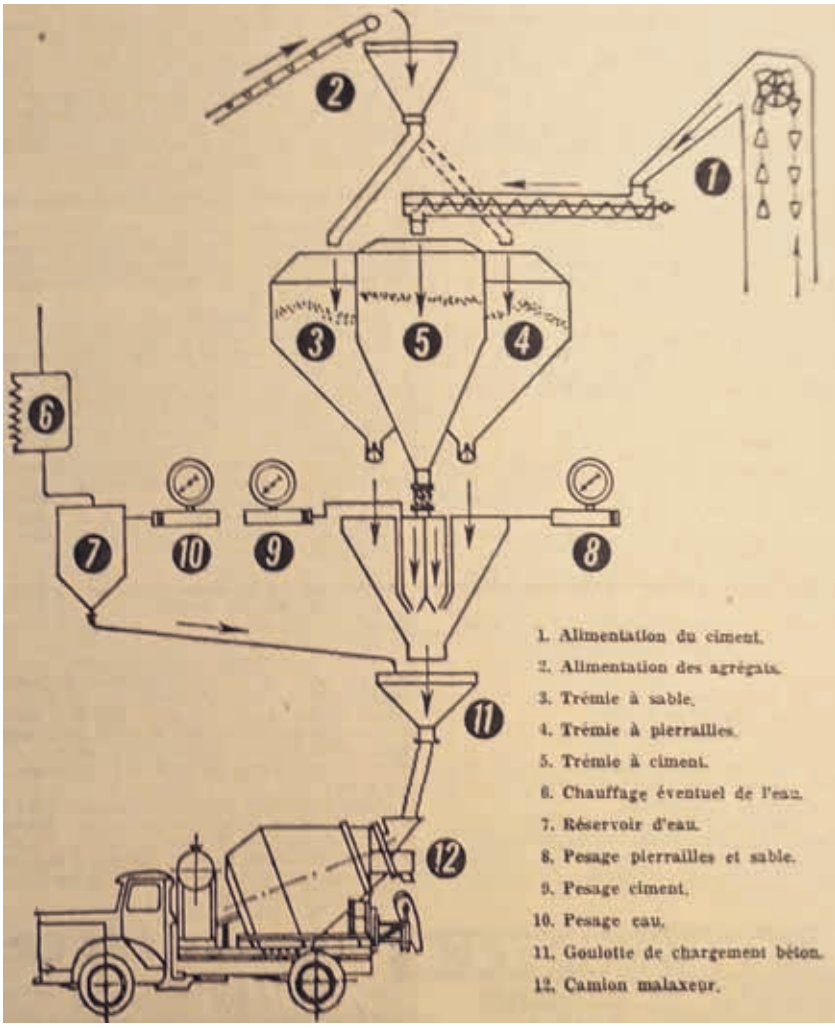
1. Typical concrete plant in Charleroi operated by Ciments d'Obourg, c. 1967. Large quantities of cement, sand, gravel and water from the Sambre are processed into ready-mixed concrete and transported by mixer trucks. The diagram illustrates the various steps in the production process of ready-mixed 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]

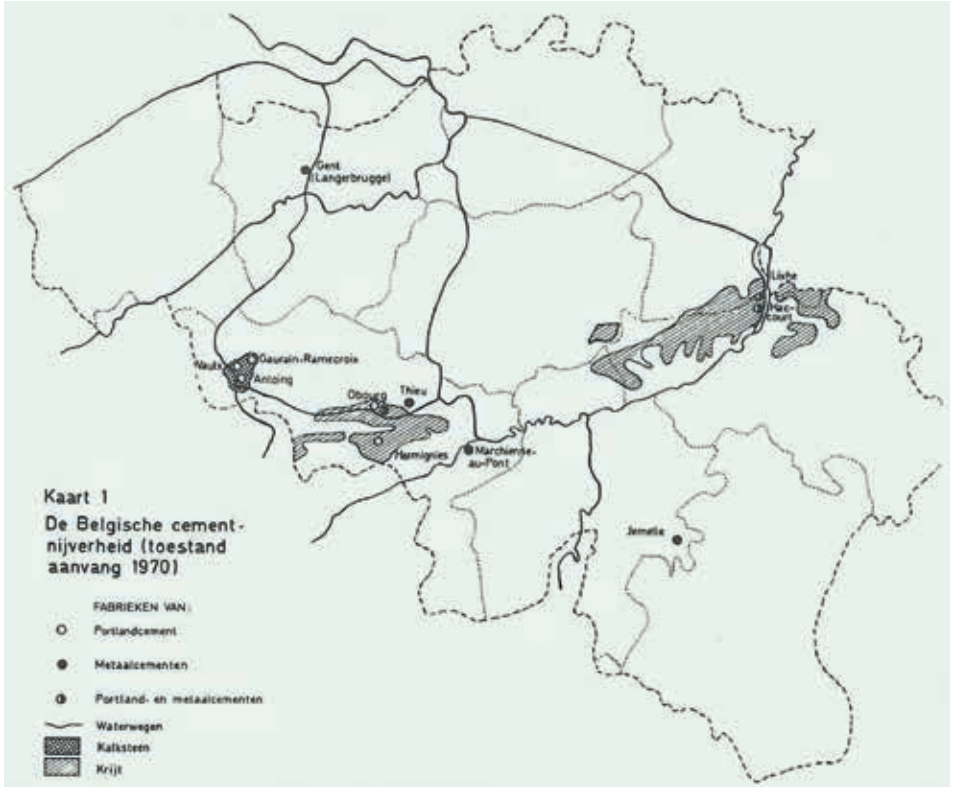
This article aims to examine in detail how the need to get cement circulating [quickly and efficiently] became one of the historical reasons for the continued success of concrete. It examines the deliberate policies and rationality with which large volumes of cement were 'realized' in the market in the 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)

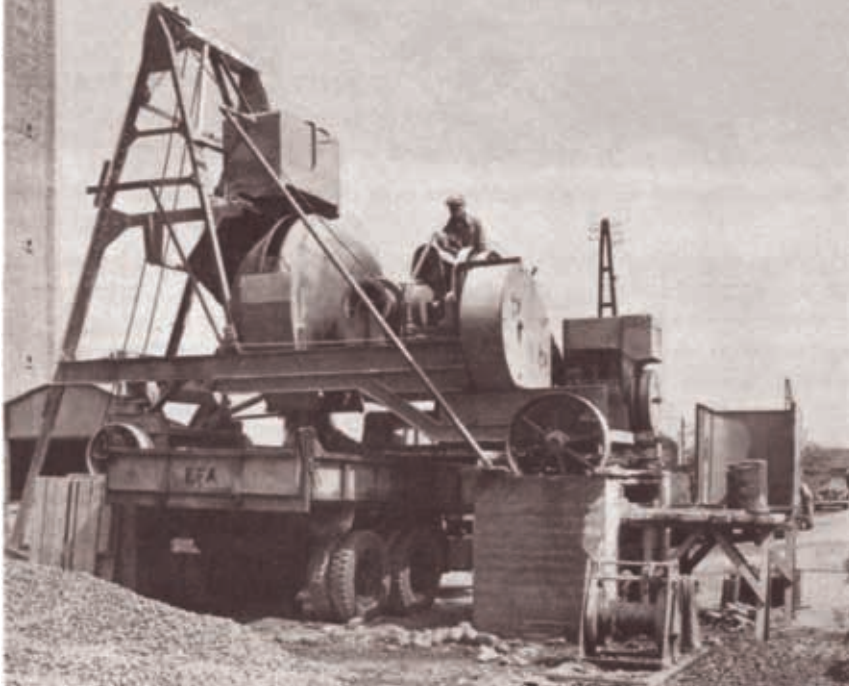
was necessary to meet the demands of the new era'.[21] Once federated, the sector explicitly sought rapprochement with the government, especially in view of the post-war 'revival of construction activity in the public works sector'.[22] In 1956, the newly founded VCN immediately became the main sponsor 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).

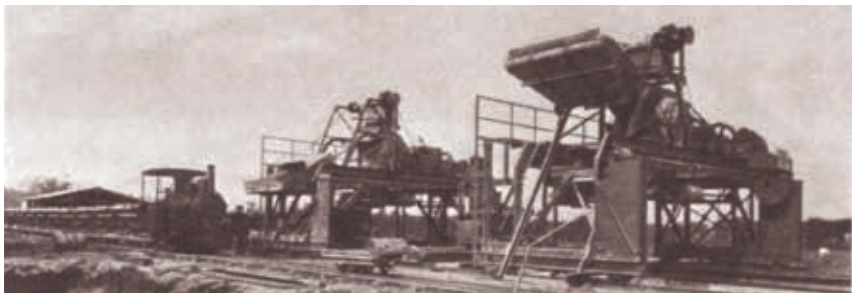
However, this firm handshake with the government did not immediately guarantee spectacular markets for cement: between 1950 and 1960, for example, no more than a meagre sixteen kilometres of motorway were built per year – considerably less than expected.[24] Early VCN brochures suggest that inadequate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

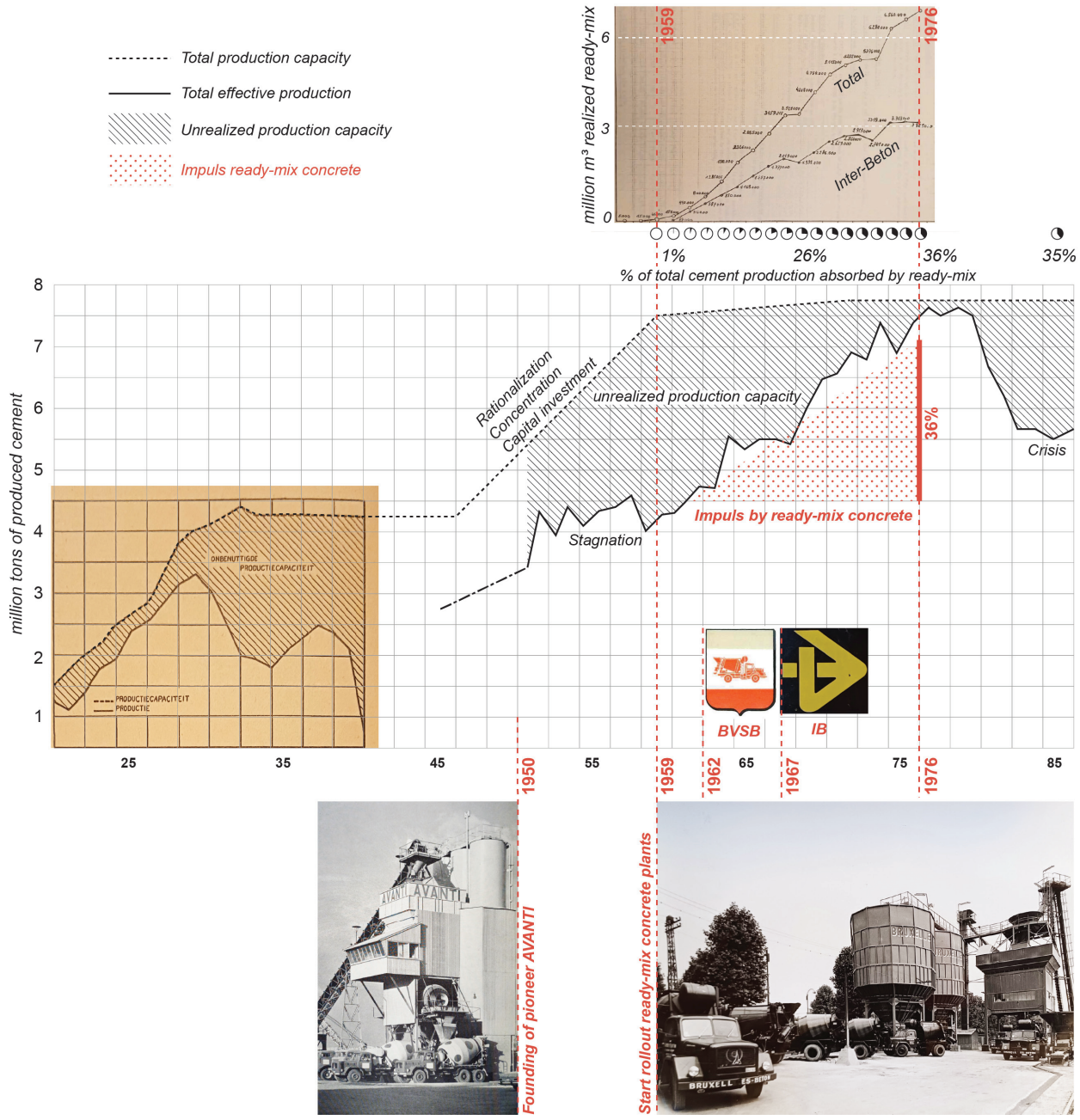
6. CO and CBR advertisements for ready-mixed concrete, first in major cities such as Brussels and Antwerp, later also in Ghent and Bruges (*De Algemene Aannemer* (1960) 10, 481; Belgian State Archives, CBR Fund, 3567)

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

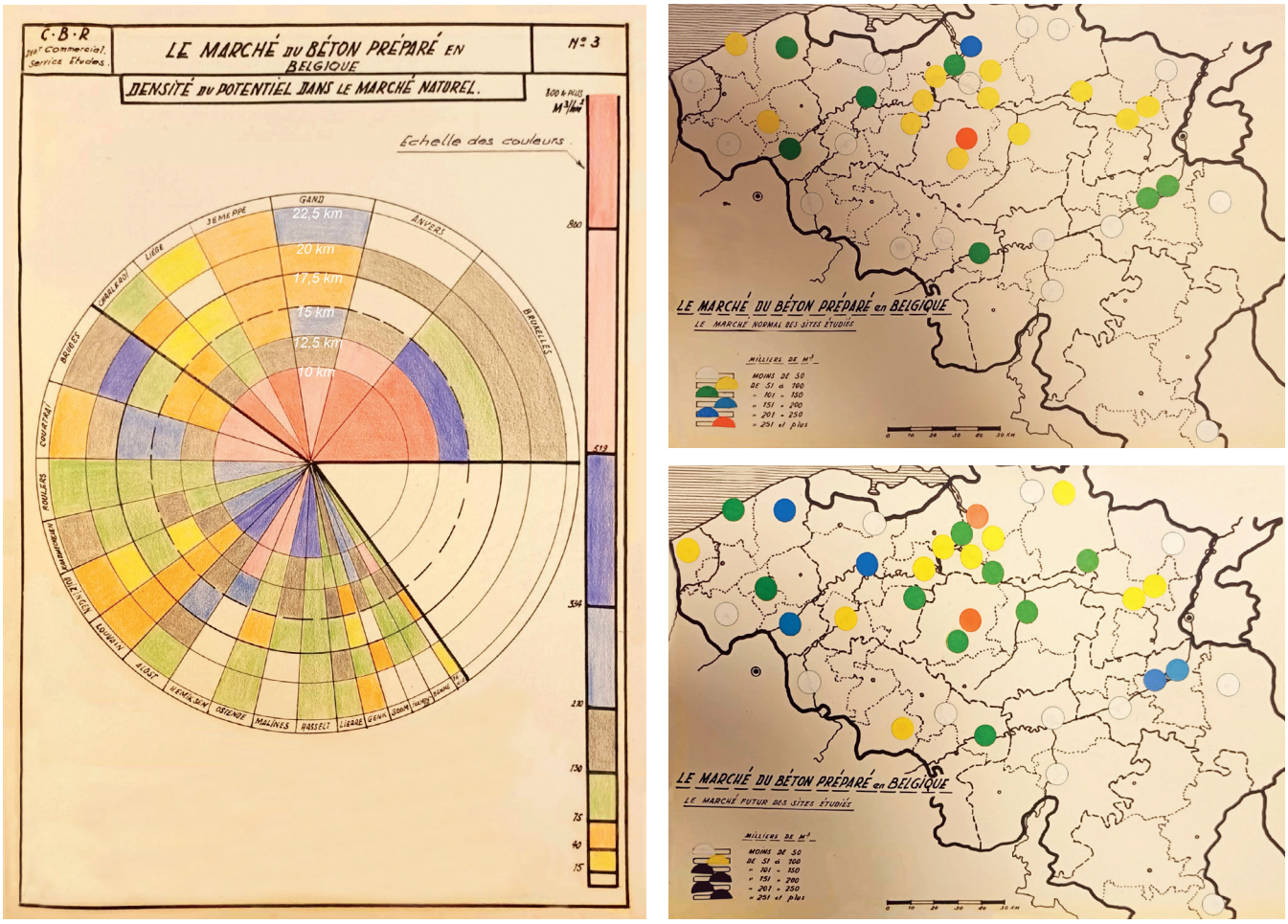


7. The emergence of concrete plants (especially from 1959), the founding of BVSB (1962) and the establishment of IB (1967) boosted the cement market: virtually the entire increase in production between 1960 and 1976 was absorbed by the growing ready-mixed concrete sector (Infographic created by the author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

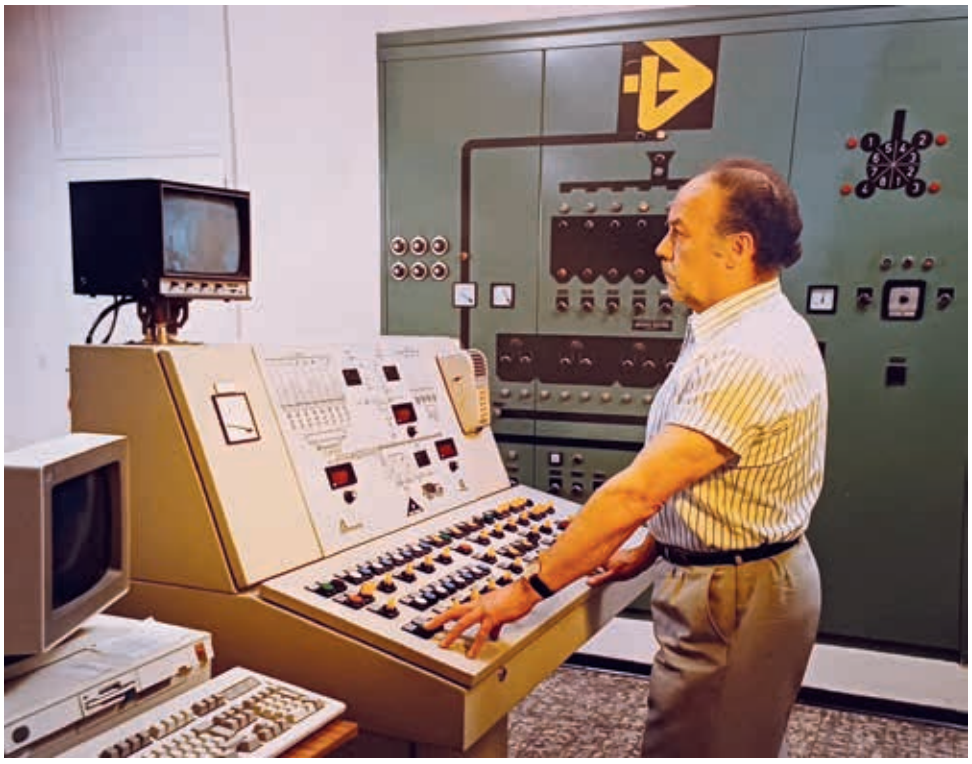
how the distribution of concrete plants was deliberately controlled by the cement industry. This control was based on various parameters, such as the potential market, but also the location-dependent costs of the supply of basic materials, workers' wages, the transport of fresh concrete, and so on.[38] 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+ m^3 of concrete/km^2) 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)

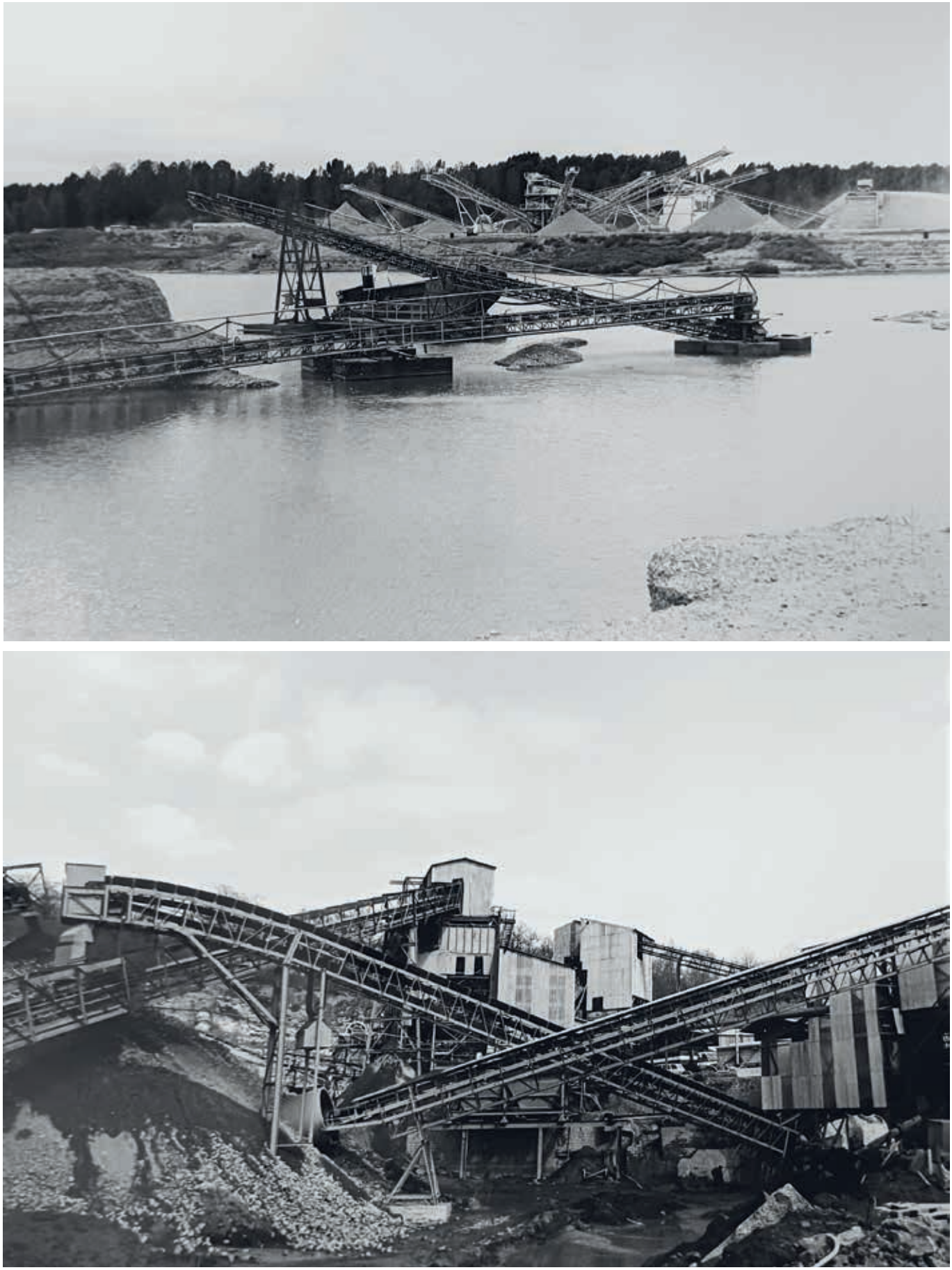


9. Growing scientific precision in the production of concrete mixes: note the graphical representation of various aggregate silos on the control panel. Research at Inter-Beton contributed to the standardization of ready-mixed concrete and the BENOR/SECO label (Belgian State Archives, CBR Fund, 3519)

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-

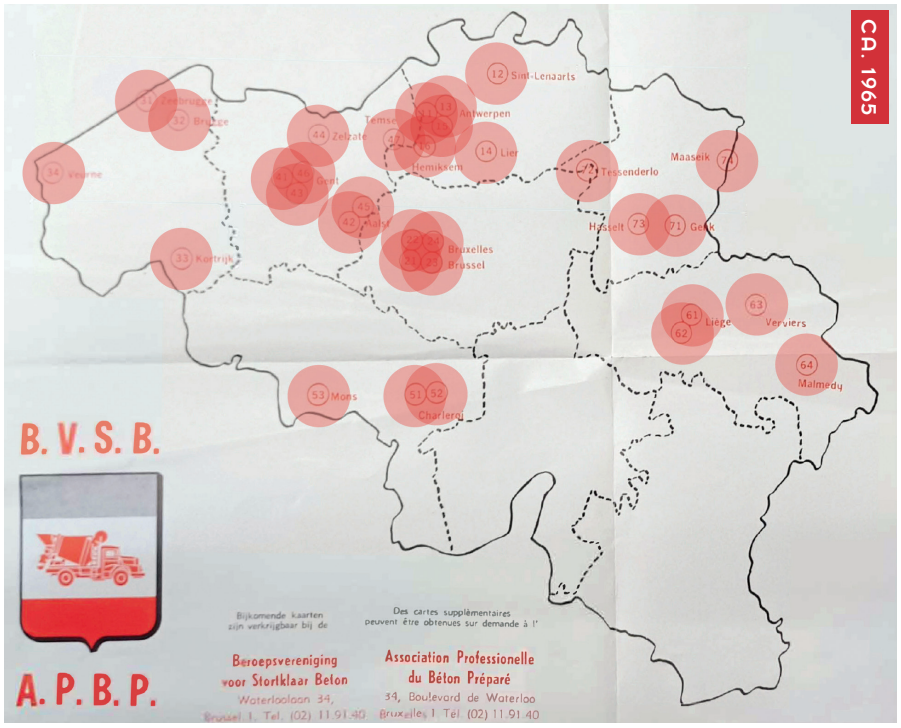


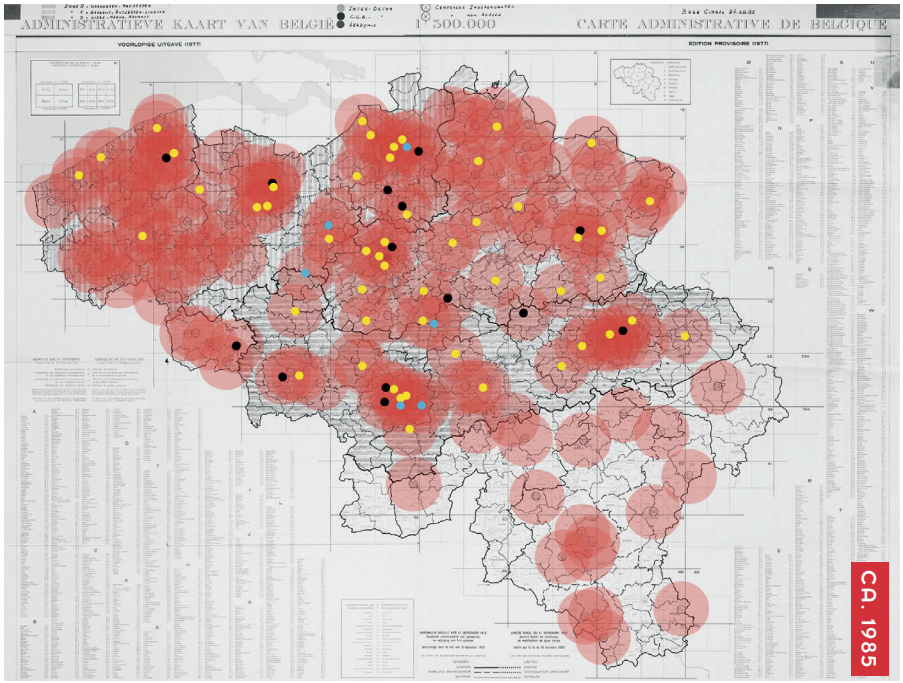
10. Gravel extraction by Inter-Beton in Dilsen and Beez in the 1970s (Belgian State Archives, CBR Fund, 3519)

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]

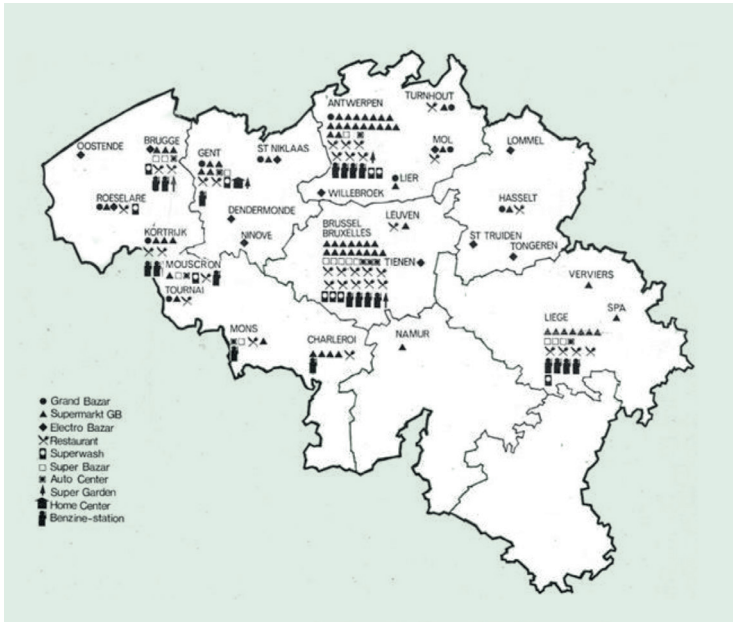
CONCRETE PLANTS: 'TRIBUTARIES OF THE CRISIS, BUT THE CEMENT INDUSTRY'S MAIN CUSTOMERS'[57]

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.)



LES ÉTUDES DU BÉTON

Les études du béton armé sont faites par des bureaux d'ingénieurs spécialisés.

Ce béton est acheminé sur les divers chantiers au départ des centrales à béton par camion mixer.

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

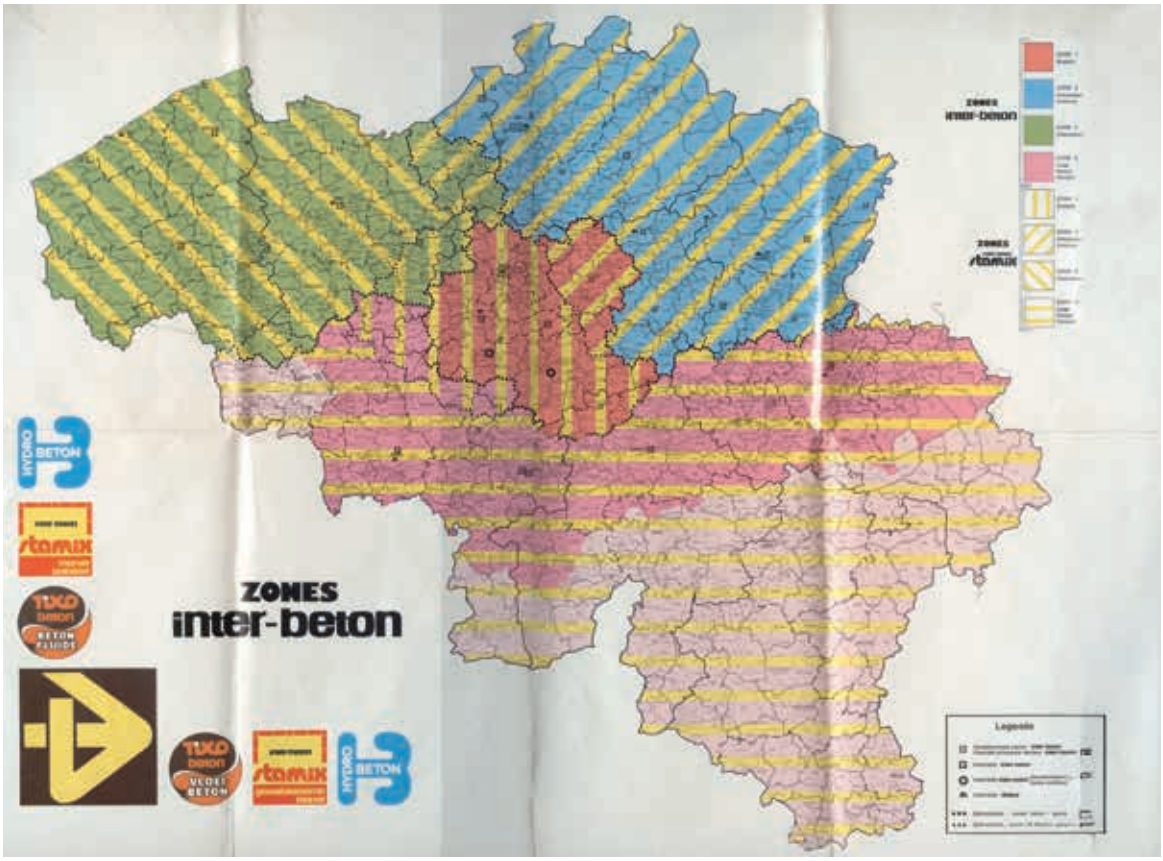
quantities' that very accurately pumped small volumes of ready-mixed concrete into housing projects throughout the country. In other words, the growth strategy did not focus solely on large construction players, but also actively targeted the bulk of small construction projects and activities (fig. 13). 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.

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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.