ALEXANDROS-ANASTASIOS TRIVIZAS

ΤΣΙΜΕΝΤΟ

TSIMENTO

towards material agency

Theoretical Statement
THEMA EPFL 2024-2025

Candidates:
Alexandros-Anastasios Trivizas

Professor Theoretical Statement:
Prof. Sarah Nichols

Pedagogical Director:
Prof. Sophie Delhay

Mentor:
Capucine Legrand

TABLE OF CONTENTS

INTRODUCTION

The word “tsimento” in Greek, as perhaps in other languages, is used to denote everything associated with construction in reinforced concrete. By extent, it tends to absorb semantically the entire domain of modern construction practice. Athens, the modern capital of Greece, is commonly described in popular culture as a “tsimentoupolis,” a city made of cement. This perception is closely tied to the “polykatoikia”, a type of mid-rise apartment block that is based on a structural frame in reinforced concrete, which became ubiquitous during the mass-urbanization of the country in the post-war period.

Cement is of course not the only material in the city. Strictly speaking, cement as a binding agent only amounts to about 10% in the weight of a structure in reinforced concrete, which contains mostly gravel and sand as aggregate but also steel as reinforcement. Moreover, the structural frame is filled with bricks to form partition walls and the whole is covered in plaster and paint. Marble, a material that is naturally abundant in the region, is often as used as dressing to confer dignity to parts like the street entrance, while it is not uncommon that the sidewalk itself is covered with marble slabs or curbstones. The street is of course made of asphalt, a mixture of pitch and aggregates, similar to those used in concrete. However, more than any of those materials, cement proves to be the one that best characterizes this built environment, even though it does not constitute its largest part neither in weight nor in visibility. Residents of the city share the acute perception of living in an environment that is dominated by cement, if not literally then at least in a moral sense, as the key element in the material culture that they tacitly inhabit.

Cement, is perhaps the building material with the widest implications for society as a whole. It constistutes what Rosalind Williams would call a ‘Large Scale Technological System’, involving

Rosalind Williams, “Cultural Origins and Environmental Implications of Large Technological Systems,” Science in Context 6, no. 2 (1993): 377–403.

a complex combination of processes across many different scales, actors and dimensions. From the laboratory to the bank and through the parliament, from the quarry to the factory, and from there to the construction site, through inhabitation to maintenance or perhaps demolition, cement mobilizes and affects every branch of society, every form of economy and labor, formal or informal, at both local and global extent. However, most of these processes remain obscure in public awareness, while the material itself, as we experience it, tells us very little about its true nature, and eludes our intuition.

We built our world 'in cement' and we have come to take it for granted but now this world, which is our heritage, is entering a two-fold crisis. First, the material has largely contributed to the environmental degradation of our planet, and continues to do so as a large part of the world is in course of development — according to the standards set by the part of the world that has already developed. Second, the built heritage of reinforced concrete in the developed world is entering a crisis of repair, bearing direct social implications as well as environmental ones. Although reinforced concrete is a highly durable building material, it is not impervious to the passage of time. Contrary to the erroneous belief perpetuated by engineers since the early decades of its use, it inherently corrodes, regardless of external factors. Moreover, the maintenance of load-bearing reinforced concrete structures is a highly specialized branch of civil engineering and cannot be taken for granted at a large scale, especially without political drive. As Sarah Nichols observes, the mis-perception of the material as immutable "is damaging twice", first "in that it validates harmful extractive processes" and second in that it "paradoxically, puts the longevity of those materials at risk by ignoring that their durability is predicated on protection and care."

In the first part of this work, I trace the history of the Greek cement industry, the way the material was absorbed by popular building culture during post-war mass-urbanization, and the extractive practices that made this possible at different levels. In this way I attempt to reveal the tacit material culture that characterizes the modern city, to render it conscious, and perhaps at the same time, to denaturalize it. The study of technological history helps to develop appreciation for the complexity and intricacies of technocratic systems but also question the inevitability of their development and domination. At the interface with popular culture we might identify sources of generational trauma, which proliferate irrational attachments or avoidances, thereby hindering critical reflection and dialog.

As an interlude, I have assembled a visual essay combining cartographic research with personal photographs and notes from the field. The goal is to piece together an intuitive understanding of material culture by looking at how it expresses itself visually, spatially and geographically. As Charlotte Malterre-Barthes has said: "understanding all actions and actors along the commodity chain of space production forms the first stage of a broader uncovering of the role of commodified construction, refuting the ongoing human and ecological devastation. Identifying the mechanisms of space production and organisation is a necessary study that articulates a mandate for design disciplines to act upon the elements, forces, and moments along the chain."

Charlotte Malterre-Barthes, "Carbon Architecture: Towards an Expanded Political Economy of Space Production," in Transcalar Prospects in Climate Crisis, ed. Jeffrey Huang, Dieter Dietz, Laura Trazic, and Korinna Zinova Weber (Zürich: Lars Müller Publishers, 2024).

Sarah Nichols, "Matters of Care," in The Great Repair – Politics for the Repair Society, 82–85, ARCH+ no. 250 (May 2023).

In the second part, I begin by scrutinizing the nature of reinforced concrete construction and the way that modern construction practice organizes accordingly. Drawing from the previous parts, I contextualize theoretical concepts to Athens, from a standpoint of social and environmental justice, while particularities are elaborated to reveal dangers and potentials as entry points for action. If material culture is what it takes to turn rocks to cities, material agency is what is needed to keep cities from turning to rocks.

View from the archaeological site in Eleusis. The cement factory of TITAN is seen in the background.

© Andreas Embiricos

From: Simon Critchley, "Athens in Pieces: What Really Happened at Eleusis?" The New York Times, March 13, 2019, https://www.nytimes.com/2019/03/13/opinion/ancient-greece-ritual-mystery-eleusis.html.

IN SEARCH OF MATERIAL CULTURE

While archaeologists revealed the marble ruins of Eleusis, a group of industrialists, known as the "Zurich Group", were attracted to the low cost of land and the town's proximity to Athens. The port of Eleusis would enable them to export goods with ease, while the growth of the road and rail network would connect their factories to a major domestic market. In 1899, Andreas Hadjikyriakos had completed his studies at the Zurich Polytechnikum and worked for 12 months at the EMPA laboratory under the supervision of Professor Ludwig von Tetmajer. The professor, a key figure in the historical development of cement, directed his student to work at Roche, a Swiss cement manufacturer, where he contributed to developing specialized cement for the construction of the Simplon Tunnel in the Alps. Gaining Tetmajer's trust, Hadjikyriakos was later placed to lead the planning of the Rezola cement factory in San Sebastian, Spain. With experience accumulated in the cement industry, he began to recognize the potential for introducing one in Greece.

Yiannis Moralis, "Πορτραίτο για τον Ανδρέα Χατζηκυριάκο [Portrait of Andreas Chatzikyriakos]," Industrial Review, October 1976.

The geography of the country offered favorable conditions for the production of cement, with abundant limestone and clay resources near coastlines with natural harbors. While this is not entirely uncommon, the combination with strong maritime culture (Hadjkyriakos himself belonged to a family in the shipping business) would facilitate provisions for cement production but also the distribution of the product by sea to a broad market in the Eastern Mediterranean, a region which was under growing pressure to modernize. Hadjikyriakos turned to other alumni of the Zurich Polytechnikum to combine their experience, networks, and capital. Together, they established the first cement factory of the Balkans in 1902, near the hill of the sanctuary of Demeter in Eleusis. The brand was named "TITAN," a word that is spelled identically in ancient Greek and Latin alphabets, reflecting the ambition to create an

export-driven industry while evoking power and ancient heritage. Rising demand led to factory expansions, increased production, and the company's listing on the stock market. Hadjikyriakos left TITAN in 1910 to plan the construction of a cement factory in Istanbul, until war broke out in 1917, and then he returned to Athens to take the lead of Heracles, a newer cement company that would become TITAN's "lifelong rival". Today, cement production is the oldest surviving industrial activity in Greece and the two companies continue to hold a duopoly in the cement market.

In the inter-war period, reinforced concrete was used to pioneer large-scale infrastructural works, for example the iconic Marathon dam that was built to solve the chronic irrigation problem of Athens. It is perhaps telling, that while the dam was built in reinforced concrete, its open "façade" was covered in marble, while a replica of an ancient Athenian temple was built at its foot as a monument to modernization, a gift from the American engineering company that constructed the dam. The marble was sourced from nearby quarries and is the same pristine marble that is found on the Parthenon and other important monuments of classical antiquity. Geographer Maria Kaika understands this unusual decoration, unique in the world for a dam, as respresentative of a "double vision of modernization, between geographical imagination and materiality".

Maria Kaika, "Dams as Symbols of Modernization: The Urbanization of Nature Between Geographical Imagination and Materiality," Annals of the Association of American Geographers 96, no. 2 (2006).

A progressive government in the late 1920's, in its effort to decisively modernize Greek society, was perhaps seeking to break out of "geographical imagination" through the adoption of international modernist architecture. The use of reinforced concrete in exalted, or at least more dis-inhibited ways, was employed for the construction of public buildings. Cultural or educational institutions were the main focus, notably a series of more than 3000 schools that were built around the country during the early thirties in the conspicuous new style. At the same time, an emerging liberal bourgeoisie was keen to introduce modernity to domestic space, giving rise to what would become the "polykatoikia". The structure in reinforced concrete allowed the multiplication of floor surface for sale or rent, while introducing new standards of comfort and projecting a dynamic cultural identity, with designs that adhered to the aesthetic principles of the international style. In any case, the polykatoikia remained for the moment limited in proliferation among the progressive urban elite, and did not find its ubiquitous popular form before the post-war era.

Andreas Giakoumatos, ed., Τα Νέα Σχολικά Κτήρια [The New School Buildings] (Athens: Kapon Editions, 2019).

In the context of Greece, the "war" in question does not only refer to the invasion and occupation by Axis powers, but also a prolonged civil war that immediately followed liberation, concerning the political orientation of the country. Greek population was rural in its majority and the Greek countryside was a terrain of sustained guerrilla warfare throughout both wars, over a span of about ten

years. As a result, this population was devastated, both in terms of economic damage as well as in terms of profound social trauma and division.

Even after the official end of the civil war, the winning side continued to prosecute perceived political dissidents with acute suspicion, maintaining a rule of terror and oppression. This would contribute over the following decades to a mass rural-exodus and conversely the mass-urbanization that came to define the built-environment in Athens and other cities. Residential construction would become not only necessary to house this population but also a primary field of enterprise and employment for the same population. The anonymity of the city offered safe-space for a new start while the typical informality of the construction sector offered employment to a multitude of politically black-listed individuals, who were excluded from conventional employment.

Engagement in construction work was not an unprecedented practice for the rural population in the post-war era. Like other European countries during this time, Greece underwent a reconstruction program driven by American financial aid and patronage. This effort focused primarily on the countryside, which remained the base of economy and society, as well political conflict that the government aimed to pacify. Aside from infrastructural development, one of they key concepts was housing aid in the form of self-sheltering, involving the state provision of building materials and training on building techniques, while construction work was carried out by future residents themselves with the assistance of family and neighbors. The program was led by architect Konstantinos Doxiadis, who served as Minister of Reconstruction and Recovery, in collaboration with American aid missions. As researcher Konstantina Kalfa discusses in her paper, the self-sheltering scheme on this scale was the first in a long series of similar initiatives introduced to developing countries.

Dimitra Lampropoulou, Οικοδόμοι: Οι Άνθρωποι που Έχτισαν την Αθήνα, 1950-1967 [Builders: The People Who Built Athens, 1950-1967] (Athens: Bibliorama, 2009).

These programs were promoted and financed by the United States, the United Nations, and institutions such as the Ford Foundation and the World Bank, emphasizing the importance of individual self-motivation in fulfilling the "natural" desire for a better life. Its implementation in Greece, as a pilot project, was intended to "Give the World a Demonstration". Doxiadis developed a "nucleus" concept: minimal and austere units, which served as a domestic core and were designed to grow incrementally according to need and opportunity. The use of local materials and building techniques was privileged, with an affinity towards vernacular forms and features. Although there is evidence of experimentation and development of prototypes in reinforced concrete, it is unclear whether this technology was used in any of the realized nuclei. However, it can be assumed that exposure to modern building technology such as reinforced concrete was granted through participation in large-scale

Konstantina Kalfa, "Giving to the World a Demonstration: U.S. Housing Aid to Greece, 1947-51," Journal of the Society of Architectural Historians 80, no. 3 (September 2021): 304–320.

infrastructural projects, such as dams, roads, and bridges, which were a significant domain of seasonal construction work for the rural population of the time. As we will see, the fusion of incremental self-building practices with reinforced concrete technology would eventually become a key component of mass-urbanization. In the end, while the reconstruction effort was targeting the countryside, it did little to prevent its eventual abandonment. In fact, it was perhaps a catalyzing factor, as the building culture that was cultivated in the process played its own role in placing construction as a significant driver of internal migration. Rural immigrants to the city had acquired technical knowledge in construction which would be utilized both in building unauthorized houses in the suburbs of the capital for themselves, and as a professional entry point to the construction trade.

The post-war development of Athens was carried out through processes with varying degrees of informality. As Platon Issaias argues in “The Absence of Plan as a Project”, on one hand the state was hesitant to frame urbanization as part of official policy, and at the same time hesitant to oppose it, because there seemed to be aspects beneficial to a political agenda that was geared towards political consensus and industrial development. While the state itself had minimal involvement in planning let alone financing the growth of the city, the attitude of the authorities tolerated or tacitly encouraged informal practices. Unauthorized construction would take place on plots of non-residential land (mostly agricultural) in what used to be the periphery of the city. Residents would typically buy and own their plot, placing capital in the form of savings or dowries, often secured through the liquidation of land in the countryside. However, obtaining a building permit was out of the question outside the official city plan, and any construction was subject to forced demolition.

Platon Issaias, Beyond the Informal City: Athens and the Possibility of an Urban Commons (Dissertation, Delft University of Technology, 2014), Supervisors: Michiel Riedijk; Advisors: Umberto Barbieri, Pier-Vittorio Aureli.

Konstantina Kalfa, “Archives of Empowerment? Unearthing Afthereta’s Architectural Documentation in 1970s Greece,” PLATFORM, June 19, 2023.

Incremental growth in unauthorized construction

Unauthorized construction in reinforced concrete with protruding rebar over the roof slab.

In those circumstances, the use of reinforced concrete proved tactically significant. It was often possible for a well-coordinated group of accomplices, given a certain degree of discreet preparation and groundwork, to carry out the execution of a small reinforced concrete structure within the span of a single night, avoiding this way interruption by the authorities. Because a structure in reinforced concrete is fairly more difficult to demolish than one in wood or masonry, a combination of inertia and occasional bribery would suffice to secure the tolerance of the police. Eventually, whole neighborhoods were built in this way, while governments tended to retroactively legalize unauthorized constructions, typically before elections. As the pioneering act of establishing a residential unit on the land plot, the reinforced concrete structure would be completed with other building materials, and was intended to grow incrementally by connecting to horizontal expansions. Vertical addition of floors was anticipated by leaving re-bar protruding from the roof slab, to allow the extension of the reinforced concrete structure.

Parallel to unauthorized construction, a land-for-flats scheme known as “antiparoche” functioned as the almost exclusive process of real estate development, first within the existing city limits and later also in the unauthorized settlements as they became official suburbs. Through payment in kind, the scheme allowed the the co-financing of apartment blocks between different actors who belonged virtually

to the same social class, with minimal exchange of financial capital between parties. Until then, the housing stock of the city consisted of mostly pre-modern, single story houses, which had suffered a great deal of damage and disrepair through war and poverty. The residents were eager to redevelop their property into modern apartment blocks but as they lacked the financial capacity to do so, agreements were made with contractors to execute a construction without down-payment but in exchange for a number of apartments in the new building.

The mechanism spared a large part of investment for the contractor, as it was possible to develop real-estate without paying the cost of land but only the cost of construction, which corresponded mostly to labor and building materials. At the same time, demand for apartments was so strong that the contractor could often entirely finance the construction of an apartment block through pre-sales of apartments. As a result, small-scale construction became a very accessible and rewarding form of enterprise for contractors, requiring little initial capital. The mass influx of internal immigrants to the city provided abundant and cheap labor power, a circumstance that was well suited to the necessity of low technical investment in the system of antiparoche. Dimitra Lambropoulou makes the case that between the extensive authorized construction of the city and the equally extensive unauthorized construction of its periphery, there took place a virtuous and reciprocal transfer of building

Dimitra Lampropoulou, Οικοδόμοι: Οι Άνθρωποι που Έχτισαν την Αθήνα, 1950-1967 [Builders: The People Who Built Athens, 1950-1967] (Athens: Bibliorama, 2009).

Settlement of unauthorized constructions in the suburbs of Athens. Small gravel quarry in the background. 1969

Dimitra Lampropoulou, Οικοδόμοι: Οι Άνθρωποι που Έχτισαν την Αθήνα, 1950-1967 [Builders: The People Who Built Athens, 1950-1967] (Athens: Bibliorama, 2009).

Platon Issaias, Beyond the Informal City: Athens and the Possibility of an Urban Commons (Dissertation, Delft University of Technology, 2014), Supervisors: Michiel Riedijk; Advisors: Umberto Barbieri, Pier-Vittorio Aureli.

Lefteris Anastasakis, Καινοτομία και Βιομηχανικός Μετασχηματισμός στην Ελλάδα 1950-1973 [Innovation & Industrial Transformation in Greece 1950-1973] (Athens: Kerkyra Publications, 2023).

culture. The practice of self-build unauthorized construction gave workers the opportunity to further develop and expand the skillset they have acquired on the job, thereby increasing their professional standing. At the same time, the collaborative nature of unauthorized construction, often based on solidarity mechanisms between construction workers, would allow them to collectively overcome the division of labor that is imposed on them at a formal construction site, and develop a more hollistic grasp of the building practice.

This had a highly emancipatory effect, as it would allow many of the workers to eventually become entrepreneurial contractors themselves, even in complete lack of formal technical training and despite the technically sophisticated nature of reinforced concrete construction. This was of course much to the displeasure of the original class of contractor-entrepreneurs, mostly of a polytechnic background in civil engineering, who would often find themselves "subcontracted" to the role of merely validating construction plans in exchange for a modest reward. The so-called "technicians", a formally trained body of construction professionals, were calling for increased protection of the trade and many of them were denouncing the 'monstrous' consequences of popular construction on the character of the city. Despite their protests, the state remained hesitant to act on their demands, as mass urbanization became entangled with matters of political interest. To begin with, it was allowing small-scale private property to become ubiquitous for the population, a phenomenon which was in complete alignment with the western cold-war political agenda; the task of preventing socialist revolution was dominating political discourse in post-war Greece, culminating with the rise of the military dictatorship in 1966. Generalized small-scale private property was thought to pacify the population and disincentivize participation in revolutionary action, thereby creating a petty bourgeois class that is willing to adhere to the values of 'nation, religion and family'. Secondly, the on-going construction frenzy proved highly beneficial for the economy, due to the high level of purchases it carried out from other sectors.

Indeed, construction became a major support of industrial development in the country and this was itself a major part of official policy, even though that was not directly the case for construction. The majority of building materials and components were domestic products, from heavy industry like cement, steel or aluminium, to relatively lighter industries such as lime, glass, wood and bricks, while the furnishing of modern domestic spaces increased demand for textiles, household appliances and even electricity. IZOLA, the first company to produce household appliances in Greece secured a deal with the Public Electricity Company, whereby the latter would pay in advance for the purchase of IZOLA electric devices on behalf of the consumer, who would then pay back the amount in parts through their electricity bill. Dimitra Lambropoulou

highlights that “construction not only did not compete with Greek industry but possibly served as the main factor for its integration”. Significant also was the strengthening of capital flows from abroad for investment in construction, as it is estimated that 20-25% of the apartments built in Athens were purchased by Greek expatriates. According to the Ministry of Coordination towards the late 1960s, findings regarding the dynamics of construction activity confirm the movement of capital driven by housing demand. Employment related to construction activity, including the building materials industry, was estimated by the authors of the report to account for approximately 3,5% of the employed labor force and at the same time, the building materials industry was dramatically developing. As recounted to me by a senior TITAN engineer, the government would informally request frequent reports on their sales of cement, as this allowed them to indirectly monitor the volume of residential development, and by extent the status of the national economy.

Just as construction boom fed into an industrial boom, it is arguable that the first would not have been possible without the second, at least not under the same privileged circumstances. For a long time, the Greek state determined the price of cement in the domestic market through administrative action, and this price remained almost unchanged from 1947 to 1962 at a level that was around half that of the European average. According to Lefteris Anastasakis, in his book Innovation & Industrial Transformation in Greece 1950-1973, breaking down the construction costs of a Polykatoikia reveals that halving the cost of cement translates to a 25% reduction in the cost of building the concrete structure. This result accounts for the tradition of “fatoura”, the custom to pay the builder an amount equal to the cost of building materials. In this case, the framework builder receives an amount equal to the total cost of poured concrete, of which roughly half corresponds to the cost of cement.

Visit of Greek Prime Minister to Heracles Headquarters. Athens, 1960

Dimitra Lampropoulou, Οικοδόμοι: Οι Άνθρωποι που Έχτισαν την Αθήνα, 1950-1967 [Builders: The People Who Built Athens, 1950-1967] (Athens: Bibliorama, 2009).

Lefteris Anastasakis, Καινοτομία και Βιομηχανικός Μετασχηματισμός στην Ελλάδα 1950-1973 [Innovation & Industrial Transformation in Greece 1950-1973] (Athens: Kerkyra Publications, 2023).

Lefteris Anastasakis, Καινοτομία και Βιομηχανικός Μετασχηματισμός στην Ελλάδα 1950-1973 [Innovation & Industrial Transformation in Greece 1950-1973] (Athens: Kerkyra Publications, 2023).

Armelle Choplin, Concrete City: Material Flows and Urbanization in West Africa (Hoboken, NJ: Wiley, 2023).

Large-scale availability of cement at a cheap price enabled development under relatively privileged conditions which cannot be taken for granted. Armelle Choplin has researched the trade of cement in the rapidly developing West African corridor, where due to a legacy of exploitative colonial relations, those economies are forced to rely on imported cement, as multinational cement companies see in them a lucrative market for the sale of their products and indirectly inhibit the development of local industry. As a result, the price of cement is highly expensive and unstable, to the point that the bag of cement becomes a vessel of “thesaurizing” use-value, contributing to erratic urban development patterns. Armelle Choplin has studied the trade of cement in the rapidly developing West African corridor, where a legacy of exploitative colonial relations has left local economies dependent on imported cement. Multinational cement corporations exploit these markets as lucrative opportunities, effectively stifling the growth of local industries. Consequently, the price of cement remains exorbitantly high and unstable, turning a simple bag of cement into a vessel for “thesaurizing” use-value. This economic dynamic significantly contributes to erratic and uneven patterns of urban development in the region.

The post-war Greek state directly promoted the development of industry by allocating to the sector a significant part of the Marshall Plan and other foreign aid programs. The total amount of reconstruction loans to TITAN cement was 2,5 million dollars; given that the sale price of cement was then about 20 dollars/ton, the loans corresponded to a production of 125.000 tons, which is little more than the average annual production of a factory in those times. The company used this capital to invest early and heavily, developing production capacity much larger than the domestic demand of the time, which was reasonably anticipated to grow. The imperative to growth was such that no dividends were payed out until 1953, so that all profit could be reinvested into expansion of production capacity. Heracles was granted reconstruction loans close to double the amount of TITAN, as the National Bank who was responsible for allocating them owned 21% of the company and held several seats on its board. While domestic demand exploded, the cement industry nevertheless sustained its traditional commitment to exports which during this time corresponded to about half of TITAN’s sales and half of total cement exports from Greece. The Greek cement industry became in 1977 the third biggest exporter worldwide, second in Europe while only in the 7th place in terms of total production. This result is completely disproportionate to the overall small scale of industry in the country but the oversize development was strategically crucial. According to a study from 1954, a cement factory that is 20% smaller than the optimal size is carrying a cost burden in the order of 30%. Cement production driven only by regional demand might have been unprofitable if

cement were to be sold at a low price.

As we have seen since the origins of the industry, an advantageous combination of natural features, position and strong maritime culture, allowed Greek cement to access markets in a broad geographic region. With the intensification of global maritime trade in the post-war era, this provided a profitable opportunity to export massive quantities of cement to an even greater geographic extent. Greek currency became tied to the dollar through the Bretton Woods system, eliminating its chronic instability, although it was devalued by 50% in the process. This might have been initially problematic for the cement industry as it was servicing its Marshall Plan loans in dollars, but the facilitation of global trade would prove very rewarding in the long run. Cargo ships bringing goods from the USA to the Mediterranean would be willing to bring back cement as back-cargo, only to cover the running fees of the return journey. With small cost of transport, Greek cement of high quality standards could be sold in the United States at a competitive price, establishing markets that persist to this day. The market in the east Mediterranean remained important. In the 1950's TITAN was commissioned as exclusive supplier for the construction of the Seyhan hydroelectric dam in Turkey, the first in a series of hydroelectric projects funded by the World Bank.

Konstantinos Skokos, retired engineer at TITAN cement, in conversation with the author.

Nikos Melios and Evaggelia Mpafouni, 100 χρόνια TITAN 1902-2002 [100 years TITAN 1902-2002] (Piraeus: P. Mpallides & Co., 2002).

However, perhaps the most lucrative market was based on the Gulf States which, through the formation of the OPEC cartel, were emerging as global economic powers and were undergoing a construction boom with insatiable demand for cement. As those states did not initially have industrial infrastructure to produce sufficient quantities of cement, Greek producers were well placed to participate in this market. With limited industrial ports that were necessary for unloading cement in bulk, the product was sold in paper sacks which were often carried to shore by helicopter, TITAN was operating floating distribution platforms where cement was unloaded to be packaged in sacks. The quantities of the sacks were such that the company decided to buy its suppliers of paper to control their costs. The demand-side was so strong, that transportation cost, even if significant, was an indifferent factor as long as the product was delivered on time. The supplying to coastal distribution centers pushed TITAN and especially Heracles to acquire direct expertise in the marine transportation of cement. Even from 1954, TITAN had chartered a 8000 ton steamship for the export of cement to the Persian Gulf, while later the company was performing transformations of general cargo ships to cement carriers. Heracles, through its subsidiary for metal constructions, performed the transformation of 20 general cargo ships to cement carriers.

Lefteris Anastasakis, Καινοτομία και Βιομηχανικός Μετασχηματισμός στην Ελλάδα 1950-1973 [Innovation & Industrial Transformation in Greece 1950-1973] (Athens: Kerkyra Publications, 2023).

Cement exports remained important even as domestic demand exploded and for this reason the production capacity of cement

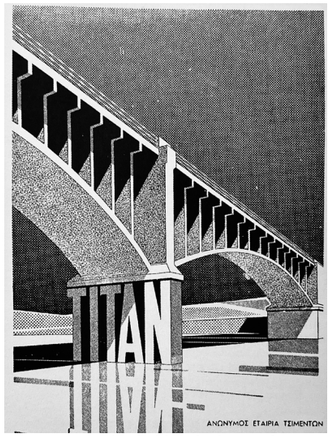
Visit of UAE Finance Minister to Heracles Headquarters. Athens, 1976

Konstantinos Skokos, retired engineer at TITAN cement, in conversation with the author.

Lefteris Anastasakis, Καινοτομία και Βιομηχανικός Μετασχηματισμός στην Ελλάδα 1950-1973 [Innovation & Industrial Transformation in Greece 1950-1973] (Athens: Kerkyra Publications, 2023).

factories continued to grow oversize. The economies of scale achieved through the possibility of exports were an important factor in keeping the price of cement low in the domestic market. It is important to note that the exporting nature of the Greek cement industry is somewhat of an anomaly in the global scene, as most cement production is not geared towards export. Greek cement companies emphasized on this aspect to the advantage of their public image, which they were careful to shape and defend. As we can see in documents from the company's public relations campaigns in the early 80's, the export activity of the cement industry was presented as a crucial force in balancing the chronically negative trade balance of the country and therefore of patriotic importance. TITAN was a "blood donor" in this crucial "transfusion" of Greek resources for foreign currency. At the same time, the Greek cement industry was careful to not take due credit for the post-war construction boom of the country. This is perhaps because the "cementification" of Athens and other cities were widely seen as regrettable, especially by the cultural elite. To distance themselves from the monstrous consequences of their product, TITAN employees would say to their friends and family that "cement builds what human commands". The idealized structures that we see on the publicity flyers of TITAN bear little resemblance to the popular polykatoikia, which was by far the largest source of cement consumption in the market.

In light of the exporting activity of TITAN, Greek "earths" were presented as "the stable currency" of the national economy. "Earths" in this case alludes to the raw materials used in the production of cement. Limestone, which is the principal of these materials, is crushed, mixed with a quantity of clay, and the mix is baked at high temperatures to produce clinker. The intermediate product, is further processed and mixed with small quantities of gypsum to finally have what is known as Portland Cement. The positioning of the TITAN factory in Eleusis was very advantageous as it was built



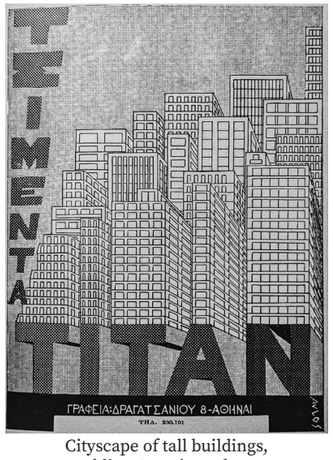
Innovative bridge design realised using TITAN cement.

"The goal is common"

"Transfusion"

Scanned from: Nikos Melios and Evaggelia Mpafouni, 100 χρόνια TITAN 1902-2002 [100 years TITAN 1902-2002] (Piraeus: P. Mpallides & Co., 2002).

Transfusion: if there is something our economy needs – it is foreign exchange. Because the situation that has always prevailed in the balance of external payments can be described as chronic anemia – not to say hemorrhaging. TITAN has always done its duty as a donor: It has established a network of Distribution Centers in the Middle East and Africa and exports half of its production, bringing valuable foreign exchange to the country – $345,000,000 in the last three years. This is no small achievement. To become part of the largest building materials market, you must face all the giants of the world – from Spain to England – and continuously supply quantities while fighting commercial battles at the ends of the earth. Today, our economy continues to succeed. The Athens Chamber of Commerce and Industry recognized this by awarding TITAN the Export Award for the three-year period 1978-1980. AT TITAN, WE ARE INTENSIFYING THE EFFORT

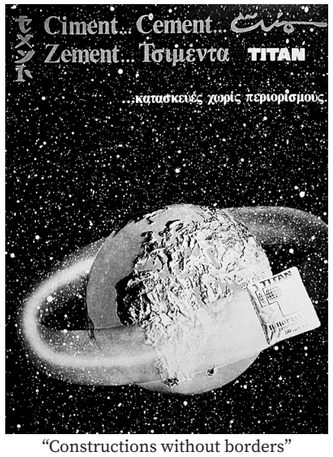


Cityscape of tall buildings, resembling American skyscrappers.

"Luck?"

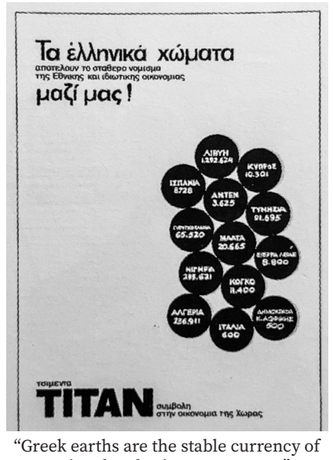
"Independence"

Independence: if we want to limit the technological dependence of our country, the only way is to develop Greek technology through research... and the utilization of Greek scientific potential. For our company, for the past 70 years, this has been the path of development and progress. In our chemical laboratories, equipped with all modern means — from spectrometers to laser rays — as well as in the new anti-corrosion laboratory, Greek technicians and scientists are working. In collaboration with three Greek Polytechnic Schools and International Research Centers, achievements have recently been made, such as: The production of new, more advanced products, such as special cement for oil well drilling (OIL-WELL CEMENT). The utilization of by-products from other industries — such as mining waste, ash, and now phosphogypsum . The use of agricultural by-products instead of imported fuels, directly resulting in foreign exchange savings. The success of new construction methods, such as the method of repairing concrete with a method successfully applied in Thessaloniki after the 1978 earthquakes. These are some of the areas where recent achievements have been made, with even greater results expected in the future. AT TITAN, WE CONTINUE THE EFFORT.



"Constructions without borders"

"Carbon?"



"Greek earths are the stable currency of national and private economcy"

Carbon? Today, at TITAN, for every ton of cement, we use on average 15% less energy than in 1966 and 30% less than in 1960. This means that for our current production of 5.5 million tons, we save 180,000 tons of fuel oil worth $30 million annually. This saving has helped TITAN to survive and grow despite the low price of cement that we have had in Greece for years, at 70% of the average price level in the E.E.C. We are gradually adopting solid fuels like our direct competitors in Spain, Italy, France, and other European countries. Only in this way will we remain competitive. The efforts to substitute oil are nearing completion. This change represents significant investments for our company, but it is the latest in terms of technology and environmental protection. It also means significant foreign exchange benefits for the National Economy by reducing the consumption of imported fuel by 350,000 tons. AT TITAN, WE CONTINUE THE EFFORT

right below a hill that became a limestone quarry, close to a riverbed where clay was extracted, and right on the coastline with its own natural harbor. Logistics are important in the production cement; based on rule of thumb, land transport over 200km increases cost by about 30%. A dedicated natural harbor facilitated not only exports but also the the provisioning of material that was necessary for the production of concrete. Gradually but from early on, the Greek cement industry adopted the large-scale use of Supplementary Cementitious Materials, mineral additives which can be sourced opportunistically and replace part of clinker to significantly lower the cost, while still contributing milder binding properties to the mix. Although the overall chemical profile of the cement is affected, sometimes this modification is actually welcome for certain specialized blends of cement. Such materials can be side-products from heavy industry, such as blast furnace slag from steel production or fly ash from lignite power plants, both of which were in proximity to cement factories.

An additive that extensively used in Greek cement is a kind of natural pozzolanic soil known as “theraic earth”, extracted from certain islands of volcanic geology. Thanks to the use of such additives, TITAN and Heracles managed to use less than 50% clinker for certain types of cement. The result was not only a dramatic reduction of costs but also an important increase in the quantity for sale in an international market of high demand. The cement that was commonly sold for construction in the domestic market was explicitly labeled as the “Greek Type” and contained a high proportion of theraic earth. Its disadvantage was that it would take longer to harden inside the formwork, which would slow-down execution time at the construction site, even though it proved to intensify the hardening process, resulting to more resilient structures in the long term.

While raw material was local to varying degrees, the cement industry is entirely dependent on global trade for certain components that are essential to production. There are two parts of cement production that are highly energy intensive. The first is the crushing of limestone into fine powder which is necessary before it enters the kiln. This energy can be in the form of electricity. Before the advent of solar and wind power in Greece, electricity was produced mostly through combustion of domestically extracted lignite, while to a lesser degree from hydroelectric plants. The high amount of electricity required, similar to that of a town with several thousand inhabitants, makes it quite dependent on state policy, while coordination and special arrangements are often necessary, for example the use of nocturnal pricing.

The second but most significant part in consumption of energy takes place for the operation of the kiln. The very high temperatures

Cement bag of blend labelled as: “Portland Cement of Common Greek Type”
© 2025 HERACLES PANORAMA

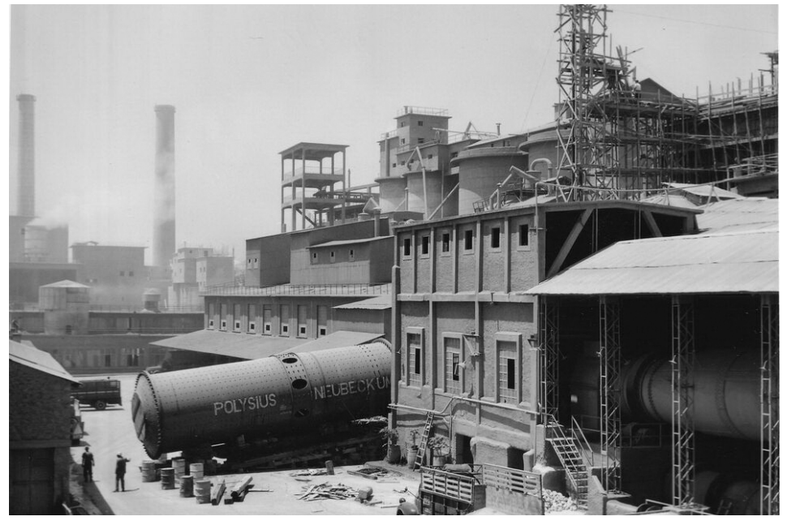
Konstantinos Skokos, retired engineer at TITAN cement, in conversation with the author.

Lefteris Anastasakis, Καινοτομία και Βιομηχανικός Μετασχηματισμός στην Ελλάδα 1950-1973 [Innovation & Industrial Transformation in Greece 1950-1973] (Athens: Kerkyra Publications, 2023).

Lefteris Anastasakis, Καινοτομία και Βιομηχανικός Μετασχηματισμός στην Ελλάδα 1950-1973 [Innovation & Industrial Transformation in Greece 1950-1973] (Athens: Kerkyra Publications, 2023).

needed require the combustion of energy-dense fossil fuels. Before the rise of the OPEC Cartel 1973, almost all kilns were designed to run on liquid fuel, as it was the most convenient and the cost of oil was low. Between 1973 and 1976, energy cost increased by 73% for Greek cement factories and fuel cost became a principal parameter accounting for up to 50% of total production costs. Globally, cement companies placed significant investment to re-configure their kilns for the use of solid fuels such as natural black coal. In Greece it was more common to use pet coke, a by-product of crude oil refineries that was sourced from the United States in large quantities. The price of such solid fossil fuel also increased rapidly after the 90’s which prompted cement production, especially in Europe and India, to further reconfigure towards “alternative fuels” based on a wide array of scavenged resources, from non-recyclable municipal waste, to bio-mass and shredded tires.

The kiln is the part of the factory that absorbs the highest investment in fixed capital; it constitutes the “heart” of the factory and directly determines its production capacity. These machines are gigantic, horizontally disposed cylinders, dozens of meters long and a few meters wide. Made of structural steel, and lined internally with heat-refractory materials, they perform rotative motion to agitate and ensure even heating of the contents, much like a drying machine does for clothes. A set of peripheral contraptions like pre-heating or cooling elements have evolved to optimize performance. A kiln turns and burns incessantly day and night, pausing only once or twice in a year, for maintencance and troubleshooting. Very few manufacturers in the world are capable of fabricating them; the Greek cement industry had a preference for FLSmidth, designed in Danemark but made in the United States, or the Polysius line of German steel manufacturer ThyssenKrupp. The kilns would arrive to the cement factory in parts to be assembled on-site, and the installation process was quite a feat in itself.



Arrival and installation of grinding mill, fabricated by Polysius, in the cement factory of Drapetsona, Athens. 1964

© 2025 HERACLES PANORAMA

This important component of cement production required strong industrial partnerships with sustained communication and consultancy service, necessary for troubleshooting at the factory but also crucial for the kiln manufacturer in ensuring the continuous development of their technology. As early 1920's, German engineers were employed at the factory in Eleusis, who moved on site with their families, to help upgrade the factory's production processes. In the late 1960's TITAN entered a joint-venture with the American Cement Corporation, to build a new cement factory near the town of Patras, which would be the first on the western seafront of Greece. The company was seeking investment opportunities all-over the world, to invest its tremendous profits from the constuction boom in California. The intensive collaboration with American engineers and managers is considered to have had profound a impact on TITAN, both in terms of technology and in terms of business culture.

The cement industry is considered as having one of the worst ratios of fixed capital investment to net value of production; this means that it takes a long time to break-even the cost of building or upgrading a factory, a cost that necessarily involves financial debt due to its great height. As the profit margin in cement production mostly comes from minimizing variable costs, it was paramount to monitor the cost in each part of a complex production process, through precise accounting methods. TITAN adopted a management system from Holderbank Cement, a Swiss company, seeking to optimize production through benchmarking methods. At a corporate level, TITAN trained their engineers, initially in Holderbank seminars and later in VDZ, the union of German cement producers. Patents, certifications and standardization were also crucial in securing the evolution of the industry and its markets, and for this the interaction between institutions across borders were of great importance. The testing and certifications of TITAN cement at the EMPA laboratories in Zurich allowed the company's exports to reach as as far as Brazil in the 1930's, while the European-level standardization of cement in the 90's would remove any remaining obstacles to the access of markets within the continent.

Over time, cement has become a truly global commodity, capable of being produced with identical specifications in any part of the world. However, the specific conditions of its production can vary widely, particularly in terms of labor and environmental conditions. This is perhaps surprisingly evident in a 2012 photography exhibition at the Bern Museum of Fine Arts, commissioned by Swiss multinational cement company Holcim for its centanary anniversary. Photographer Marco Grob, together with Hiepler & Brunier, travelled to production plants of the company in dozens of countries around the world to document the laborers and their workplace environments. Although the project was intended as a homage to those thousands of industrial workers, who are so fundamental to production, it

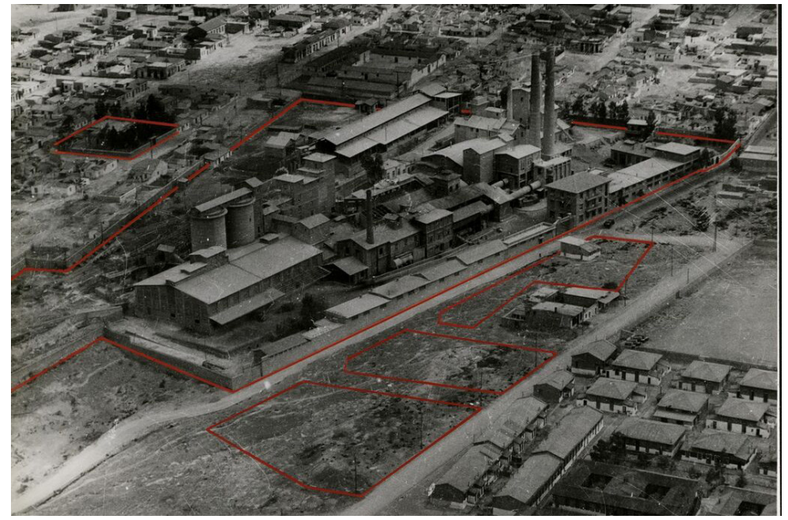
Konstantinos Skokos, retired engineer at TITAN cement, in conversation with the author.

Lefteris Anastasakis, Καινοτομία και Βιομηχανικός Μετασχηματισμός στην Ελλάδα 1950-1973 [Innovation & Industrial Transformation in Greece 1950-1973] (Athens: Kerkyra Publications, 2023).

Nikos Melios and Evaggelia Mpafouni, 100 χρόνια TITAN 1902-2002 [100 years TITAN 1902-2002] (Piraeus: P. Mpallides & Co., 2002).

Marco Grob, David Hiepler, and Fritz Brunier, Industrious (Kempen: teNeues, 2012), page number(s).

Aerial survey of Heracles Cement in Drapetsona, Athens, in 1947.



was shockingly clear how disparate the conditions were from one context to another ,regarding such aspects as protective equipment and safety measures.

As we can see on the public campaigns of TITAN, the company takes pride in its historic commitment to workplace safety and social benefits to its workers. While archival evidence seems to support this position, it is a fact that the positioning of the factory within the town of Eleusis was of significant nuisance to the population, of which all workers and their families were part. Transport of labor power to the production facilities was perhaps an important factor in the early days of the industry, but the factory continued operation on the location until 1976, when it finally moved further inland. The documentary "Mourning Rock" by Filippos Koutsaftis, filmed through decade-long field work in the 1990's, documents the consequences of haphazard industrialization in Eleusis, parallel to the archaeological exploration of the town as an important spiritual center of the ancient world. Through some of the narrative footage and interviews, former employees of TITAN would tactfully point to the heavy nature of their work, as health problems caused in the lungs by inhalation of cement dust led many of their colleagues to premature deaths. On another occasion an elderly woman describes how her drying laundry "cementified" when wind blew from the direction of the factory.

The placement of the Heracles plant in Drapetsona, even closer to Athens, was of similar and perhaps more complicated circumstances. It was surrounded by informal settlements, primarily inhabited by Greek refugees from Asia Minor. This population arrived to Athens in numbers of hundreds of thousands, after the Greco-Turkish war of the early 1920's, and many of their communities were allowed to settle around emerging industrial districts, where they served as cheap labor. An additional source of nuisance here was an elevated

Filippos Koutsaftis, director, Αγέλαστος Πέτρα [Mourning Rock] (Greece: Filmakers Library, 2000), Film.

MLP, "Εναέριος [Overground]," in MLP Blo G Spot, April 2022, https://mlp-blo-g-spot.blogspot.com/2022/04/enaerios.html.

Former quarries in Ano Koryd-
allos, Athens; 1:10.000

© Google Satellite
Edited by author

Former quarries in Nikaia,
Athens; 1:10.000

© Google Satellite
Edited by author

Former quarries in
Tourkovounia, Athens; 1:10.000

© Google Satellite
Edited by author

Former quarries in Vyronas,
Athens; 1:10.000

© Google Satellite
Edited by author

funicular infrastructure, transporting wagons of limestone to the cement factory, over a few kilometers of inhabited land. Sometimes, rocks could spill out over the heads of inhabitants, and in order to prevent injuries, the company placed elementary protective nets in the more frequented parts of the neighborhood. Those living close to the quarries would additionally suffer from the noise of drilling while shrapnel from explosions would rain at times on their homes. Limestone appears twice in the supply chain of concrete. The first time, it is processed to produce cement, using advanced equipment and a lot of energy. The second time it is introduced in raw form as gravel and sand, that is mixed with cement to create concrete. The so-called “aggregate” consitutes up to 80% of the final blend. This material does not react chemically with water like cement does to harden; rather it plays an inert structural role. Gravel and sand pack tightly together while cement fills the gabs in-between to bind the grains together, much like mortar in masonry. Aggregate, together with water, corresponds to roughly half the cost of concrete, the other half corresponding to cement. Unlike cement, the extraction of aggregate does not at all require investment in advanced technology, factory equipment or a tremendous energy consumption; it can be extracted opportunistically, not necessarily at a large scale, and with relatively primitive equipment such as drilling tools and explosives. Its cost comes mostly from the necessity of transport, hence it is advantageous to minimize transport by extracting it as near as possible to its destination. Throughout the construction boom of Athens, several quarries for aggregate would operate around the city, to directly aliment the construction of neighborhoods that were emerging around them.

A crucial development in the evolution of reinforced concrete was the emergence of the “readymix” sector. Until 1970 in Greece, almost all cement was distributed in sacks and very little in bulk. Distribution shops were common in the form of ranches in every neighborhood, where builders could shop for building materials and transport them to nearby construction sites. Cement, aggregate and water would arrive on site separately and they would be manually mixed to prepare concrete for pouring. Readymix concrete involves the centralization of the mixing process to a local distribution point, where the mixing can take place in bulk, with greater efficiency and precision, using mechanized action. Liquid concrete, ready to be poured, can then be transported to the construction site by motorized vehicles. Beyond the comfort and expediency granted by this development, a significant impact it had on the construction site was that it overcame the seasonality of construction work, as in-situ mixing of concrete was not possible during the cold winter months. What did not change was the necessity of positioning near the quarry, to minimize the transport cost of aggregate, and in fact, most quarry operators themselves created readymix units on their locations.

Lefteris Anastasakis, Καινοτομία και Βιομηχανικός Μετασχηματισμός στην Ελλάδα 1950-1973 [Innovation & Industrial Transformation in Greece 1950-1973] (Athens: Kerkyra Publications, 2023).

Distribution of cement by spherical silo carrier vehicles

Distribution of cement by spherical silo carrier vehicles

© 2025 HERACLES PANORAMA

Although this development increases the capital intensity of the aggregate business, operations remain limited to a relatively local scale as liquid concrete must arrive to its destination, before it hardens, within one hour after its preparation. However, as the road network developed, aggregate quarries with readymix units, became larger, fewer and moved further away from the city center. This trend had important implications for the cement industry; as readymix operators became large-scale buyers of cement, mediators between industry and customers, they gained significant leverage on negotiating its price, thereby decreasing the profit margins of the cement industry to their advantage, as was the case with the infamous Calzestruzzi in Italy. This was perhaps easier in the Italian context which was based on smaller and more distributed factories, compared to Greece where cement production was generally centralized and oversize. Nevertheless, Greek cement companies took notice of this threat and reacted by buying out first or by creating their own readymix subsidiaries to maintain control on the market. With the involvement of cement producers in the extraction of aggregate, the latter took a less informal character with increased control on the quality of the product and the conditions of its production.

Today, despite the decade long recession in the domestic construction sector, the Greek cement industry continues to do well owing perhaps to its sustained and growing international presence. TITAN has developed into a multinational, as the company was able to capitalize on the markets that were created through exports, to expand aggressively by establishing overseas distribution centers and later even quarries and factories. Notably, in 2000 TITAN purchased the totality of TARMAC AMERICA, including its two factories in Florida and Virginia, its quarries, as well as its readymix and distribution units. Similarly, the company has developed a network of production and distribution across the Mediterranean, with cement factories in Albania and Egypt but also quarries and distribution units in many other locations. The bulk of its production remains in Greece, where it operates four factories in strategic positions. In 2019, the company was restructured under TITAN Cement International, to facilitate access to global financial market. It was listed on the Euronext stock exchange in Paris and Brussels where the board of the company moved, while the headquarters remain in Greece. TITAN America, an overseas subsidiary, is earmarked for listing on the New York Stock Exchange. It is is perhaps noteworthy that despite being a publicly traded company from very early on, its leadership has remained within one of its founding family lines, now in its fourth generation; a specimen of fusion between Western corporate culture and the Mediterranean family-business archetype.

Heracles took a somewhat different trajectory into globalization. In the early 80's the company's board faced conflict with the socialist government of the time and the company was essentially nationalized by force. A decade later, the next government, this time neo-liberal, privatized the company by selling to Calzestruzzi, a fore-mentioned Italian readymix company which was attempting upstream integration of supply chain. Its ambitions were interrupted as the company's board faced prosecution by the Italian authorities because of its alleged connections to the mafia. Heracles was further sold over to Blue Circle, a British multi-national cement manufacturer, which was itself bought by Lafarge, a French multinational, merging finally with Swiss-based multinational Holcim. The operational model of Heracles in Greece is more centralized than that of TITAN; when the Drapetsona factory in Athens was closed in 1983, all production was concentrated between two very large factories, in Mylaki and Volos. Both situated on private harbors, cement is transported from there by sea to a multitude of coastal distribution centers, around the country and abroad. Interestingly, different brand labels are used for each of the company's operations, blurring the fact behind all of them is essentially the same parent company. Cement continues to sell in the domestic market under the original Greek label, "Heracles", preserving brand legacy in the national market. When it comes to sensitive matters, new or foreign labels are used, mysterious and little known to local population. For the factories and distribution centers, "Lafarge" is preferred, while the aggregate quarry close to Athens, the 5th largest in Europe, operates under "Holcim". Little effort is taken to hide those facilities, compared to those of TITAN which are always hidden from plain view behind topographic features. "Lava" is yet another subsidiary of Holcim through the Heracles Group, responsible for mining and quarrying pozzolan, silica sand, gypsum and pumice, mostly from islands in the Aegean Sea. Those are highly valuable resources and can be used to produce advanced or otherwise specialized blends of cement and concrete, while they are equally precious as buildings materials in themselves.

Lefteris Anastasakis, Καινοτομία και Βιομηχανικός Μετασχηματισμός στην Ελλάδα 1950-1973 [Innovation & Industrial Transformation in Greece 1950-1973] (Athens: Kerkyra Publications, 2023).

Nikos Melios and Evaggelia Mpafouni, 100 χρόνια TITAN 1902-2002 [100 years TITAN 1902-2002] (Piraeus: P. Mpallides & Co., 2002).

INTERLUDE

VISUAL ESSAY

0.1

0.2

0.3

0.4

0.5

0.6

0.1 Occasionally, remnants of a lost—though not so distant — material culture is found in ruins, sitting on plots miraculously spared from the relentless urbanization of the post-war period.

0.2 Most of what is Athens today consisted of orchards and arrid grazelands, which were gradually collonized through settlements and unauthorized construction practices.

0.3 Once legalized, those would grow into apartment blocks through a land-for-flats system driven by small-scale private enterprise. Reinforced concrete construction had a significant role.

0.4 It was common practices for neighborhood-scale contractors to paint their “business card” on top of what they built. This would allow them visible to potential buyers of apartments but also to owners who wanted to develop their small plot of land.

0.5 Reinforced concrete construction had a significant role in enabling the mass-urbanization of an entire society. However, inherrent complications are starting to emerge, raising questions regarding the fate of our built heritage.

0.6 Repair, restoration, and reinforcement of these structures is an important technical challenge. In Greece, ENKA is one of few engineering practices specializing in this domain. Originating in industrial or infrastructural applications, the company has started to take on apartment blocks as well, although such operations remain a privilege to well-off circumstances.

2. ELEUSIS

3. "THE WEST SOLUTION"

5. MOUNT PENTELICON

1. DRAPETSONA

4. ATHENS

GREATER ATHENS REGION — 1:200.000 —NORTH ^

- active: limestone
- active: clay
- active: marble
- inactive: limestone
- inactive: clay
- inactive: marble
- road
- contour 50m
- sea

1.1

1.2

1.3

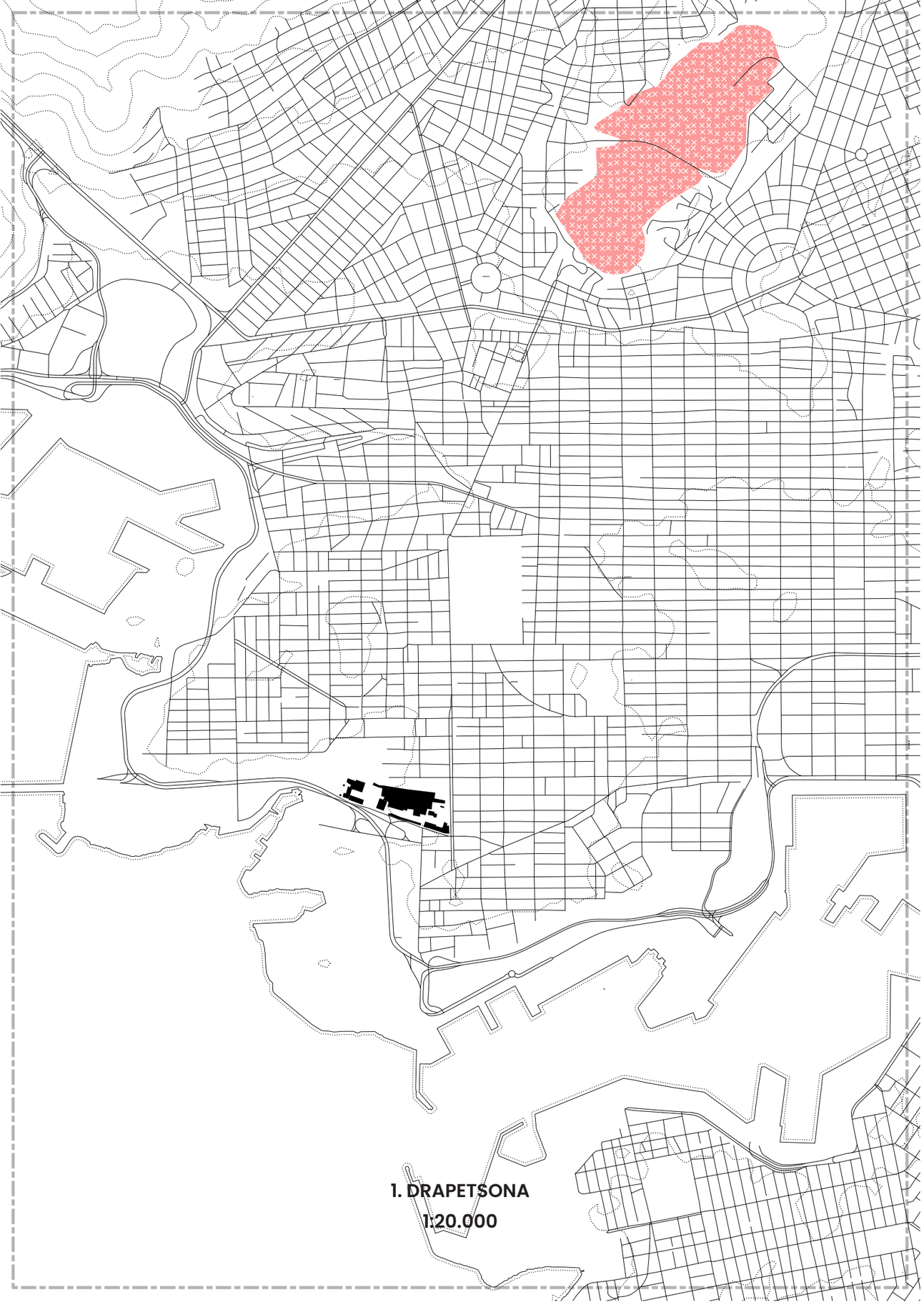
1.4

1.5

1.6

1.7

1.8



1.1 The defunct cement factory of Heracles with the neighborhood of Drapetsona in the background. The striped chimney belongs to the local electricity plant, also defunct.

1.2 After the factory closed in 1983, Drapetsona rapidly developed with tall apartment blocks, through the usual system of land-for-flats.

1.3 Heracles Cement changed ownership 4 times between 1981 and 2007, when it was finally bought by Lafarge. The latter merged with Holcim in 2015. Each of the three brand labels are used circumstancially for different occasions.

1.4 Today, the facilities are used as a storage and distribution center, providing building materials in both bulk and retail. In what used to be the space of the rotary kiln, pallets are stacked with concrete block.

1.5 This is the empty “heart” of the factory. A gigantic, horizontally disposed cylinder, would turn and burn night and day to produce clinker. After the factory closed the kiln was sold as scrap steel.

1.6 Next to the kiln, clinker would be mixed with other minerals to produce diffrent blends of cement.

1.7 The proximity to the sea, with a dedicated natural harbor, was an important factor in the placement of the factory, facilitating exports and provisions.

1.8 This is of course still useful, in the current function as a distribution center.

2.1

2.2

2.3

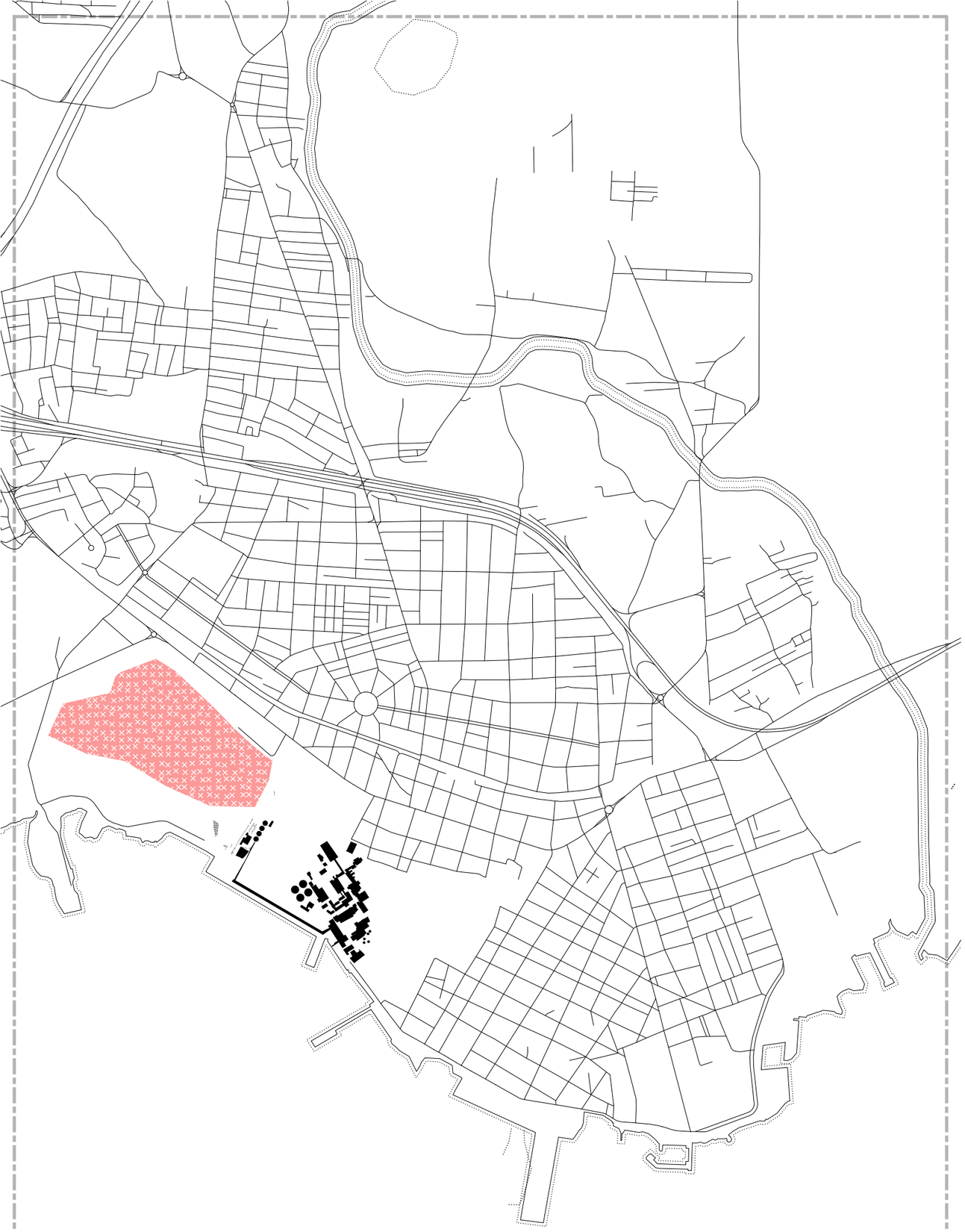
2.4

2.5

2.6

2.7

2.8



2. ELEUSIS

1:20.000

2.1 Established in 1902, TITAN cement in Eleusis is the oldest cement factory in the Balkans. Production of clinker stopped in 1976 and the location remains in use as a storage, packing and distribution facility. Cement is loaded on boats in bulk or in sacks.

2.2 Unlike Heracles in Drapetsona, the facilites here function as direct extension of a newer factory, a few kilometers inland.

2.3 The complex evolved and expanded through its long history of operation, agglomerating layers from different industrial epochs.

2.4 INTERBETON is the readymix subsidiary of TITAN. An arsenal of mobile equipment lays on a cemented field next to the factory.

2.5 A hill on one side of the factory was quarried for limestone as raw material. One is greeted from afar by a soaring absence, a volume suggested by two sharp brackets of remaining rock.

2.6 The “crater” inside the hill has been handed over to the town of Eleusis, which makes use of it as storage and parking space for municipal equipment.

2.7 On the other side of the factory stands the archaeological site of the histroric city, an important spirutual center of the ancient world. Layers of remnants and debris tell a material history that spans millenia.

2.8 It is not a story of progress but one of piecemeal transformation. Marble, stone, brick and earth, concrete ancient and new, wood, steel, glass and plastic, a multitude of materials are found here in coexistance, and the order in which they join together or replace each other is entirely subject to the twists of history.

3.1

3.2

3.3

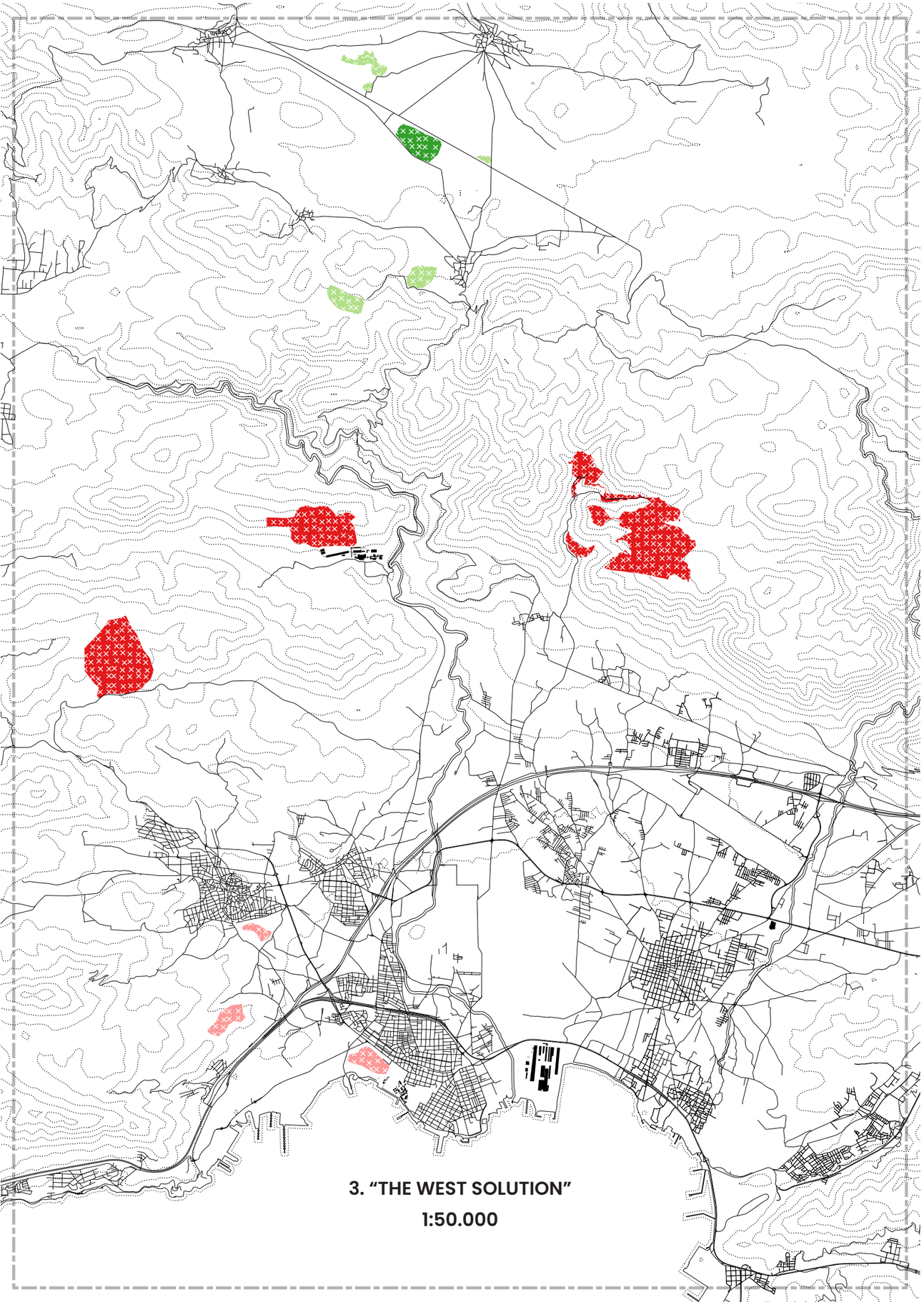
3.4

3.5

3.6

3.7

3.8



3. “THE WEST SOLUTION”

1:50.000

3.1 In 1973, production moved from Eleusis a few kilometers north to Kamari, a rather discreet location concealed from casual view behind natural topography.

3.2 As with the previous location, a great advantage is the in-situ extraction of limestone, the principal raw material for the production of cement.

3.3 Clay, which is also required in great quantity for cement production, is extracted from the Dervenochoria plateau, a few kilometers to the north. The villagers in the area find occupation between farmwork and industry.

3.4 Apart from TITAN, a portion of the clay extracted from this plateau is used for brick manufacturing in the nearby plain. This geographic constellation in the west of Athens has been described as a “solution” for the city, owing to its combined proximity and relative obscurity, which allowed industrial activity to operate conveniently and with minimal disruption.

3.5 The only remaining brick factory in the region, ran by the fourth generation of the Kokkinogenis family. The name litteraly translates to “Redbeard”.

3.6 The Redbeards were one of many families of brick manufacturers who settled as internal immigrants in the lowlands of Athens during the post-war period. Raw material was extracted from the clay-rich ground around the Kifissos riverbed. The brickworks were initially small and numerous but with time they merged into bigger ones, moved out of town or went out of business.

3.7 The historic steel factory of Chalivourghiki, visible to the east over the rooftops of Eleusis, has been out of operation since the financial crisis. Its production of reinforcement bars was crucial to the regional construction sector.

3.8 Over the rooftops of Eleusis, we can also see the regional limestone quarry of Holcim, a Swiss multinational cement company. Little effort was made to hide behind topography, unlike the two other major quarries of the region.

4.1

4.2`

4.3

4.4


ΑΣΤΗΡ ΛΑΤΟ
ΤΗΛ 2910 291-5 2930 801-5 FAX.
TOTALLY
MOOD!
RN

4.5


POOKIE
<3

4.6

4.7

4.8

4.9

4.10

4.10

4.11

4.11

4.12

4.13

4.14

4.15

4.16

4.19

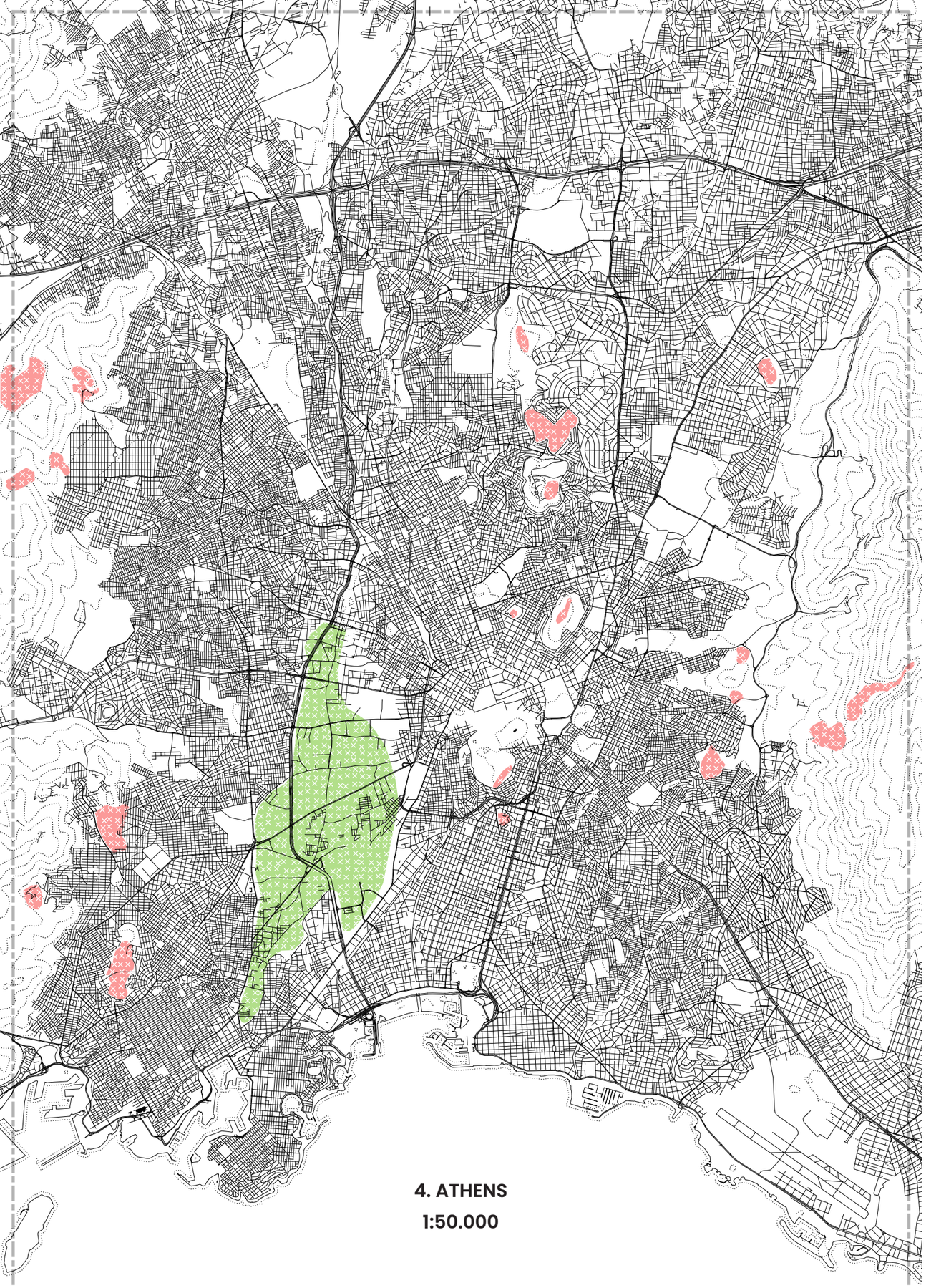
4.20

4.21

4.22

4.23

4.24



4. ATHENS

1:50.000

4.1 In the distance, we see one of the many old limestone quarries in the periphery of the city. It featured a large kiln, as it was operated by a company producing lime. It is likely that aggregate was sold as well, since Petroupoli, the area below, was a major site of unauthorized settlement. The name translates to “city of stones.”

4.2 Closer to the center of the city lies a larger complex of limestone quarries. I used to play here with my friends, though we never made the connection, that the rock removed from here was quite probably inside the reinforced concrete structures of our homes.

4.3 Before aggregates—mandated by the rise of reinforced concrete— quarrying activities often began for small-scale lime production. To minimize cost of transport, the kiln was built on top of the very rock that it was churning down.

4.4 Lime was widely used in the past — since ancient times, often as mortar or plasterwork. Like cement, its production involves the heating of limestone, though at much lower temperature. In terms of complexity and capital investment, the two processes are vastly different in magnitude.

4.5 “ASTER LATO”, a readymix concrete provider and subsidiary of Heracles Cement, accounts for most of the extracted volume on the quarrying complex.

4.6 Inside the silo, cement was mechanically mixed with water, and aggregate from the quarries. Liquid concrete, ready to pour, was then loaded onto carriers for transport to construction sites.

4.7 If concrete is not poured in time, it hardens inside it container. For this reason, transport time should generally not exceed one hour.

4.8 Even large operators like ASTER LATO would operate at a relatively local scale, mostly serving the neighborhoods direclty around them.

4.9 Aggregate comes in different qualities and sizes. The choice of type and proportion in the mix gives different results in the properties of concrete. Here, separating walls organize heaps of different types within compartments.

4.10 Readymix concrete became increasingly popular after the 1970's. Nevertheless, it remained possible to buy aggregate directly on site in bulk or retail. Those neighborhood-scale quarries would sometimes sell other building materails as well, serving as shopping centers for builders.

4.11 After the quarries closed, residential development intensified in the surrrounding neighborhoods. In the Nikaia quarries, the former readymix unit has been integrated into a small municipal park.

4.12 Inside, an array of "taps" would manually open to let concrete pour into carriers. The low height under the silo suggests that transport was done with small means.

4.13 Part of the quarry itself was used for the construction of a large university building. Another part remains as urban wilderness.

4.14 Some houses are overlooking the cliff that was once advancing towards them.

4.15 A large open-air amphitheater was placed inside another quarry of the complex. This and other theaters that were built in former quarries throughout the 1980's have now become some of the most esteemed institutions in the cultural life of the city, and host a multitude of important performances and concerts.

1.16 Sports facilities, especially football, always remain part of the mix.

4. 17 What used to be the quarry of the Heracles in Drapetsona, was eventually transformed into a public park. It bears the name of the prime minister who nationalized the cement company in 1983 and discontinued industrial activities in the area.

4.18 A portion of the site was used for the construction of a large public school. The industrial coastline, where the cement factory stands, can be seen further down in the distance.

4.19 Further up on the hills, the quarries of Ano Korydallos are not as integrated in urban life. The land around it used to be a protected pine forest but a fire allowed its eventual urbanization through informal practices.

4.20 The location included readymix units as well as small manufactures for pavement slabs or prefabricated elements. There is not much to obstruct entrance to the crater, where is a makeshift racing track for model cars lies below the dramatic precipice of the quarry.

4.21 Another open-air theater is hosted inside the Petroupoli quarry, that we saw from afar in the first picture. Legendary performances have taken place inside this lunar landscape. It is currently under renovation.

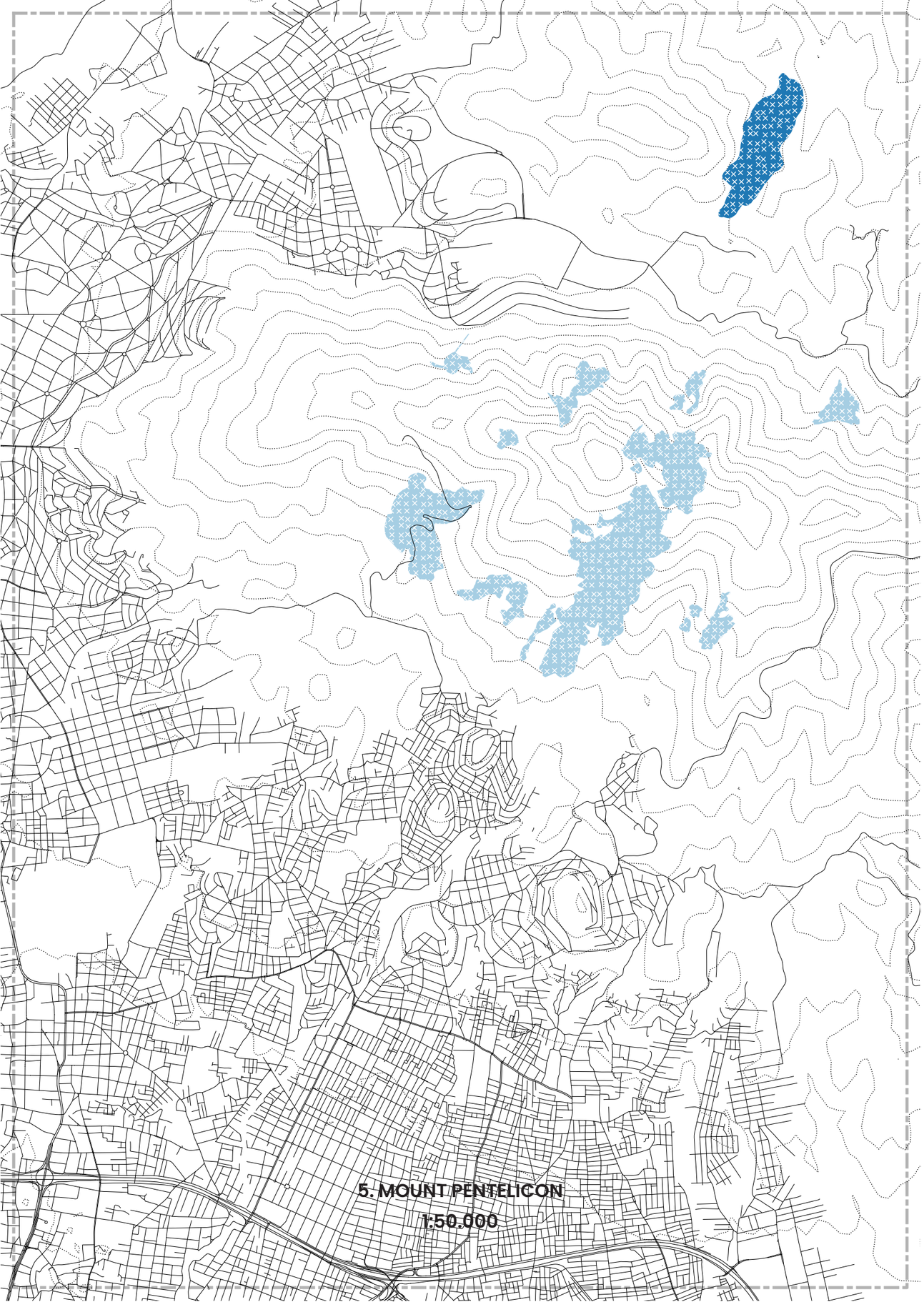
4.22 Not far, although hidden from plain view, a larger quarry has been transformed into an extensive sports complex that is well cherished by local population. Ironically, while those local extraction sites enabled the informal and unregulated development of the city into an endlessly dense and mineral fabric, the quarries themselves were the only spaces left empty, open and outside the real estate market, allowing their eventual appropriation as a much needed urban commons

4.23 The Heracles Cement factory in Drapetsona, and in the foreground its grandchildren. The football field is named after the company, which donated its construction to the muncipality. Football culture has historically played a significant role in industrial development, serving to mediate struggles between social classes, identities and convictions.

4.24 In the players quarters under the concrete tribunes, a motto is written on a big red panel at the deep end. It reads: "Football is sport, not war"

5.1

5.2



5.1 In the north part of Athens, Mount Pentelicon has been quarried for marble since ancient times. Pentelic marble is found in important monuments of antiguity like the Parthenon, while it was even used to dress the nearby Marathon dam, built in the 1920's. With time, quarrying activity moved towards the back of the mountain, hidden from the side of the city. While earlier methods involved surface scraping, modern quarrying techniques have introduced in-depth extraction methods, allowing marble to be carved out from within the mountain's interior.

5.2 The private company operating the quarries since 1877, takes pride in its heritage:

"More than 80% of the world's Pentelic marble, from antiquity to today, has been supplied by us. While our marble graces buildings and monuments across all eras and continents, we have also directly provided both our marble and expertise to projects around the globe. From New York's 5th Avenue to the foothills of Mount Fuji, we have built an impressive project portfolio over the past century, which includes..."

FROM CITY TO ROCKS?

TOWARDS MATERIAL AGENCY

Reinforced concrete is both a marvel and a liability. As we know, concrete resists compression while steel resists tension, and their compatibility—due to sharing a similar coefficient of thermal expansion—produces a composite material that is exceptionally strong, versatile, and durable. Furthermore, its primary raw materials, iron ore and limestone, are abundant in the Earth's crust, even though their processing is highly energy-intensive and environmentally destructive. In the past, low cost of energy and lack of regulation on environmental damage has allowed these materials to be produced on a massive scale and to be sold at very low prices. If reinforced concrete is a pact with the devil, this is the first clause.

The second clause is that steel rusts. While cement is highly airtight and can protect its steel content for decades, air and moisture inevitably infiltrate and lead to corrosion. The resulting condition, known as 'concrete cancer,' compromises the structural integrity of buildings. Degradation can be treated by removing the affected concrete, cleaning and coating the steel to prevent further corrosion, before recasting new concrete around it. The operation is costly and significantly demanding in equipment and technical expertise. Furthermore, such repairs perpetuate dependency on cement. While this may be justified for preserving public heritage structures or essential infrastructure, can it reasonably be scaled to address a whole multitude of private residential buildings?

Reinforced concrete does not reveal its inner workings. Yet those inner workings—from the chemistry of cement and the granulometry of aggregate to the precise placement and joining of steel reinforcement—are fundamental to its functionality. The smooth, hard surface that we see is merely a thin outer layer of cement, a result of direct contact with formwork. The material is perceived

as monolithic, homogeneous and therefore immutable like solid rock; but its steel entrails, although functionally vital, inherently complicate its endurance in time as they rust and cause it to degrade. The mental opacity imposed by the hard and homogeneous cement surface leaves us feeling powerless to engage with it, as we lack intuitive or practical knowledge on its mysterious workings. Agency is reserved for scientific experts, who are trained to conduct detailed surveys and operations between on-site inspection and laboratory analysis. Without access to such expertise, common citizens are left to rely on speculation or superstition when it comes to assessing the integrity of the structures they inhabit.

In recent years, significant corrosion of the material has been observed in buildings, not due to any external mechanical action, such as earthquakes or load stresses, but as a result of natural aging. While reinforced concrete is falling short of its original promises of resilience, considerable effort is placed in obscuring this embarrassing reality. In Western building cultures the restoration of reinforced concrete is often performed in a way that dissimulates its own traces, to perpetuate the image of the material as one that is immutable, contributing to the absence of public awareness on this important aspect. To a certain extent this is also because the material is relatively recent, in the order of a century, in contrast to earth, stone or wood which have been used as building materials for millenia. [x]

Sarah Nichols, "Matters of Care," in The Great Repair – Politics for the Repair Society, 82–85, ARCH+ no. 250 (May 2023).

In Western Europe, collective residential housing was typically built by large-scale developers and contractors, while residents typically rented their domestic space, holding little agency or concern to act upon it. According to Sergio Ferro, reinforced concrete was introduced as a way to reorganize the construction trade into a more subordinate body, based on the fact that the knowledge of the building technique was was not yet part of any popular building culture but constructed through scientific research:

> *In the case of concrete, the advantages for capital began to draw attention later (in France even later than in England) and were not limited to an immediate cost reduction. Most important was that concrete, unlike iron, did not entail any historically accumulated know-how, any tradition of crafts that welded the alliance of the workers in charge of its production. This absent or incipient know-how did not, as did the crafts of stone and wood, constitute a weapon, a workers' monopoly to be used in class struggle and to reinforce strikes of direct action. Concrete was a weapon—but for capital."*

Sergio Ferro, "Concrete as a Weapon," in Architecture from Below: An Anthology, ed. Sergio Ferro (London: MACK Books, 2024).2023).

This allowed a thorough and controlled division of labor, where, just like in industrial production, individual construction workers are limited to a exercising a very specific and isolated action, which requires little skill, making labor cheap, interchangeable and of little bargaining power. Furthermore reinforced concrete construction

was considered to be inherently resistant to popular appropriation by builders, due to to its fundamental complexity.

> *Even more than iron, this artificial material requires calculation, precise technical details, exact quantification of components, and so on. It implies complex knowledge that has little relation to the empirical know-how and approximate methods of masons and carpenters [...] Such instruments were inevitably in the hands of engineers and technicians, who, following the customs of the industrial management that had by then invaded every corner of society, were not willing to disclose them to the workers [...] No other means of construction allowed such a satisfactory separation of the mental from the manual elements of labour.*

Sergio Ferro, "Concrete as a Weapon," in Architecture from Below: An Anthology, ed. Sergio Ferro (London: MACK Books, 2024).

Nevertheless, the art of building in reinforced concrete is not entirely impervious to appropriation by popular building culture. As we have seen in the first chapter, during the post-war mass-urbanization of Greece, the knowledge of reinforced concrete seems to have "leaked" among construction workers, in the Promethean sense, who were able to overcome division of labor between formal and informal practices. This had a powerful and emancipatory effect as it gave construction workers unprecedented agency in the development of the city but also in their professional self-determination. There are however some limits. It is perhaps telling that despite a virtually high degree of constructive freedom, the building stock in Athens is impressively homogeneous in type and morphology, with very little variation. Despite the professional and social emancipation of the construction workers it was not possible without expertise in technology and design to produce enough evolution in the production of the built environment, through critical reflection of building practice.

Although such a trajectory is legitimate in the context of vernacular tradition, it becomes problematic at the overwhelming scale and footprint of a modern city like Athens. Furthermore, the emancipation of construction work that emerged from the popularization of reinforced concrete turned out to be short-lived. Even in the heroic years of construction, when the work was relatively well paid, the physically difficult and damaging nature of the work was making it a temporary occupation in most cases. In the 1960's, the president of the National Technical Chamber observed that no other production sector is subject to such abandonment by workers and consequently no other sector lends itself so well to migration. "From 180.000 workers, today 50% of the total have quit and perhaps 70% of the skilled ones. The gaps left by the skilled ones who leave are filled by unskilled ones. In this way, a current is created from unskilled to skilled and from the Greek countryside to the Greek city, where living conditions are more humane and the demand for skilled work is greater."[x] Skilled workers would eventually either become contractors themselves, change profession

Dimitra Lampropoulou, Οικοδόμοι: Οι Άνθρωποι που Έχτισαν την Αθήνα, 1950-1967 [Builders: The People Who Built Athens, 1950-1967] (Athens: Bibliorama, 2009).

or emigrate to pursue higher wages abroad, limiting the availability of skilled labor in the local construction sector. The high turn-over of employees in construction work is not an innocent or spontaneous phenomenon. As illustrated in *Chantier Interdit au Public*, but also in older works such as *The Seventh Man* it is generally established that modern construction practice actually prefers to employ seasonal migrant workers. This is exactly because it prevents the excessive development of skill while at the same tie obstructs dynamics of acquaintance and solidarity among the workers and the contextual community, keeping labor inexpensive and vulnerable to exploitation. When the "heroic" period of construction in Athens faded out, the generation of its protagonists dispersed into other professions and the transmission of accumulated construction knowledge stopped trickling down from one generation to the other.

John Berger and Jean Mohr, A Seventh Man: A Book of Images and Words About the Experience of Migrant Workers in Europe (London: Penguin Books, 1989).

Nicolas Jounin, Chantier interdit au public: Enquête parmi les travailleurs du bâtiment (Paris: La Découverte, 2023).

Here, the durable and low-maintenance nature of reinforced concrete, becomes yet another obstacle to popular agency, as constructive knowledge has enough time to fade within a community in the long interval between construction and repair. In contrast to reinforced concrete, "building techniques that require periodic maintenance, like rammed earth, stone masonry, or thatched roof construction, keep know-how alive through regular cycles of repair. Each maintenance cycle can be used to train new laborers and is income for local workers. As long as know-how remains, what is treasured can be maintained for generations and new projects can also employ the same techniques". The necessity of maintenance as cycles of renewal, produces and reproduces tacit knowledge. Today, few generations after a vibrant popular building culture built what constitutes a modern city in the span of two decades, "labor shortage" has entered political discussion as a major challenge for the Greek construction industry, at the same time as unemployment rate is among the highest in Europe.

Ilka Ruby and Andreas Ruby, eds., The Materials Book (Berlin: Ruby Press, 2021).

The *Materials Book* advises: "If construction creates employment within the community, projects have an immediate local benefit through the influx of wages and the potential introduction of new skills. If work is done remotely or workers have been transported to the site, under what conditions has it been conducted, and on what grounds"? At the moment, a high amount of investment in commercial real estate, as well as tourism and transport infrastructure, is fueling a construction boom that is in desperate need of working hands. This has prompted negotiations, both within the government and with other states, to grant temporary work-visas to hundreds of thousands of immigrants, addressing indirectly the refugee crisis of the last decades which is still on-going in detention camps.[X] These work-visas would be entirely conditional on employment and can be immediately revoked if employment is lost, something that obviously makes their subject highly vulnerable to exploitation. There is of course nothing humane about this prospect, and it would do little to towards the European-level challenge, as

Ilka Ruby and Andreas Ruby, eds., The Materials Book (Berlin: Ruby Press, 2021).

Eleni Varvitsioti and Amy Kazmin, "Greece to Integrate Irregular Migrants amid Labour Shortage," Financial Times, September 26, 2023.

refugee integration which should not be dependent on exploitative practices.

In 2012, the Greek state put up for sale a 6.2 million m^2 urban plot known as Ellinikon, the site of the former Athens International Airport. A prime location along the coastline and in proximity to the historic city center, it makes for one of the most lucrative real estate opportunities in the world. Through an international tender process, the acquisition of the plot was awarded to real estate firm LAMDA Development, a dominant player within Greece but rather small compared to its international competitors. Indeed, the monumental scale of the development, currently the largest in Europe, is entirely unprecedented for the country. The acquisition of the plot and undertaking of the project was made possible through the financial backing of Swiss private banking group EFG International, owned by a billionaire of Greek origin. In what sparked controversy, the land was sold for only 915 million Euros, while different sources valued the asset between 3 and 8 billion.

Sophia Davaris, "Urbanisme en Grèce: Athènes construit une ville nouvelle," Tribune de Genève, October 9, 2022, https://www.tdg.ch/urbanisme-en-grece-athenes-construit-une-ville-nouvelle-592210750257.

The bargain sale was defended with promises of wide public benefit, including a 2 million m^2 metropolitan park, a sports center, and local infrastructural up-grades concerning traffic and water management. Moreover, the execution and operation of the project expects to massively mobilize the national economy, contributing 2.5% to the GDP over the next years. However, the core of the investment relies extensively on luxury residential and leisure amenities clearly geared towards a global elite and largely inaccessible to local population. While urban planning and architectural design were trusted to prestigious international practices such as Normal Foster, construction work has been taken on by a handful of gigantic construction companies that are based in Greece but their activities extend to the Balkans and the Middle East. These companies share an oligopoly in the infrastructural development of the country and are widely considered to hold clientelistic relations with the State. French multinational contractor Bouygues International was exceptionally engaged for the construction of the Riviera Tower, a residential skyscrapper designed by Norman Foster, as such a construction is unprecedented in Greece and the required expertise is missing. Global engineering consultants like AECOM were also engaged to contribute expertise to the execution of the overall masterplan. Swiss multinational cement producer Holcim, which is involved in the project through its Greek subsidiary Heracles, is promoting Ellinikon as a flagship project, a terrain of experimentation for the development of innovative products in the quest of performance and sustainability. However, cement will never be a climate friendly material, and there is nothing in the project that is not made of reinforced concrete. LAMDA Development considers that the accumulation of expertise through the undertaking of the Ellinikon project will position the Greek construction industry as a "global player". It is questionable whether this kind of expertise is what is

really needed in the world, or in Greece for that matter.

According to the 2021 building census, 46% of residences in Greater Athens are inside buildings constructed between 1961 and 1980, the “heroic” era of post-war economic development. Virtually all of these buildings feature reinforced concrete load-bearing structures. Taking into account the typical projected lifespan of 50 years for such structures, a substantial portion of Athens’ residential stock can be considered within a critical phase of service life. The perishability of reinforced concrete is of course exacerbated by poor maintenance. Although data on building upkeep is scarce, it is perhaps telling that the 2011 census revealed that 64% of residences built between 1961 and 1980 lacked any form of thermal insulation whatsoever. Perceptions of compromised construction quality are common, ranging from substandard workmanship and insufficient steel reinforcement to questionable blends of cement, all in a logic of reducing construction cost. Nevertheless, the building stock of Athens has repeatedly withstood seismic shocks in recent decades, inspiring relief and optimism of miraculous tint among residents. It was a running joke among employees of TITAN Cement to attribute this resilience as a testament to the “god of cement”, a god who “forgives”.

Konstantinos Skokos, retired engineer at TITAN cement, in conversation with the author

The high rate of homeownership in Athens stands on a regime of horizontal property, where individual apartment owners share

Opposite: “currently the largest urban redevelopment project in Europe, the Ellinikon alleviates development pressure away from the historic core of Athens. The 243-hectare (600-acre) Park is the centerpiece of a mixed-use district that will create a new center of gravity for the city.”

© 2024 Sasaki Associates, Inc.

Below: current state of construction site in Ellinikon, Athens. August 2024.

Photographs taken by author.

responsibility for the maintenance and repair of structural and technical systems in the buildings. Decisions require unanimous consent among owners, and financial burdens are shared. Given the challenging economic conditions, many residents cannot afford necessary repairs, and the state lacks the capacity, or at least the political drive, to support maintenance on such a vast scale. To some extent, the situation is similar in the heritage of large-scale state housing in western Europe, like the grands-ensembles in France. In those often immense structures, typically constructed in reinforced concrete, residents were eventually allowed to become owners through “right to buy” policies, only to find themselves today obliged to pay maintenance costs in the order of what they would pay in rent. A much more frightening prospect, is the example of the Noailles tragedy in Marseille, where a centuries old stone residential building collapsed, costing life to 8 residents. In panic reaction to the tragedy, the authorities moved on to evacuate a large number of buildings in the city which were suspected of poor structural condition due to lack of maintenance. Hundreds of families, mostly of vulnerable social groups, were forced to live precariously for years before they could return to their homes while a number of properties were expropriated by the state.

Structural maintenance is not the only challenge those buildings face. Most of them are poorly insulated, a combination of financial and energy crisis has made ‘energy poverty’ a household term. As

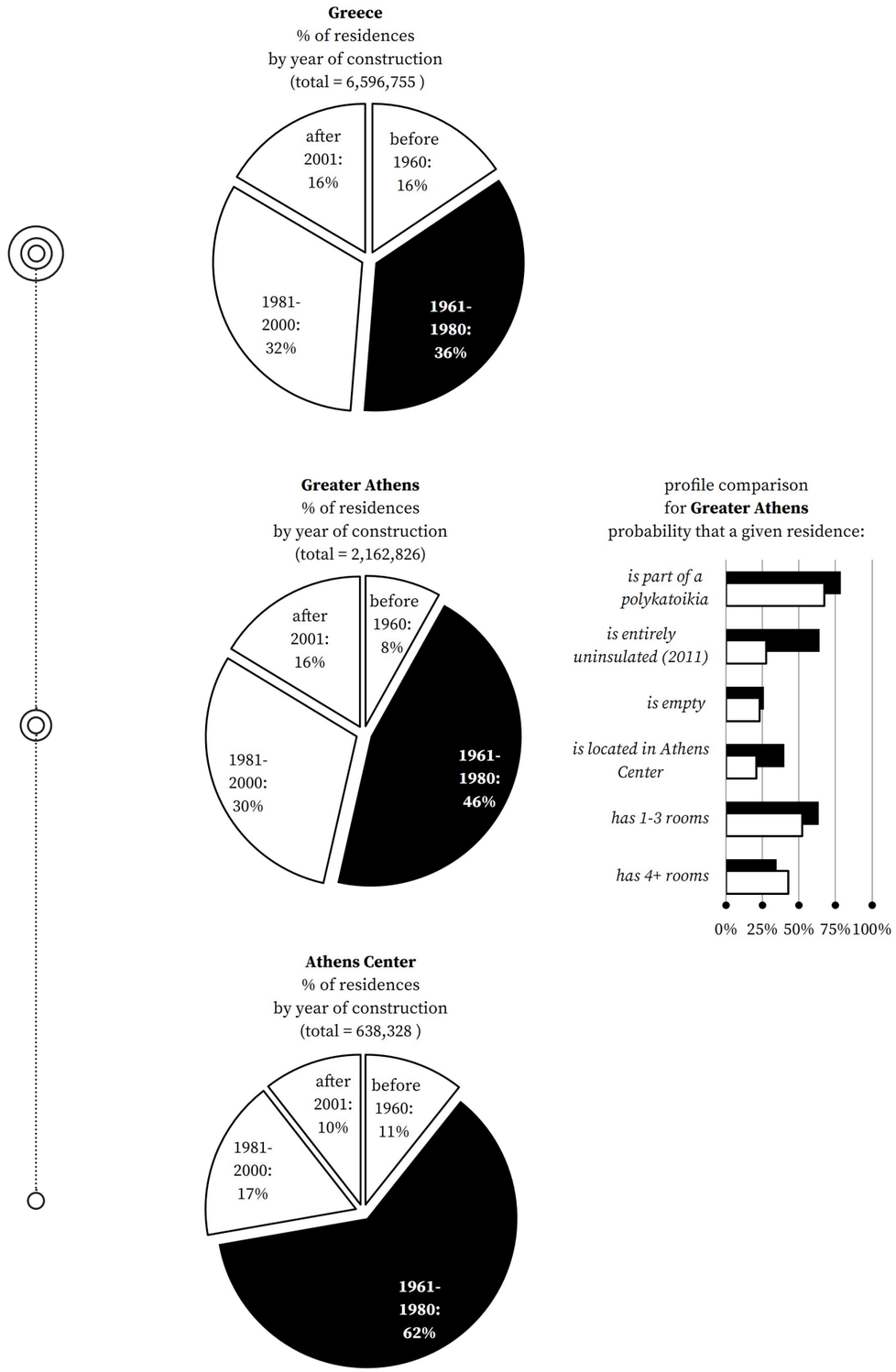
explored by Fereniki Vatavali in *Geographies of Energy Poverty in Athens during Crisis*, centralized heating based on petrol, standard for the post-war apartment blocks, was paralyzed in many occasions for the whole block when not all apartments could contribute to the expenses. Residents increasingly disconnected from centralized heating, opting for individual solutions such as electric heating stoves or air-conditioning. After 'energy poverty', the new household term has become 'housing crisis'. The inability to pay for maintenance and operational costs poses a direct threat to the very foundation of small-scale private property as over time, residents may find themselves forced to abandon their homes. Although resident home-ownership is common in Greece, primary residence is no longer protected by law. Expropriation and liquidation of apartments is possible for the servicing of even small personal debts, of which maintenance and operational costs can become a common source.[X] Stories of forced eviction have been terrorizing the Greek public over the last years.

In her work *Immobile*, artist Sofia Donna makes the case that the typical regime of co-ownership in the polykatoikia provides a natural buffer against gentrification or financialization, as securing an apartment does not allow an investor to directly speculate on the land-value of the apartment block. Most decisions on the building legally require absolute consensus among the owners, and it is often possible to resist undesirable transformation even as minority. However, as soon as a legal person can seize the ownership of all apartments in a block, there is nothing that prevents the complete redevelopment of the property. In the best case, this involves thorough renovation of the building, while in the worst case it involves demolition, and construction of a new building, not fundamentally different from the old one, but perhaps with even higher floorspace index and a touch of neo-imperialist aesthetic. It becomes interesting at this point, to consider the polykatoikia as an element of cultural heritage, as urged by Ioanna Theocharopoulou, and to protect it accordingly. Such legislative action would not only preserve the character of the city, but would create a social buffer by disabling the aggressive redevelopment of the urban fabric. It is perhaps important that the existing fabric does not become fetishized in the process, as this would have similar adverse effect in the long-term. To prevent this, the quality of built cultural heritage must not be decoupled from the community that inhabits it. Rather, the community should be empowered to develop agency on this heritage, in both spatial and material terms.

The challenge cannot be underestimated. The very morphology of the polykatoikia, even for those built after 1980 when insulation became mandatory, complicates aspects such as energy performance as the ubiquitous façade-long cantilevering balconies act as significant thermal bridges. These elements are perhaps the most iconic feature of the polykatoikia and an important component of the social

Fereniki Vatavali and Evangelia Chatzikonstantinou, Γεωγραφίες της Ενεργειακής Φτώχειας στην Αθήνα της Κρίσης: Τρία Κείμενα και Έξι Ιστορίες Πολυκατοικίων [Geographies of Energy Poverty in Athens During Crisis: Three Texts and Six Stories from Apartment Blocks] (Athens: Angelus Novus, 2018).

Ioanna Theocharopoulou, Builders, Housewives, and the Construction of Modern Athens (Barcelona: Actar, 2022).



Based on data from the 2021 Population and Building Census; ELSTAT (Greek Statistics service). Charts drawn by author

dynamic of the city, allowing the inhabitants to participate in the life of the street while accessing exterior space within the domestic context. At the same time, it is interesting that balconies can serve in function as a built-in scaffolding, useful for the exterior maintenance of as well as any construction work. Drawing inspiration from scaffolding, balconies could rather consist of an independent self-bearing structure that does not interrupt the thermal envelope of the building, neither creates structural vulnerability as when cantilevered from the main structure. Those could be assembled in a different material, such as wood or modular steel elements.

Other features of the polykatoikia also complicate its maintenance, especially in the context of horizontal property. Flat roofs have proved vulnerable to water infiltration. In the short term, this affects only those residents who live on the last floor and for this reason it is difficult to mobilize collective action and expense, even though in the long term there might be serious consequences on the structural integrity of the whole building. Rooftops could be furnished with lightly constructed shelter structures that protect the flat ground of the roof from direct rainfall and at the same time render the space more inhabitable, without enclosing it. Additionally, the structure could accommodate solar panels, contributing to the energy affordances of the inhabitants. On the urban scale, the high floor-space index that was allowed by building regulation, especially during the time of the dictatorship, has produced a very dense urban fabric where tall buildings were built on narrow streets and with narrow courtyards, resulting to poor climatic conditions, especially in the hot summers. Moreover, the narrow sidewalks complicate pedestrian mobility, which is especially problematic for an increasingly aging population. It is important that the design flaws of the polykatoikia and its urban fabric do not feed into a counter-productive discussion about obsolescence. However, these points can be taken as important lessons for any future development in the city. For the moment, new apartment blocks are still built like old ones, with exposed flat roofs and vast cantilevering balconies, while the floor space index was increased in the last building regulation, a subject of on-going scandal.

While co-ownership through horizontal property was essential to the historic development of the city, it is unclear whether it is appropriate at this point for the preservation of the city in the future, especially since as we have small-scale private property is threatened by the deterioration of the collective building stock. Alternative ownership systems like cooperatives prioritize responsibility of functional operation and maintenance of shared infrastructure over individual property rights while community is acknowledged as a fundamental component of collective housing. Community-Land-Trusts, perhaps take this on a bigger scale by opening up towards an extended area, perhaps a small neighborhood. Buildings as property are decoupled from the land plots that they stand on, which can

An advanced state of disrepair led to the structural collapse of two buildings in the Noailles neighborhood of Marseille, costin life to eight inhabitants. In the system of co-ownership residents own or rent the “air” inside apartments, while shared infrastructure is vulner-able to neglect.

Found image, edited by the author.

merge with others to form extended parcels of communalized land. This allows an extended community to organize, pooling resources and responsibilities at a larger scale. Moreover, there is an increased resistance to forces of financialization or gentrification as the purchase of even a whole building does not allow an investor to speculate on the land-value of the plot itself, which is shared between many different buildings. Ownership of a building, whether full or partial, becomes entirely subject to the preservation of the building as an object, much like a private car on a public parking lot.

Such systems are challenging to implement as they require innovation in legal framework, especially when it comes to reconfiguring property rights in the existing urban fabric. Real estate development projects like the Ellinikon, provided with such an extensive plot of urban land of public property, could have been a unique opportunity to implement community-driven ownership schemes with social character, for example a neighborhood-wide community land trust populated with cooperative housing blocks and open space with public facilities. The large scale of the operation would be sufficient to mobilize the development of legislative framework which in turn would facilitate the generalization of such systems to the existing fabric of the city. Finally, to make possible the preservation of the modern city as built heritage, it is necessary that expertise on the restoration of reinforced concrete structures becomes accessible at a large scale; currently it remains a highly specialized field, limited to the preservation of privileged structures. This would involve

increased effort on training professionals for the job and perhaps, to the extent that it is possible, popularization of such expertise as part of contemporary building culture. The subject is one of global concern, and any expertise and technology developed in one place can be of value well beyond the local context.

Renovation or new construction should seek to to employ local and natural materials. The generalization of their use can lead to crucial refinements in their technology and improve their performance as building materials. Their cost can decrease accordingly, through economies of scale. Urban development projects such as the Ellinikon could play a pivotal role by committing to such materials at a large scale, thereby accelerating their normalization through the development of patents, standards and certifications. As we have seen, materials like clay, limestone and marble are widely available in the region. Their extraction, especially that of limestone for use as aggregate in reinforced concrete, has taken place opportunistically in many locations within the city while often operating at the neighborhood scale. It is perhaps a serendipitous outcome of the frenetic construction boom in the post-war period, that such local practices of extraction have created landmark locations that have been appropriated by the city to produce public space of high quality. As we have seen through the interlude, many of the former quarries were transformed into park-like spaces with sports facilities, open theaters, schools and other municipal infrastructure while others, although without official initiative, constitute informal parks of urban wilderness, suitable for many kinds of play. [X]

In a newspaper article, Theodosios Tassios, a notable civil engineer, professor and philosopher, instructs the public: 'Concrete is a Greek material. We do not have wood, we do not have steel, and although we do have stones we cannot use them due to seismic activity'. I would dare to oppose this statement on two counts. First, concrete in itself is not earthquake resistant, at least not without steel reinforcement. As a side note, although Greece does not produce iron ore, the primary material for steel, the latter is today exclusively produced using scrap metal, a resource that abounds in the broader geographic context. Second, seismic activity should not immediately exclude stone masonry, neither the use of other natural materials, as research and development on those methods can lead to innovative solutions, that improve structural performance including in the face of seismic danger.

Beside vernacular traditions, that are rich in such knowledge, scientific research and industrial partnerships are producing promising results, for example the natural stabilizer/plasticizer additives for earth construction developed by Oxara, or the interlocking earth bricks developed by Aziza Chaouni for earthquake-resistant constructions in Morocco. We should not forget, that the development of reinforced concrete into a viable technology has been a continuous effort for more than a century, absorbing significant capital in research and development, while enjoying considerable benefit of doubt in the process. Compared to the capital intensity of cement, alternative techniques based on natural materials could be explored in much less costly ways, generating expertise that is beneficial for the local context as well as potentially for the rest of the world. After all, the production of knowledge and technology that contributes to fighting the surging socio-ecological crisis is a matter of global responsibility.

Ioanna Soufleri, "Θεοδόσιος Τάσιος: Ο Γεφυροποιός Φιλόσοφος [Theodosios Tasios: The Bridge-Building Philosopher]," To Vima, December 31, 2019

Side note: although Europe does not generally produce iron ore, contemporary steelworks in the geographic context use mostly scrap metal as raw material.

Found in: Dimitris Rigopoulos, "Νταμάρια Ψυχικού: Ένας Προορισμός Που Γεννήθηκε Μέσα στην Καραντίνα [The Quarries of Psychiko: A Destination Born During Quarantine]".Kathimerini, May 17, 2020.

EPILOGUE

While material in architecture has historically been a subject of aesthetics, and perhaps increasingly a subject of ecology, I hope to have contributed in placing it equally as subject of cultural and social importance. Material has significant consequences on how we build and inhabit our domestic space, our cities and our world. Analysis of material flows and embodied carbon is crucial to evaluating our choices in terms of social and environmental justice, while a less obvious aspect is the significance of capital intensity; it determines whether a technology or production process is truly democratizable.

Care, maintenance and repair of the built environment—if not its very construction—must actively involve the agency of the community that inhabits it. This does not only create social and economic value but also serves as important component in fostering the notion of community itself. However, the role experts should not be underestimated in this effort. Design, planning, and technological innovation are perhaps more necessary than ever before but should not insist in attempting to greenwash inherrently technocratic and unsustainable practices. Rather, the development of new systems should be geared towards empowering spatial and material agency within communities, thereby ensuring long-term social and environmental sustainability.

To create a vibrant interface between community and expertise, we could perhaps draw inspiration from an approach such as “The Pattern Language”. Developed by the team of Christopher Alexander, the intention was to provide tools of dialog and collaboration between ordinary people and professionals. Patterns are a sort of vocabulary, each of them describing a design problem and at the same time proposing a solution; through the combination of patterns, a design project is comprehended as a sum of design choices, of which the implications are acknowledged and understood.

Christopher Alexander, Sara Ishikawa, and Murray Silverstein, A Pattern Language: Towns, Buildings, Construction (New York: Oxford University Press, 1977).

BIBLIOGRAPHY

ALEXANDER, Christopher; ISHIKAWA, Sara; SILVERSTEIN, Murray. A Pattern Language: Towns, Buildings, Construction. New York: Oxford University Press, 1977.

ANASTASAKIS, Lefteris. Καινοτομία και Βιομηχανικός Μετασχηματισμός στην Ελλάδα 1950-1973 [Innovation & Industrial Transformation in Greece 1950-1973]. Athens: Kerkyra Publications, 2023.

BERGER, John; MOHR, Jean. *A Seventh Man: a Book of Images and Words about the Experience of Migrant Workers in Europe. London: Penguin Books, 1989.*

CHOPLIN, Armelle. Concrete City: Material Flows and Urbanization in West Africa. Hoboken, NJ: Wiley, 2023.

CRITCHLEY, Simon. “Athens in Pieces: What Really Happened at Eleusis?” The New York Times, March 13, 2019. https://www.nytimes.com/2019/03/13/opinion/ancient-greece-ritual-mystery-eleusis.html.

DAVARIS, Sophia. “Urbanisme en Grèce: Athènes construit une ville nouvelle.” Tribune de Genève, October 9, 2022. https://www.tdg.ch/urbanisme-en-grece-athenes-construit-une-ville-nouvelle-592210750257.

FERRO, Sergio. “Concrete as a Weapon.” In Architecture from Below: An Anthology, edited by Sergio Ferro. London: MACK Books, 2024.

GIAKOUMATOS, Andreas, ed. Τα Νέα Σχολικά Κτήρια [The New School Buildings]. Athens: Kapon Editions, 2019.

HUTTON, Jane. Reciprocal Landscapes: Stories of Material Movements. 1st ed. London: Routledge, 2019.

ISSAIAS, Platon. Beyond the Informal City: Athens and the Possibility of an Urban Commons. Dissertation, Delft University of Technology, 2014. Supervisors: Michiel Riedijk; Advisors: Umberto Barbieri, Pier-Vittorio Aureli.

JOUNIN, Nicolas. Chantier interdit au public: Enquête parmi les travailleurs du bâtiment. Paris: La Découverte, 2023.

KAIKA, Maria. "Dams as Symbols of Modernization: The Urbanization of Nature Between Geographical Imagination and Materiality." Annals of the Association of American Geographers 96, no. 2 (2006): 276–301. doi:10.1111/j.1467-8306.2006.00478.x.

KALFA, Konstantina. "Archives of Empowerment? Unearthing Afthereta's Architectural Documentation in 1970s Greece." PLATFORM, June 19, 2023.

KALFA, Konstantina. "Giving to the World a Demonstration: U.S. Housing Aid to Greece, 1947-51." Journal of the Society of Architectural Historians 80, no. 3 (September 2021): 304–320.

KOUTSAFTIS, Filippos, director. Αγέλαστος Πέτρα [Mourning Rock]. 2000; Greece: Filmakers Library. Film.

LAMPROPOULOU, Dimitra. Οικοδόμοι: Οι Άνθρωποι που Έχτισαν την Αθήνα, 1950-1967 [Builders: The People Who Built Athens, 1950-1967]. Athens: Bibliorama, 2009.

MAGALHÃES, Nelo. Accumuler du Béton, Tracer des Routes: Une histoire environnementale des grandes infrastructures. Paris: La Fabrique, 2024.

MALTERRE-BARTHES, Charlotte. "Carbon Architecture: Towards an Expanded Political Economy of Space Production." In Transcalar Prospects in Climate Crisis, edited by Jeffrey Huang, Dieter Dietz, Laura Trazic, and Korinna Zinova Weber. Zürich: Lars Müller Publishers, 2024

MELIOS, Nikos; MPAFOUNI, Evaggelia. 100 χρόνια TITAN 1902-2002 [100 years TITAN 1902-2002]. Piraeus: P. Mpallides & Co., 2002.

MLP. "Εναέριος [Overground]." In MLP Blo G Spot, April 2022. https://mlp-blo-g-spot.blogspot.com/2022/04/enaerios.html.

MORALIS, Yiannis. "Πορτραίτο για τον Ανδρέα Χατζηκυριάκο [Portrait of Andreas Chatzikyriakos.]" Industrial Review, October 1976.

NICHOLS, Sarah. "Matters of Care." The Great Repair – Politics for the Repair Society, 82–85. ARCH+, no. 250 (May 2023).

RIGOPOULOS, Dimitris. "Νταμάρια Ψυχικού: Ένας Προορισμός Που Γεννήθηκε Μέσα στην Καραντίνα [The Quarries of Psychiko: A Destination Born During Quarantine]." Kathimerini, May 17, 2020. https://www.kathimerini.gr/k/k-magazine/1080868/ntamaria-psychikoy-enas-proorismos-poy-gennithike-mesa-stin-karantina/. Accessed January 13, 2025.

RUBY, Ilka; RUBY, Andreas, eds. The Materials Book. Berlin: Ruby Press, 2021.

SOUFLERI, Ioanna. "Θεοδόσιος Τάσιος: Ο Γεφυροποιός Φιλόσοφος [Theodosios Tasios: The Bridge-Building Philosopher.]" To Vima, December 31, 2019. https://www.tovima.gr/2019/12/31/science/theodosios-tasios-o-gefyropoios-filosofos/.

THEOCHAROPOULOU, Ioanna. Builders, Housewives, and the Construction of Modern Athens. Barcelona: Actar, 2022.

VATAVALI, Fereniki; CHATZIKONSTANTINOU, Evangelia. Γεωγραφίες της Ενεργειακής Φτώχειας στην Αθήνα της Κρίσης: Τρία Κείμενα και Έξι Ιστορίες Πολυκατοικίων [Geographies of Energy Poverty in Athens During Crisis: Three Texts and Six Stories from Apartment Blocks]. Athens: Angelus Novus, 2018.

VARVITSIOTI, Eleni; KAZMIN, Amy. "Greece to Integrate Irregular Migrants amid Labour Shortage." Financial Times, September 26, 2023. https://www.ft.com/content/1f2c3997-a783-4d7f-9823-4043720e9708.

WILLIAMS, Rosalind. "Cultural Origins and Environmental Implications of Large Technological Systems." Science in Context 6, no. 2 (1993): 377–403.