

Constructing the Construction State: Cement and Postwar Japan

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Abstract

This paper inquires into the revival of the cement industry in postwar Japan. The Allied Occupation did not immediately undertake comprehensive plans to rebuild the country's infrastructure. Only after controls on the production of basic industries were lifted in 1948 did cement production begin to rise. By 1956, Japan produced 13,737,594 tons of cement, double that of the prewar peak in 1939. This paper examines the rebirth of the Japanese cement and limestone mining industries in the period between 1945 and 1956 and highlights the cement industry's role in the rebirth of Japan as a "construction state."

Keywords: Japan, cement, limestone, postwar, construction

Introduction

As the war in Asia and the Pacific drew to a close, air raids destroyed Tokyo, Yokohama, and nearly all other major Japanese cities. Reconstruction began in earnest in the late 1940s with onset of the Cold War serving as a major stimulus for Japanese economic recovery. In addition to new ferro-concrete buildings, bridges and roads, cement was necessary for river and coastline repair, tetrapods, embankments and dams. Although Japanese cement production had declined dramatically during the war years, the revival of the cement industry was initially slow. It was only after the so-called "reverse course," around 1948-49,

that the Allied Occupation began to make comprehensive plans to rebuild the Japanese economy and undertake basic reconstruction of a country in ruins. In 1949, controls on the production of basic industries, coal, iron, steel, and concrete were lifted; and after the outbreak of the Korean War in 1950, cement production began to rise dramatically. By 1956, Japan produced 13,737,594 tons of cement, double that of the prewar peak in 1939, and could boast the largest cement export industry in the world. This paper examines the rebirth of the Japanese cement and limestone mining industries in the period between 1945 and 1956. It assesses the contribution of the Cold War, and the Korean War in particular, in reviving Japan's cement industry. The paper inquires into some of the colonial origins of Japan as a "construction state" and concludes with thoughts on the environmental impact and legacy of cement in Japan and the world today.

A Variety of Colonial Origins

During the 1930s, thousands of idealistic engineers, most connected with the Home Ministry, flocked to Korea, Taiwan and Manchukuo to construct the infrastructure of modern states: roads, bridges, railroads, canals, ports, water works, and communications networks.¹ All of these projects required vast quantities of cement. To that end state-of-the-art cement factories, one after the other, were set up in different parts of Japan's colonial empire as branch factories of major cement producers in Japan, particularly Onoda and Asano. After the war, many of these engineers returned to Japan and eventually became involved in rebuilding a country that

had been decimated by war. And, as in the case of Manchukuo, the revival of Japan's cement industry was essential for national reconstruction. Asano, Onoda and other major cement producers were able to draw on the Manchurian experience. As a recent book on the history of civil engineers in Manchukuo concludes, the "nation building" (*kokudo tsukuri*) of postwar Japan was constructed on foundations laid by the "national building" of Manchukuo.²



To this we may add another set of colonial origins. After defeat and loss of empire, Japan was occupied by the Allied Powers and primarily by the United States. The occupation lasted for seven years, from 1945 to 1952. Goals to democratize and demilitarize Japan did not initially include economic reconstruction. Aside from so-called "zaibatsu busting," plans were made to re-locate remaining industrial infrastructure to Japan's former enemies as war reparations. Within a few years, the scale of this program was cut back, but by 1948 a few industrial plants and around 20,000

machine tools had been sent to China, the Philippines, and other former enemy territories.³ And while some cement factories did resume production, nearly 50 percent of production for the first three years was requisitioned by occupation forces for huge base construction projects.⁴ In the meanwhile, Japan remained in ruins. The so-called "reverse course" changed occupation policy. By 1948, American and Japanese officials initiated plans to build up basic Japanese industries, including cement, designated as a "strategic industry" along with steel, oil, chemicals, and electricity. Suddenly Japan was the recipient of American technology transfer, especially in areas related to strategic industries. The physical reconstruction of Japan began in the wake of the cold war and expanded dramatically during the very hot war in Korea—in 1950 and 1951, more than five years after the near total destruction of Japan's urban infrastructure. And, as with the construction of Manchukuo, steel and cement were the building materials of choice for roads, bridges, buildings, ports, and communications and transportation systems. Aided this time by the United States, prewar policies dedicated to "wealth and power," or what Janis Mimura calls "techno-fascism," resurfaced in sustained and comprehensive programs of national reconstruction.⁵

Revival of Japan's Cement Industry

The peak in prewar cement production was in 1940 at 6,048,499 metric tons. At that time Japan ranked among the top five cement producing countries in the world, with a total of 38 cement factories within the country, and branch factories in Korea, Manchuria, and China. The war years, however, exacted a heavy toll. In 1945, only slightly over 1 million tons were produced and in 1946, Japan's first peacetime year, production further declined to 927,089 metric tons. Some plants had been dismantled and sent to the Philippines as reparations. All overseas production facilities were lost and most homeland plants were in

poor shape. Moreover, industrial giants, such as Asano and Onoda, were targets of SCAP's ambitious zaibatsu dissolution program.

Recovery was slow; indeed wartime controls over the manufacture of cement were replaced by occupation controls. For the cement industry, substantial and sustained growth came only after January 1, 1950, when government and military controls over cement production and limestone mining, in place since 1934, were finally eliminated.⁶ Cement factories saw this new age of free competition (*jiyū kyōsō no jidai*) as a major turning point, especially as the new exchange rate (360 yen to the dollar) served to encourage exports of Japanese cement. At the same time, extensive damage caused by Typhoons Kathleen (1947) and Kitty (1949), coupled with explosive population growth (Tokyo's population swelled from 2.8 million in 1945 to over 5 million in 1950), made the need for housing and urban reconstruction all the more urgent.

The outbreak of the Korean War in June 1950 accelerated the expansion of cement production. As the *Asahi* reported on October 15, 1952, the special procurement system produced a welcome "cement boom" that served as a sort of guardian angel (*keiki no kami*) over Japan's economic recovery.⁷ Indeed the war proved profitable for Japan, the one major non-combatant in the Korean War. After three years of a no growth policy and three years of failed attempts to stimulate production, in 1951 the mining and manufacturing industries, including cement, were suddenly able to surpass prewar levels. Instead of the Dodge Line, it was the "three white product boom" (*sanhaku keiki*) – sugar, ammonium sulfate (fertilizer), and cement – that led Japan out of its economic doldrums. Cement production in 1949 stood at 3.2 million tons; by 1951, production had doubled to 6.5 million tons, rising to 7 million tons in 1953, to 12.9 million tons in 1956, then soaring to 15 million tons in 1957.⁸

On the one hand special procurements meant demand for Japanese products, including cement, necessary for the war effort. At the same time, the war made export-led industrial growth possible. Cement companies had long dreamed of profits from exports. As Kasai Junpachi, the founder of Onoda Cement (1881, Japan's first private cement company), was fond of saying: "We must guard against imports and buying dirt from foreign countries; instead, it is the duty of our countrymen to engage in trade with Shanghai and Hong Kong and thereby make profits by selling them our dirt."⁹ Cement exports had expanded in the 1930s, primarily to Japan's colonies; but it was only after 1948 when SCAP and Japanese government officials began to encourage free trade that Kasai's dream was realized. In 1948 the Japan Export Corporation was founded and export by private corporations was allowed in 1949. One year later, the outbreak of the Korean War gave Japanese cement exporters access to markets in Southeast Asia, India, and Australia. On February 18, 1950, for example, negotiations with the Philippines, Japan's new-found ally in the Cold War, resulted in permission for Nihon Cement to export 14,000 tons of cement.¹⁰ Orders continued to roll in. Exports in 1948 were a mere 140,000 tons; in 1949, they tripled to 486,000 tons; nearly doubling in 1951 to just over 1 million tons, and again by 1956 to over 2 million tons at which point Japan was the world's largest exporter of cement. The Japanese cement industry continued to expand in the 1960s. The Suez crisis in 1957 increased Japan's comparative advantage in Asian markets, and the damage caused by the massive 1959 Isewan Typhoon (Typhoon Vera) which left 5,000 dead, created opportunities and demand for further expansion of Japan's cement industry. Finally, there was a special category of "export" cement destined for Okinawa in the 1950s, for use by the American military to create the infrastructure for its permanent occupation of the islands.

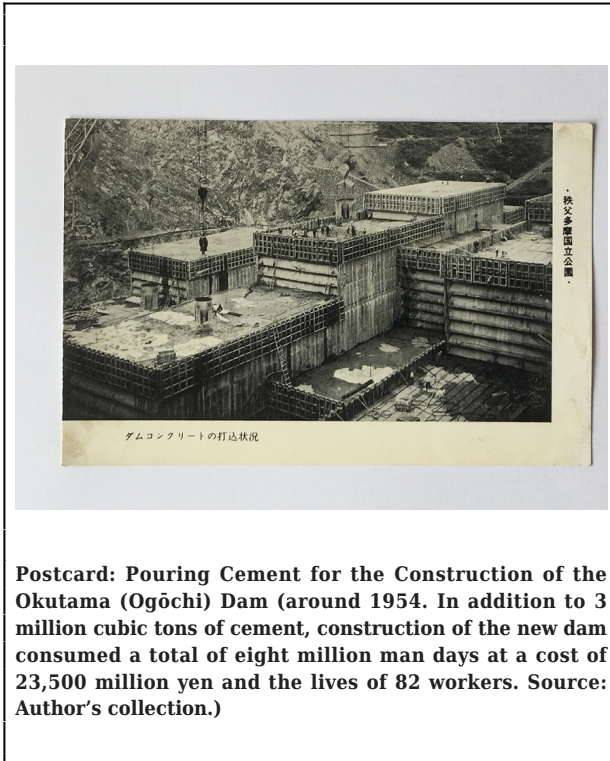
Rebuilding Japan—White Products at Work

After the war, several plans for the reconstruction of Tokyo and other burnt-out urban centers were advanced, but to no avail. By 1950, little of Tokyo was rebuilt according to any sort of comprehensive scheme—and when the reconstruction of Tokyo and other major cities accelerated thereafter, the only general principle in force was the near universal use of cement: building, roads, bridges, sewers, dams, river embankments, docks, sea walls, even cement telephone poles.

From around 1950, aside from exports, close to 60 percent of cement produced was consumed by public works, construction, roads and bridges, and power supply—areas dominated by public spending. This postwar reconstruction boom, sparked by the Korean War, re-asserted a mode and structure of development that continues to characterize Japan's political economy: the so-called "Construction State" in which, up to the 1990s, sometimes as much as 40 percent of the nation budget was devoted to construction (and, in turn, to the abundant use of cement).¹¹ Not surprisingly, the reconstruction boom began with little consideration of environmental consequences; moreover, local interests were often secondary to the needs of the center. Here too the postwar construction state (and its confidence in reshaping the environment to meet human needs) had multiple prewar origins.

Dams: In 1950, the Japanese government enacted a Comprehensive National Land Development Law (*Kokudō sōgō kaihatsu-hō*), inspired by America's depression era public work projects including the TVA, as a starting point for massive infrastructure construction (rail, roads, seaports, airports, dams, and flood control). A dam boom followed; between the early 1950s and 1990, over 1000 dams were built, making Japan one of the dammed countries in the world.¹² Of key importance was

the construction of multi-purpose dams that could aid flood control, food production, and electric power generation. Japan's first postwar large-scale development project was the construction of the Sakuma Dam on the Tenryū River, begun in 1952 and completed in 1956—at that time, the "the largest dam in the Orient," and symbol of Japan's national revival.¹³ On the one hand, the dam derived from American New Deal thinking, especially the TVA dam projects of the late 1930s, and relied on American dam building technology and heavy machinery, including imported Caterpillar bulldozers.¹⁴ At the same time, however, Japan's postwar dams profited from mammoth colonial "national land planning" projects in Korea and Manchukuo, such as the Fengman Dam and the Sup'ung Dam (completed in 1944 and, at that time, "the largest dam in Asia" and symbol of the power of Japanese imperial rule).¹⁵ Naturally such projects required extraordinary amounts of cement. In 1956, for example, the Hazamu Gumi, the firm in charge of the construction of the Sakuma Dam, took advantage of its own Manchurian experience, to pour some 5,180 cubic meters of cement per day—thus setting a new world record.¹⁶ Other massive civil engineering projects included the Okutadami Dam in Niigata, begun in 1953 and completed in 1960 (even today Japan's largest hydroelectric station), the Kurobe Dam in Toyama, begun in 1956 and completed in 1963 (even today Japan's tallest dam at 183 meters), and the Ogōchi Dam in Okutama, construction begun in 1936, halted in 1943, resumed in 1948, and completed in 1957; some 3 million cubic meters of cement were used in its construction.¹⁷ In all cases, these showcase national reconstruction projects resulted in the displacement of local peoples, the destruction of local environments, the devaluing of local economies--and electric power produced sent to the big cities.



Postcard: Pouring Cement for the Construction of the Okutama (Ogōchi) Dam (around 1954. In addition to 3 million cubic tons of cement, construction of the new dam consumed a total of eight million man days at a cost of 23,500 million yen and the lives of 82 workers. Source: Author's collection.)

Public Housing: Housing was a priority in urban reconstruction throughout Japan. Over 4 million homes, largely in urban centers, had been destroyed in firebombing raids in the final months of the war. And yet, reconstruction was slow. In Tokyo, for example, by 1948 only 6.8 percent of those areas burnt by repeated napalm bombing raids, had been rebuilt. Millions of people lived in slum-like conditions. From the late 1940s, housing developments composed of clusters of multi-story concrete apartment buildings known as *danchi*, were built to help alleviate the housing crisis. Early examples include the Takanawa apartment (1946) and the Toyama apartments (1949), but large scale building was hampered by difficulty in obtaining sufficient quantities of cement.¹⁸ After its establishment in 1955, the Japan Public Housing Corporation (now Urban Renaissance Agency) began a nation-wide program of construction that continued for more than twenty years. Concrete was the building material of choice. Most *danchi* were four to five stories high and composed of multiple units, sometimes up to 30 buildings,

making up what came to be called a “new town.” Other *danchi* began to spread upwards; the first of these was the 10-story Harumi Housing Apartment completed in 1958.¹⁹ Looking back, the *danchi* seem cold and oppressive and are often described as “Soviet style public building blocks,” but in the 1950s, these were dream houses, which offered “the life we longed for.”²⁰ Concrete was modern and progressive; the stainless steel sinks and flush toilets allowed an aspiring middle class to dream of a better future. The “new towns” in fact had prewar roots: *danchi* prototype cement structures were designed by architect Ichiura Ken in the early 1950s—based on his own prewar plans for standardized / rational public housing (*jutaka no gorika*), as a member of the 1941 Public Housing Commission (Jutaku Eidan). The use of cement was championed because of its ready availability; with nothing needing to be imported, cement was not only practical but patriotic.

国づくりに貢献する

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 高炉セメント
 ダム用高炉セメント
 生コンクリート

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 中央区銀座東 7 の 6

第一セメント
 コンクリート

—広セア—

Ready Mix Cement: Contributing to National Construction. Source: Advertisement in *Nihon Cemento Nenkan* (Japan Cement Annual, 1968)

Roads, Bridges, and Expressways

In 1946, roughly 1 percent of Japan’s 900,000 kilometers of roads were paved. The occupation did little to improve the situation. Ralph J. Watkins, an economist invited by the Japanese government to advise on highway modernization, reported in 1956: “The roads of Japan are incredibly bad. No other industrial nation has so completely neglected its highway system.”²¹ By the late 1950s, construction began on a vast system of national expressways, national toll roads, and metropolitan expressways. Bridges and tunnels were built everywhere (and sometimes to nowhere)—concrete being the prime building material. Many of the engineers who worked on

these postwar road construction projects, including Kaneko Masaki, Kishida Akira, Sakata Shizuo, Oshima Hidenobu, Seto Masaaki, and Katahara Nobutaka, had their training in the prewar Home Ministry and in Manchukuo and other of Japan’s colonies where they were given a relatively free hand to experiment with new construction materials and techniques. Kaneko, for example, wrote a primer on cement roads in 1941 and was active in the early 1950s in road improvement and city planning in Yokohama. His 1955 publication on “Concrete Road Pavement in Japan” (*Waga kuni no semento konkurito hosō ni tsuite*) along with Setō Masaaki’s 1943 text on “The Design and Construction of Automobile Expressways” (*Jidōsha senyōdōro no sekkei*) were essential reading for Japan’s postwar highway engineers.²² Similar to the Shinkansen, the Tōmei Expressway has prewar roots.²³

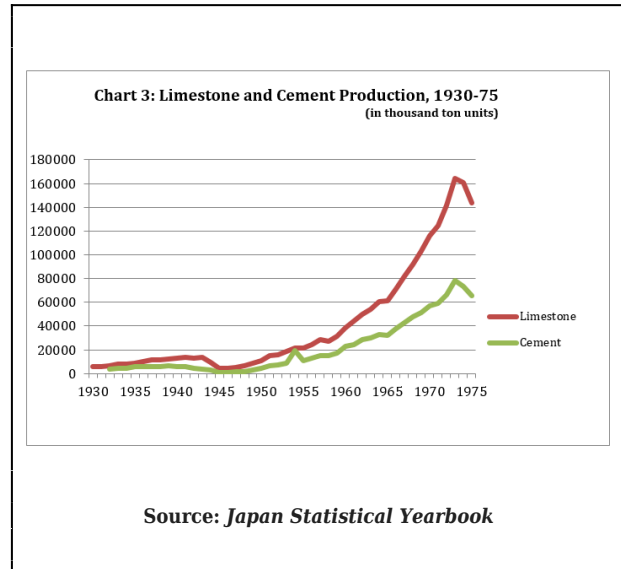
Technology Transfers

Many of these postwar construction projects began in the prewar period. More particularly, the origins of Japan’s “construction state” ideology and planning may be found in the Manchukuo experiment. Kishi Nobusuke, Japan’s prime minister between 1957 and 1960, was, after all, the former head of the Manchukuo Industrial Development Bureau that had produced a series of five-year comprehensive plans to modernize the new country’s infrastructure. As a result, the cement industry in Manchukuo was among the most technically-advanced in the world—surpassing the quality of domestic production. Occupying Soviet forces relocated many of the most modern facilities to the Soviet Union, but, as we have seen, many workers and engineers returned to help rebuild Japan’s domestic cement industry.²⁴ In addition to these areas of continuity with the prewar period, the cold war alliance between Japan and the United States allowed new cement technologies (many developed for military purposes) to flow into postwar Japan. In particular, the 1950s saw the

introduction of dry process kilns, which allowed for greater efficiency and productivity.²⁵ Ready mix concrete (*nama-kon*) was another innovation that added to the efficiency of concrete construction. Tokyo Concrete's Narihira-bashi Factory began to deliver ready mix on November 15, 1949, inaugurating the "ready mix" era (*nama-kon jidai*).²⁶ In 1958, 615,715 tons of ready mix was delivered to construction sites; by 1968, this had risen dramatically to 12.4 million tons.²⁷

Limestone - Japan's Most Abundant Mining Resource

As can be seen in Chart 1, in the postwar period, limestone mining experienced explosive growth alongside the cement industry.²⁸ The process to produce so-called Portland cement, the building material of the modern world, was developed in the middle of the nineteenth century. It is produced by heating limestone (and other clay-like materials) in a kiln to temperatures over 1,400 degrees C. This resulting clinker is then ground into a fine white powder. In immediate postwar Japan, although variable, about 1,777 kg of raw materials, including 1,250 kg of limestone, was required to produce one ton of cement. (Coal consumption per ton varied from 200 to 500 kg, depending on the quality of the coal).²⁹ Japan is often known as a country without significant natural resources, a so-called "have not country" (*motazaru kuni*).³⁰ In the case of limestone, however, Japan was and remains very much a *moteru kuni* - a country that has. Japan has estimated recoverable reserves of limestone amounting to around 380 billion tons. There are more than 200 limestone mines or quarries throughout Japan, from Hokkaido to Kyushu, with the greatest activity overlapping with cement producing centers occurring in the Kanto and in northern Kyushu. Prewar mining was largely open cut; large machinery including steam shovels and conveyer belts were introduced in the late 1920s and 1930s, along with tunneling and



the use of transport chutes. From the 1950s, in response to increased demand, and deprived of the cheap labor available in prewar Japan (sometimes in the form of forced Chinese and Korean laborers and POWs), new heavy machinery, including bulldozers, cranes, drilling and digging equipment, forklifts, and crushers, were introduced from the United States. New quarrying techniques were also imported. For example, the bench-cut method was introduced in 1955 and quickly spread throughout the industry; it was not pretty, but it was productive and allowed easy use of heavy machinery. The prewar peak of limestone production was in 1941 at 13.1 million tons. At war's end, production had fallen to 4.5 tons but revived quickly after the beginning of the cold war in 1948. The prewar peak was surpassed in 1951 with the production of 15.5 million tons, rising to 40 million tons in 1960, and 120 million tons in 1970 rising to over 160 million tons in 1973.³¹ Despite its importance and abundance, not much attention has been paid to limestone production. Nonetheless, integral to Japan's recovery and years of high growth, limestone was the foundation of Japan's construction state. Limestone production kept

pace with growing demands from the cement, steel, chemical and construction industries. But like the cement it helped to produce, limestone has left a mixed legacy of creativity and entropy, imprisonment and liberation, construction and destruction.

Concluding Thoughts - A Mixed Legacy

Is cement ugly? If this is cement's only sin, then the world would be in much better shape. To be sure, Japan, is one of the most cemented-covered nations in the world. And, in the absence of new thinking, there appears to be no end in sight. The way to protect Japan's seacoast from a giant tsunami like the one that hit northeastern Japan in 2011 has seemed to Japan's leaders to be more concrete: a 400 km seawall, 12 meters in height at some places.³² But cement is also a major polluter, accounting even today for about five percent of global CO₂ emissions.³³ Cement produces greenhouse gases both directly (burning of fossil fuels, often coal, used to heat kilns) and indirectly (limestone, made of calcium carbonate, breaks down when heated into calcium oxide and CO₂). Recent advances in technology have made the cement industry cleaner, but not yet carbon neutral. In 1950s Japan, the cement industry, alongside Chisso Corporation producing chemical fertilizers in Minamata and the Daiichi Petrochemical Complex in Yokkaichi, contributed mightily to Japan's status, by the early 1960s, as one of the most polluted countries in the world.

Yes, cement is often an eyesore—it is the building material of mindless bureaucrats and construction companies. And yes, the making of cement and the mining of limestone are threats to the integrity of the natural environment. But cement can also be creative, liberating, and even beautiful. For postwar Japanese architects, including Tange Kenzō, Maekawa Kunio, and Ōtaka Masato, cement allowed for

the construction of a new Japan, liberated from the past. As Ōtaka put it, "Concrete is our material. (*Konkurito wa wareware no mono*)." He continued: "Concrete is a material which comes out of Japan. We don't have to go to Manchuria or wherever, to get it, and we can't afford American, we can't afford sophisticated American goods. We build with concrete."³⁴ Moreover, concrete was "manufactured from materials from the earth of the home islands and was created by the efforts of the people themselves," making it the ideal material out of which to construct a new Japan stripped of its past.³⁵

The point is that cement and limestone have left a mixed legacy of environmental liberation and destruction. Cement-based construction, including housing, bridges, highways, and even sea walls have allowed the construction of a state in which people can live in increased comfort and security. And whether deemed ugly or beautiful (or both), there is no going back. As Adrian Forty has noted, cement's "indestructibility is both one of its most valued, and at the same time most reviled features."³⁶ The legacy of the "construction state" is also mixed; as with business and politics nearly everywhere, public good and private greed are often not far apart. An examination of the history of the construction of the Japanese construction state allows us (writ large) to learn from its failures as well from its successes.

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Notes

¹ For Japan's colonial highway construction projects, see M. William Steele, "Roads, Bridges, Tunnels and Empire: Highway Construction and the Great East Asian Co-Prosperity Sphere," *Asian Cultural Studies*, vol. 42, 2016, 87-101.

² Doboku Gakkai, ed., *Gijutsusha no jiritsu - gijutsu no dokuritsu o motomete*, Doboku Gakkai, 2014, 270.

³ Joseph Z. Reday, "Reparations from Japan," *Far Eastern Survey*, vol. 18, no. 13 (June 29, 1949), 145-151.

⁴ For postwar cement use, see Han Jaehyang and Takeda Haruhito, "[Sengō fukkyō-ki no semento sangyō](#)," Tokyo University MMRC Discussion Paper 55 (October 2005).

⁵ Janis Mimura, *Planning for Empire: Reform Bureaucrats and Japan's Wartime State*, (Ithaca: Cornell University Press, 2011); see especially her epilogue: "From Wartime Techno-fascism to Postwar Managerialism," 195-200.

⁶ The *Asahi shinbun* reported that controls would be lifted at the end of the year on October 19, 1949; see also Aso Hyakunenn-shi Hensan I'inkai, ed., *Aso hyakunenshi*, (Tokyo: Aso Cement Company, 1975), 488 and Shashi Hensan I'inkai, ed., *Nihon Cement hyakunen-shi*, (Tokyo: Nihon Cement Company, 1983), 449.

⁷ *Asahi shinbun*, October 15, 1952.

⁸ Cement production peaked in the late 1990s at around 100 million tons, declining to 81 million tons in 2000, 69 million tons in 2005, 51 million tons in 2010, and up after 3/11 to just over 60 million tons in 2015. See *Nihon tōkei nenkan (Japan Statistical Yearbook)*, (Tokyo: Sōifu, Tōkeikyoku, Nihon Tōkei Kyōkai), 2016.

⁹ Quoted in Fujita Minoru, *Semento*, (Tokyo, Yūhikaku, 1960), 40.

¹⁰ "Hitō de semento no yunyū kyōka," *Asahi shinbun*, February 18, 1952, 1.

¹¹ The idea of the "construction state" was developed by Gavan McCormack in *The Emptiness of Japanese Affluence*, revised edition, Routledge, 2015. See Chapter 1, "The Construction State: The Pathology of the Doken Kokka," 25-77. See also Jeff Kingston, *Contemporary Japan: History, Politics, and Social Change since the 1980s*, John Wiley & Sons, 2010, 162-64.

¹² Gavan McCormack, "Modernity, Water and the Environment," in William Tsutsui, ed., *A Companion to Japanese History*, (Oxford: Blackwell Publishers, 2009), 447.

¹³ For a short documentary video on the construction of the Sakuma Dam, including the pouring of cement, see "[Sakuma Dam](#)" in the Japan Society of Civil Engineers video library.

¹⁴ For details on the connection with the New Deal and the TVA, see Eric Dinmore, "Concrete Results? The TVA and the Appeal of Large Dams in Occupation Era," *Journal of Japanese Studies*, 39.1 (Winter 2013), 1-38, and Eric Dinmore, "High-Growth Hydrosphere: Sakuma Dam and the Socio-natural Dimensions of "Comprehensive Development" Planning in Post-1945 Japan," in Bruce Batten and Phillip Brown, eds., *Environment and Society in the Japanese Islands*, (Corvallis, Or.: Oregon State University Press, 2015), 114-135.

¹⁵ Aaron Moore, "The Yalu River Era of Developing Asia: Japanese Expertise, Colonial Power,

and the Construction of the Sup'ung Dam," *Journal of Asian Studies*, 72.1 (February 2013), 115-139. Also see Aaron Moore, *Constructing East Asia: Technology, Ideology and Imperialism in Japan's Wartime Era, 1931-1945*, (Palo Alto: Stanford University Press, 2013).

¹⁶ Dinmore, "High Growth Hydrosphere," 125.

¹⁷ M. William Steele, "History of the Tama River: Social Reconstructions," in Terje Tvedt, ed., *A History of Water, Vol. 1 Water Control and Water Histories*, (London: I.B. Tauris Publishers, 2006), 232.

¹⁸ Uchida Seizō, et. al., *Zusetsu kindai Nihon jūtaku-shi*, (Tokyo: Kashima Shuppankai, 2008), 136-37.

¹⁹ Uchida, 46-49.

²⁰ Laura Neitzel, *The Life We Longed For: Danchi Housing and the Middle Class Dream in Postwar Japan*, (Portland, Me.: Merwinasia, 2016).

²¹ Quoted in Takaaki Nambu, "[History of Road Development, Finance and Investment in Japan](#)," n.d.

²² Seto Masaaki, *Jidōsha senyō dōro no sekkei*, (Tokyo: Tokiwa Shobō), 1943. Seto was in residence as a civil engineer in Manchukuo assigned to road construction between 1938 and the end of the war.

²³ On the prewar origins of the Shinkansen, see Takashi Nishiyama, *Engineering War and Peace in Modern Japan, 1868-1964*, (Baltimore: Johns Hopkins University Press, 2014); see especially Chapter Seven, "Former Military Engineers and the Development of the Shinkansen, 1957-1964," 157-183.

²⁴ On the removal of equipment and machinery from cement factories in Manchukuo, see Edwin Pauley, [Report on Japanese Assets in Manchuria to the President of the United States, November 1945 to April 1946](#), Washington: U.S. Government Printing Office, 1946. See especially Chapter II, "Cement Industry," 209-219.

²⁵ On similar technological advances in the cement industry in the postwar world, see: Sangaya Lall, *Learning to Industrialize: The Acquisition of Technological Capability by India*, (London: Palgrave Macmillan Publishers, 1987), 52-74.

²⁶ Thereafter November 15 is known as the Memorial Day for Ready Mix Concrete.

²⁷ *Nihon semento nenkan* (Japan Cement Annual) for the year 1968, published by the Semento shinbunsha, vol. 20, 1968, 81.

²⁸ For a general history of the limestone industry in postwar Japan, see Shimanishi Tomoki, "[Sengō sekkaishi kōgyō-shi](#)," *Mita shōgaku kenkyū*, 47.4 (October 2004), 115-138. See also: Maki Yūichirō and Matsumoto Masayuki, "[Sekkaishi no kōgyō no genjō to kadai](#)," *Chishitsu News* 47 (March 2000), 23-35.

²⁹ General Headquarters Supreme Commander for the Allied Powers (SCAP), *Cement Industry of Japan*, Natural Resources Section, Report 105, Tokyo, 1948, 37.

³⁰ For a recent book on the resource debate, see Satō Jin, *'Motazaru kuni' no shigen ron: jizoku kannō o meguru mō hitotsu no chi*, (Tokyo: Tōkyō Daigaku Shuppankai, 2011).

³¹ Mining production of limestone peaked in the late 1990s. In 1995 output was 201 million tons, declining in 2000 to 185 million tons, in 2005 to 165 million tons, in 2010 to 134 million tons, and rising, after the triple disasters of March 11, 2011, to 148 million tons in 2014. For statistics, see *Japan Statistical Yearbook*, 2016.

³² "[Japan to build a 250-mile-long, four-storey-high wall to stop tsunamis](#)," *The Independent*,

March 25, 2015.

³³ Madeleine Rubenstein, “[Emissions from the Cement Industry](#),” *State of the Planet*, May 9, 2012, online publication of the Earth Institute at Columbia University.

³⁴ Peter Armstrong, “Architecture in the *mono no nai jidai*,” in Roman Rosenbaum and Yasuko Claremont, eds., *Legacies of the Asia Pacific War: The Yakeato Generation*, (London: Routledge, 2011), 225. Original quote derives from Kawazoe Noboru, *Gendai kenchiku o tsukuru mono*, (Tokyo: Shōkokusha, 1956), 92; and “[Rebuilding Japan](#),” an interview with Peter Armstrong, Radio National (ABC), *Saturday Review*, August 13, 2005. See also Kimura Toshihiko, “Kenchikuka to konkurito,” *Konkurito kōgaku*, 18.8 (August 1980), 8-9, for the argument that concrete is a liberating medium allowing architects free artistic expression.

³⁵ Peter Armstrong, “Architecture in the *mono no nai jidai*,” 225.

³⁶ Adrian Forty, “Concrete and Memory,” in Mark Crinson, ed., *Urban Memory: History and Amnesia in the Modern City*, (London: Routledge, 2005), 79-80.