SITE UNSEEN: AMERICAN PORTABLE BUILDINGS FOR EXPORT, 1879-1945

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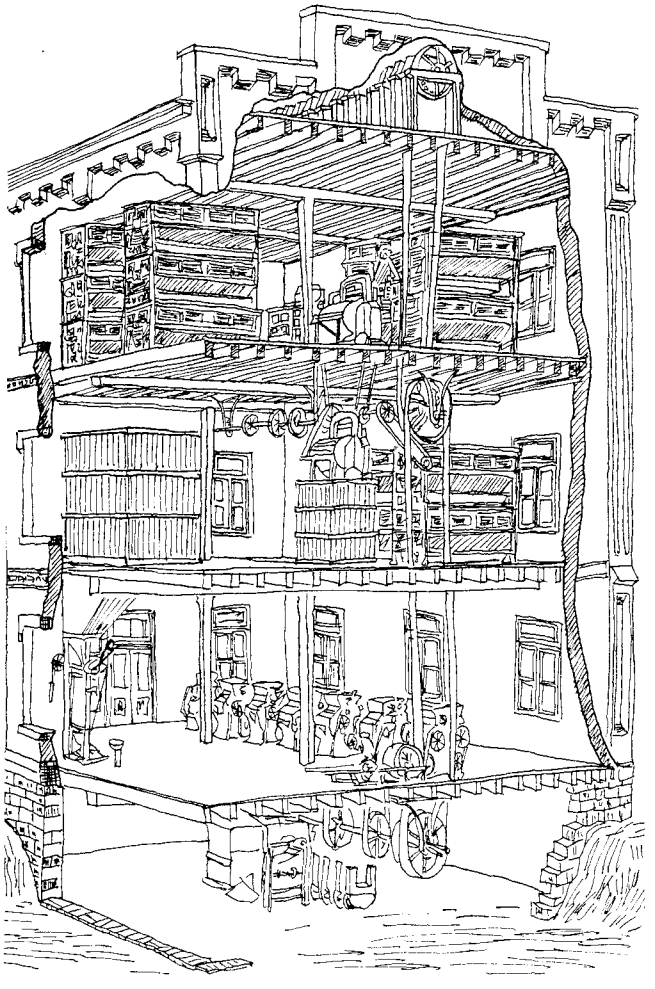
INTRODUCTION

This paper analyzes six American companies that exported either whole buildings or building components, such as steel or concrete, between 1879 and 1945. They are the Milliken Brothers Company, the Ideal Concrete Machinery Company, Truscon, and the Berger, Edwards and Butler Manufacturing Companies. Their architectural activities suggest that prefabrication provided domestic and exported standards for construction, a fast and cheap method of creating architectural space with versatility, and a flexible means of translating design concepts into built form. As American industrialists standardized portable building technologies for export, and as they applied Frederick W. Taylor's theories of industrial production, they both enhanced and weakened design quality, depending upon geographic variation as well as the criteria applied to "quality design." In the multinational marketplace of American portable buildings, some businesses provided their clients with flexible designs using innovative standardized parts, while others sold goods off a shelf, showing less concern for the quality (however defined) of the architectural spaces where those goods played a role. Prefabrication implied both proportional order and repetition, but contemporaries did not equate repetition with inferiority. Judging by what they expressed in promotional literature and trade journals (where I have trawled for most data), exporters of portable buildings craved profit, speed and construction systems yielding both adaptability and universal methods. There were significant variations in where portable buildings were erected, how people reacted to them, and how well or poorly exporters fared.

Figure 1. Exported Flour Mill, 1898, Nordyke & Marmon Co.



The portable building is one designed to be constructed with prefabricated elements, assembled either in principle or practice in one location, and then transported either in part or whole to a new site often unseen by the designer, builder or producer. American portable buildings have not been comprehensively studied.[1] Some scholars have explored domestic trends regarding the dissemination of the balloon frame and the popularity of mail-order residences. However, the history and significance of the export market for American portable buildings and prefabricated parts is less clear. Without documented examples, it has been difficult to draw conclusions about the design and cultural implications associated with American portable buildings for export. This paper spotlights some key examples and draws some initial conclusions.

AMERICAN STEEL SOLVES FOREIGN BUILDING PROBLEMS, CA. 1876-1930

Prior to the late 1870s certain American urban lumber merchants who had sawmill partnerships in the hinterlands were primarily those who marketed portable buildings for export. Many designs were characterized by one-story, rectilinear, structures whose uncomplicated joinery could be completed by novices. For example, in the 1860s West Indies plantation owners purchased designs from Boston or New York to house slaves, and twenty years later wooden but "warm as brick houses built to any size or design" were being shipped from Chicago.[2] Relative to European exports, these were small-scale operations that specialized in satisfying clients' needs for cheap, quickly-transported, low-rise, boxy spaces.[3] At century's end, however,

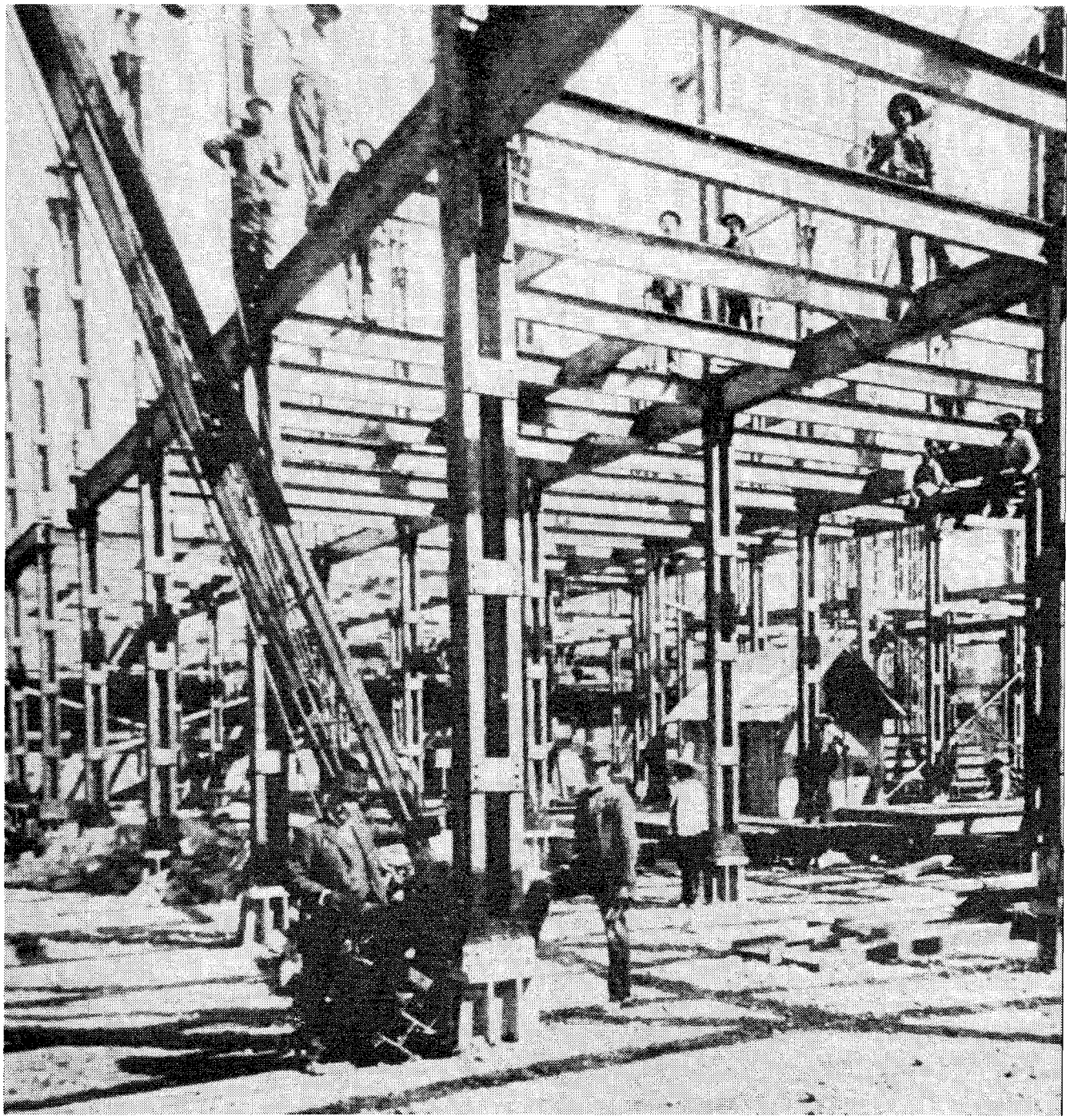


Figure 2. Roberto Boker Building, Mexico City, constructed with prefabricated steel members by the Milliken Company, 1899.

materials became more diverse. Designers first used iron, then steel and concrete to create higher, broader and more flexible spaces in more far-flung markets.

The transition began at the Philadelphia Centennial Exposition of 1876 when exhibitors demonstrated with products such as the Corliss engine that it was worth monitoring American solutions to larger-scale technological problems. American pumps and other heavy machinery attracted large crowds at the Exposition. They inspired confidence in American exporters and intrigued potential foreign clients. In 1877, to facilitate commercial interaction between American manufacturers and foreign clients, two publishers founded the journal *The American Exporter*, with the motto: "Export is the flywheel of production."[4] That flywheel, made of steel, drove American manufacturers to meet the needs of foreign clients. Within a quarter-century they competed successfully with British and, to a lesser extent, German manufacturers, who had been predominant in the iron and steel trades for most of the 19th century. By the early 20th century, three innovations related to steel quite literally elevated portable architecture and enhanced its spatial varieties.

The first significant breakthrough came in 1899 when

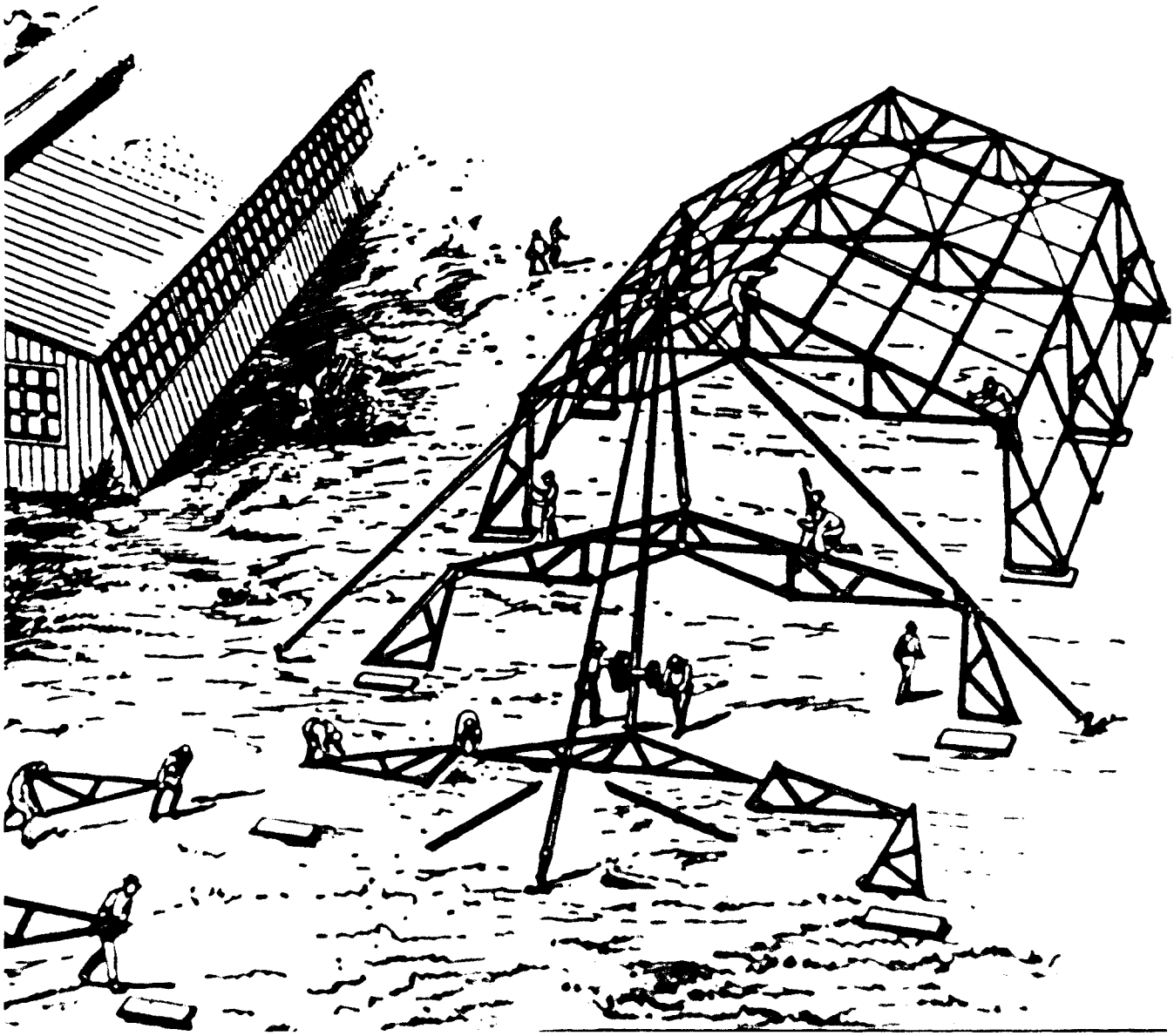


Fig. 3. Erection of a Milliken Building, 1920

an American ironworks firm outbid a British company to supply quality materials promptly for the Atbara Bridge in the Sudan.[5] Soon several American bridgebuilding companies were undercutting their European competitors from Africa to Southeast Asia.[6] Low domestic prices and intense industrial activity abroad facilitated a dramatic surge in a full range of American iron and steel products for export, from nails and spikes to rods and sheets.[7] The metal products not only signaled a material shift from the earlier wood products, but they also implied that wider spans could be created by using arches and trusses. As new spaces were created using these prefabricated materials, some contemporaries marveled at the industrial progress those spaces seem to bring with them. The media of steel arches and trusses became the messages of social and economic change. However, without further research it is still too early to speculate conclusively about the social, ideological implications associated with the erection of steel-framed high-rises in cultures where none had ever existed.

The second important shift concerning steel occurred when American entrepreneurs began to construct skyscrapers overseas. As Chicago, New York and other cities began to see their skylines change in the late 19th century due to the inventive use of steel-framing for high-rises, some Americans realized that these structures could be marketed as a set of discrete, stackable components to be assembled abroad, in principle if not in practice, as easily as in America. The time seemed ripe for such forays, especially in Europe, because several designers from the Old World by the 1890s were being awed in Chicago or New York by the birth of the "American Century" christened in the form of the skyscraper.[8] Not all were thrilled, however. In 1901, when the first American-style skyscraper was being planned for the Strand in London, some critics feared that by exporting the skyscraper, building syndicates were planning "an American invasion of Europe."[9] If there was such an invasion, it was not restricted to Europe. By the turn of the century, high-rises erected with American components were soaring from East Asia

to South Africa to Central America.[10] One observer perceptively noted that "the American producer introduces economies quite outside the matters of labor and material. These economies arise from closer perception of the thing needed, the reduction of superfluous weight to a minimum, and developing to the last limit the resources of mechanical skill."[11]

That "closer perception of the thing needed" was at the heart of the third crucial innovation: to use American steel components to create American-style industrial spaces. In 1876 the Nordyke-Marmon Company, for example, began to export the designs for American-style, multi-story flour mills, and continued to do so until the early 1930s.[12]

By the early 20th century textile manufacturers, sugar refiners and automobile makers followed suit. Standardization of building parts was matched with the standardization of labor tasks. Shifts in labor practices regarding the assembly line and the commodification of time accompanied the importing of standardized parts used to build the places where the standardization of labor was occurring.

The American company that first demonstrated an understanding of how profitable it might be to capitalize upon these three innovations overseas was the Milliken Brothers Company, established in N.Y. in 1887.[13] In the early 1890s Milliken secured contracts for several high-rises in U.S. cities, but by 1899 it began marketing its expertise globally. The Milliken Brothers published an export edition of their catalogue and soon thereafter steel-framed buildings designed in, and shipped from N.Y. were being erected from Mexico to South Africa.

Over 100 designers and draftsmen were employed in N.Y. to fill orders and the company set up branch offices in London, Havana, Mexico City, Johannesburg, Honolulu and Sydney. Milliken proudly delivered its kits for constructing low and high-rise buildings within six weeks after receipt of an order. It boasted that "all our work is made by template; that is, the piece is first executed in wood and then all similar pieces are made from the same wooden template. This insures accuracy and prevents trouble when work comes to be erected at its destination."[14] Milliken envisioned the template as a means to achieve architectural flexibility rather than as a recipe for architectural boredom. The standardization of the template did not preclude careful craftsmanship. Clients specified their budgetary and spatial requirements (e.g., for wharf facilities or commercial buildings), and Milliken's designers, sites unseen, satisfied those requirements rapidly by shipping prefabricated steel members, writing instructions specifying how to join those members, and providing designs predicated on those steel units suited to individual needs.

The Milliken approach was in contrast to most other companies that exported prefabricated steel parts, such as the Edwards Manufacturing Company of Cincinnati, which exported sheet metal cladding materials from 1909 to 1932. Edwards chose not to become directly involved with architectural design until 1930, by which time it was too late.[15]

The major problem Milliken faced was related to its economy of scale; the company could not match the resources of larger domestic producers who also began to diversify for export markets. In 1903, for example, Andrew Carnegie capitalized on the markets for American structural steel when he established the United States Steel Products Export Company.[16] Between 1918 and 1929, other conglomerates competed with Carnegie's company.[17] Like Milliken, these companies specialized in exporting either entire steel buildings or partial building components and, like Milliken, they offered a wide variety of design choices, from arches to office blocks, and from whole factories to conveyor framing. These larger, more rationalized, corporate conglomerates either bought out companies such as Milliken or edged them out by undercutting their prices. For these steel-based conglomerates, standardized and prefabricated parts for portable structures implied profit, versatility, adaptability, constructability and, in an era epitomized by this word, progress.

CONCRETE BLOCKS AND SLAB TECHNOLOGIES SHIPPED TO SITES UNSEEN, CA. 1905-1945

Increasingly after the turn of the century, concrete complemented steel as a problem-solving, exported building material. By reinforcing concrete with steel rods, or by using steel machinery to form concrete blocks as prefabricated building blocks, Americans seeking a foreign market for portable buildings further diversified their architectural offerings. In so doing, they provided the means for creating imaginative design solutions, often in cultural settings (such as East Asia or South America) where residents were experiencing the architectural spaces created by concrete materials for the first time.[18] My research in China suggests that some indigenous building traditions initially survived the competition posed by concrete blocks or slabs, although the cross-cultural dynamics of these architectural changes have not yet been sufficiently researched to draw firm conclusions.

At the 1876 Philadelphia Exposition, American Portland cement was demonstrated to be a viable building material, but production only began in earnest in 1880 and domestic cement only began to overtake European imports in 1897, by which time American machinery for crushing aggregate and making concrete had also begun to replace European machines, even in Europe itself.[19] By 1905 American manufacturers began investing in machinery that could mould concrete into workable components. Just as the jigsaw in the 1870s had helped produce a multitude of wooden architectural elements, so too did concrete block machinery in the early 1900s facilitate creative uses for concrete.

One of the companies that touted its creativity most in this regard was the Ideal Concrete Machinery Company, established in 1906 in South Bend, Indiana with an export office in New York. Already by 1907 "the importing of American concrete block machinery into every land on the globe [was assuming] vast proportions."[20] The Ideal Company was at the forefront of this activity, advertising its products of almost "unlimited adaptability and artistic possibilities,...from the most massive construction to daintily beautiful styles of architecture." Ideal's interchangeable products were manufactured by a "face-down principle" whereby a coarse mixture on the back of the block contrasted with a "rich facing material." A contemporary Ideal advertisement graphically illustrates the company's rationale.

In 1907 Ideal not only sent American representatives abroad to demonstrate the company's techniques, but it also brought foreign agents to Indiana. Four were based in Asia, three in Central or South America and two in Europe.[21] However, the company did not itself design architectural spaces using its building blocks, as Milliken was doing. Perhaps that was its downfall. By 1916, possibly because of market saturation by American competitors or because it had overextended its geo-

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THE BEST TO PRODUCE A BLOCK THAT IS

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VERMIN PROOF
SANITARY
INDESTRUCTIBLE
STRENGTHENS WITH AGE
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ADAPTABLE

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Brick, Tabique, Solid Veneer, Hollow Veneer

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by several of the

European Governments

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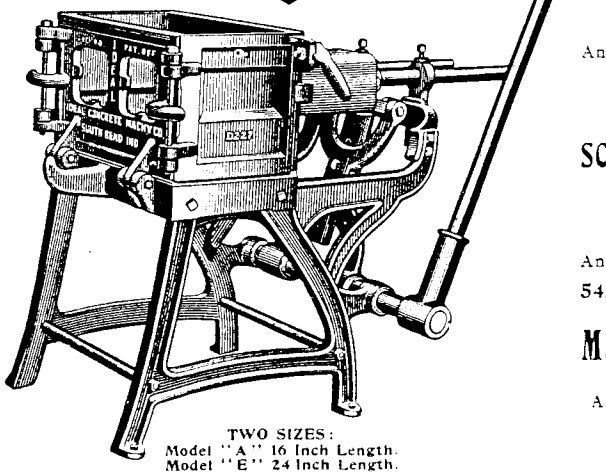

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Model "E" 24 Inch Length.

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at Adelaide, Australia

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Send for free catalogue, printed in English and Spanish, showing complete line of concrete machinery, including Mixers, Brick Machines, Sill and Lintel Machines, Spindle, Ball, Sidewalk, Step and Sill Molds, etc. A practical encyclopedia of the concrete industry.

IDEAL CONCRETE MACHINERY CO

401 North Emerick Street, South Bend, Ind., U. S. A.

Figure 4. The advantages and appeal of the Ideal Concrete Block, 1909

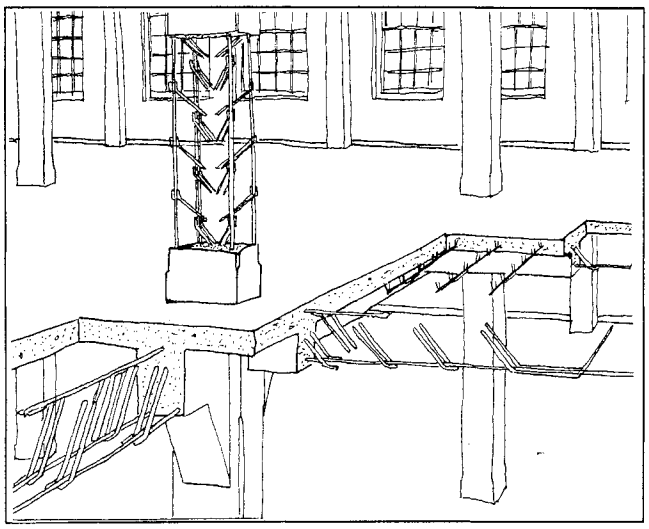

Figure 5. Kahn system of reinforced concrete, as used by Truscon, ca. 1904

graphic reach, Ideal faltered.[22] By the end of World War I, cement-based firms smaller and perhaps wiser than Ideal, merged into more extensive corporate entities, such as the Cement Export Company.[23] These and other kinds of concrete-exporting firms supplanted Ideal's position.

One of the most important of these firms was Truscon, founded by Albert and Julius Kahn, designers of some of the first U.S. automobile factories.[24] The company's technological backbone was the steel "Kahn Trussed Bar," also known as the Hy-Rib, invented by Julius Kahn. The trussed bar was characterized by a horizontal main bar with flanges, combined with rigidly connected shear members set at a 45 degree diagonal, all formed from one piece of steel. With no loose stirrups, the bars were laid in moulds into which concrete was poured to form precast elements. The Kahn system facilitated long span, solid-slab construction wherever shearing stresses had to be resisted.

By 1907 the Kahn system had been utilized not only in over 1500 U.S. and ninety U.K. structures, but also on a broader global scale. From corporate headquarters in Detroit and with a main factory in Youngstown, Ohio, Truscon was represented by four agents covering Central and South America, two in Europe and four in Asia.[25] The company diversified its prefabricated offerings, selling collapsible column reinforcements, steel joists and entire buildings. "They are built of standardized units, yet are individually designed to meet your needs."[26] Although some designers used other American systems for concrete reinforcement (e.g., Turner or Ransome), Truscon's system because of its standardized, adaptable, durable and well-marketed components became the pre-eminent system exported by Americans between the World Wars. Between 1929 and 1932, for instance, Truscon supplied designs and standardized building materials for 520 industrial plants in the Soviet Union alone.[27] However, Truscon not only supplied standardized parts; it provided for clients and builders a comprehensive construction standard by conducting training programs and by publishing instruction manuals with calculation methods, specifications and assembly instructions.[28] Truscon, then, supplied design ideas (as Milliken did) that made the use of their prefabricated building elements more palpable and convincing. Truscon also faced a similar challenge to Milliken with respect to its economy of scale. Financially, Truscon had succeeded so well by 1935 that it was absorbed by the world's largest producer of stainless steel: Republic Steel.

In late 1935 Republic also purchased the Berger Manufacturing Company, an early producer of standardized sheet metal, that in 1934 began to market the "Berloy Steel-Frame House." This prefabricated dwelling unit differed from others because it could be built by one person without erection machinery, and only its frame was steel so that clients could choose from a variety of exterior finishes and design additions. In 1936 Republic merged Truscon and Berger's export concerns, hoping to capitalize on the expertise of two proven giants in the commercial field of standardized, prefabricated technologies.[29]

Ultimately, it was because of the American war effort in the 1940s that the export of portable buildings to sites unseen was boosted to new levels of sophistication. In 1940 the Butler Manufacturing Company became the licensed fabricator for a "Panelbilt" construction system that featured a truss-less rigid frame and steel panels "of such large size that [it] is probably the simplest of all, so far as erection is concerned."[30] During the war the U.S. government used Butler technologies for structures as large as airplane hangars, and subsequently commercial clients followed suit, for reasons that manufacturers and designers had trumpeted since the late 1870s: "strength in relation to weight, compactness of materials in ocean shipping, simplicity of assembly, fire-safeness, and mobility, i.e. the readiness with which they are enlarged or taken down and re-erected on a new location."[31]

CONCLUSIONS AND IMPLICATIONS

What is suggested by the activities of these companies, spanning nearly seven decades? First, their metamorphoses suggest adaptability, which ironically was at the root of their appeal. Although these firms produced standardized parts, they marketed themselves as being flexible to clients' needs. Second, those firms that combined design services with material production seemed to be thrive longer in the increasingly competitive marketplace for standardized building components. Large, vertically integrated companies both consolidated design functions and diversified materials' production. Third, these examples were historically part of the "foundation for a larger structure" of industrialized building systems that proliferated after 1945. One key example was foreign-aid sponsored, low-cost ("sites-and-services") housing schemes that used precast concrete slabs-on-grade, panels and concrete block machinery. Recipients of these technologies often designed their own housing plans. Finally, the brief analysis of these cases begs the larger questions of how specific designs were elaborated, how well or badly they were received at sites unseen, and what relationships they might have had with contemporaneous European proponents of prefabrication. Further research will no doubt cast brighter light on these and other issues associated with exporting portable buildings.

NOTES

1. Alfred Bruce and Harold Sandbank, *A History of Prefabrication* (N.Y.: Arno Press, 1972); Robert Kronenburg, *Houses in Motion: the genesis, history and development of the portable building* (N.Y.: St. Martin's Press, 1995); Cecil D. Elliott, *Technics and Architecture: the development of materials and systems for buildings* (Cambridge, Mass.: MIT Press, 1992); and James Strike, *Construction into Design* (London: Butterworth, 1991).
2. *D.N. Skillings &D.B. Flint's Illustrated Catalogue of Portable Sectional Buildings*, (n.p.: Boston and New York, 1861). See design no.21: "Houses for Negroes, in a hollow square around that of the Overseer," and Ayer's Portable House and Construction Co., Chicago, in the *American Exporter* 3, no.6 (May 1879), 35.
3. See Miles Lewis, "The Asian Trade in Portable Buildings," *Fabrications: Journal of the Society of Architectural Historians, Australia and New Zealand*, 4 (June 1993): 31-55. In the early 20th century, several American companies were still exporting "knocked-down" houses. See, e.g., Aladdin Houses in the *American Exporter* 73, no.7 (July 1913), 135 and 74, no.1 (January 1914), 119.
4. *The American Exporter* was established in 1877 by Charles Root and Franklin Tinker. See *The American Exporter* 70, no.5 (November 1912), 75-83; and 122, no.1 (January 1938), 62+.
5. Penroyd Iron Works, of Philadelphia, undercut the bid of Rigby & Westwood, of London. See the *New York Times*, 4, 6, 8 and 9 April 1899; 10 and 28 August 1899; 7 October 1899; and the *American Exporter* 44, no.4 (September 1899), 30.
6. *American Exporter* 46, no.4 (September 1900), 30; 51, no.10 (October 1903), 24; and J. Shannahan, "The Gokteik Viaduct," *The Book-Keeper* 21, no.1 (July 1908), 1-5.
7. *American Exporter* 43, no.2 (January 1899), 17. Some companies retained shed designs and replaced wooden members with steel. See *American Exporter* 35, no.3 (February 1895), 45.
8. Jean-Louis Cohen, *Scenes of the World to Come: European Architecture and the American Challenge, 1893-1960* (Paris: Flammarion and the Canadian Centre for Architecture, 1995), 19-37.
9. *The Times* (London), 20 November 1901; the *New York Times*, 21 November 1901; *RIBA Journal* 9, ser. 3 (1901-2), 39; and the *American Exporter* 49, no.2 (January 1902), 20. In this case the fears were unwarranted because the building was never constructed. See *American Exporter* 16, no.3 (August 1905), 68.
10. The history of the skyscraper's diffusion beyond North America and Western Europe has not been adequately studied. See, e.g., *Far Eastern Review* 8, no.2 (July 1911), 49-53.
11. *American Exporter*, 46, no.4 (September 1900), 17.
12. In 1876 the company moved from Richmond to Indianapolis, Indiana. By the 1920s it was exporting entire mills to every continent. See *Nordyke & Marmon Company: an Institution* (Indianapolis: n.p., 1920), 18; *American Exporter* 43, no.1 (December 1898), 15; 81, no.1 (July 1917), 59; and 88, no.1 (January 1921), 74.
13. The company was initially a partnership between Foster Milliken (1865-1945) and Edward Milliken (1862-1906). In 1907 the company was reorganized under receivership. *Architectural Record* 11 (April 1902): 123-4; and the *Export News* 1, no.5 (September 1919), 19.
14. *Milliken Brothers Catalogue, Export Edition 1899*, 8.
15. *American Exporter* 63, no.1 (January 1909), 130; 66, no.4 (October 1910), 111; 72, no. 3 (March 1913), 112; 74, no.2 (February 1914), 111; and 106, no.4 (April 1930), 109.
16. *American Exporter* 51, no.11 (November 1903), 24; and Alfred Chandler, *Scale and Scope: the dynamics of industrial capitalism* (Cambridge: Harvard U. Press, 1990).
17. These included the American Steel Products Co., Consolidated Steel Corp., Republic Iron and Steel Co., Vulcan Steel Products Co., Liberty Steel Products Co., R.M. Ford & Co., Pennsylvania Steel Export Co. See *American Exporter*, especially from 1919 to 1929.
18. This situation was not as prevalent in regions under French colonial control because Hennebique's patented concrete system was more often employed there. I thank Dr. Chris Luebkeman for bringing this trend to my attention.
19. *American Exporter* 43, no.5 (April 1899), 30; and 58, no.3 (September 1906), 79-87.
20. *American Exporter* 60, no.1 (July 1907), 26.
21. Quotation from advertisements in the *American Exporter* 60, no.2 (August 1907), 6 and no.4 (October 1907), 3. In late 1907 agents were in Kobe, Sydney, Calcutta, Penang, Havana, Mexico City, Buenos Aires, Glasgow and Budapest.
22. Between 1907 and 1918 competition for the export market of concrete blocks came from the Century Cement Machinery Co. (Rochester, N.Y.); Ransome Concrete Machinery Co. (Dunellen, N.J.); Cement Machinery Co. (Jackson, Mi.); Waterloo Cement Machinery Co. (Waterloo, Ia.); and Concrete Machinery Sales Co. (Wichita, Ks.).
23. The Cement Export Company was incorporated in 1919 and conducted business from N.Y. acting as the sole exporter of eleven cement companies and handling orders "such as no individual company could possibly maintain." See *The Export News* 1, no.10 (February 1920), 79; and *American Exporter* 85, no.2 (August 1919), 176.
24. Ford's Highland Park plant (1910) was one of the most significant. Grant Hildebrand, *Designing for Industry: the architecture of Albert Kahn* (Cambridge, Mass.: MIT Press, 1974); and Reyner Banham, *A Concrete Atlantis: U.S. Industrial Building and European Modern Architecture, 1900-1925* (Cambridge, Mass.: MIT Press, 1986), 84. The Trussed Concrete Steel Company was incorporated in 1903; in 1918 it became the Truscon Steel Company. *Moody's Manual of Investments* (1951), 2878.
25. *American Exporter* 60, no.1 (July 1907), 85.
26. Advertisement in *The Constructor*, 12, no.6 (June 1930), 71.
27. For Kahn's work in the Soviet Union, see Anatole Kopp, "Foreign Architects in the Soviet Union during the first two Five-Year Plans," in William C. Brumfield, ed., *Reshaping Russian Architecture: Western Technology, Utopian Dreams* (Cambridge: Cambridge University Press, 1990), 176-212; and Jean-Louis Cohen, *Scenes of the World to Come*, 82-7.
28. George G. Shor, Jr., Elizabeth N. Shor and Fred N. Spiess, *The George H. Scripps Memorial Marine Biological Laboratory*, Historic Structure Report, California Office of Historic Preservation, SIO Reference 79-26, (October 1979), 10.
29. Berger Manufacturing Co. was based in Canton, Ohio. See *American Exporter* 62, no.5 (November 1908), 96; 96, no.5 (May 1925), 46; 118, no.1 (January 1936); *The Constructor* 17, no.6 (June 1935), 6-7; and A. Bruce and H. Sandbank, *A History of Prefabrication*, 46.
30. *American Exporter* 134, no.6 (June 1944), 96. The Butler Manufacturing Co. was in Kansas City, Mo. Also see *American Exporter* 126, no.1 (January 1940), 169; 127, no.4 (October 1940), 65; 133, no.4 (October 1943), 35; and 136, no.4 (April 1945), 36.
31. *American Exporter* 137, no.3 (September 1945), 38.