Experimental Logistics:
Extra-architectural projects at SOM, 1933-1986

by

Ann Lok Lui

Bachelor of Architecture
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Submitted to the Department of Architecture
in Partial Fulfillment of the Requirements for the Degree of

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ABSTRACT

In 1950, the Museum of Modern Art exhibited for the first time the work of an architectural office instead than a single designer. The exhibition's poster child was Skidmore, Owings & Merrill (SOM), billed in MoMA's press release as a firm driven by both the "discipline of modern architecture" and "the discipline of American organizational methods." MoMA's pivot to showcase collaborative practices rather than individual designers represented the broader emergence of large architectural offices in the postwar period. This thesis investigates the work of SOM, characterized by Frank Lloyd Wright with perhaps unbeknownst precision as a 'plan factory.' It does so by introducing the idea of the 'extra-architectural' artifact: the residual traces of the procedures and protocols undergirding the office's built projects, as of yet overlooked by the chroniclers of the firm. These artifacts are used as evidence to show how SOM's in-house design of managerial logistics resulted in a subsequent architecture of logistics. This thesis begins first in 1933, with the exhibition of products and urban-scale infrastructure at the Century of Progress; second, with a wartime advertising practice in print and prototype, and subsequent federally funded defense housing contracts; and third, with early "crude" efforts to calculate an 'optimized' architecture-by-spreadsheet in the '60s and '70s in partnership with IBM. This study of SOM's extra-architectural projects ultimately reveals a similarity to the experimentation of the architectural avant-garde and provokes a rethinking of Manfredo Tafuri's theoretical metropolis. Emerging intrinsically from the conduct of a large organization, SOM's experimental logistics suggest a different way to understand the self-propagation of the corporate office, a model for architectural practice growing at an exponential rate in the contemporary field.

Thesis Supervisor: Arindam Dutta
Title: Associate Professor of the History of Architecture

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Significantly: I want to express my sincere gratitude to the office of SOM, my former employer, which perhaps unwittingly provoked in me a curiosity and admiration beyond my job description. Thank you to Brian Lee for supporting my research by allowing me access to the office's archives. I'm also grateful to Eric Keune, who first suggested a writing project on the office. Thank you for your mention of under-examined housing projects and for reading an early draft of Chapter 2—I hope you do not regret asking me to look more closely. I should also express my gratitude to the members of the Computer Group who generously spoke with me for this project: Lavette Teague, David Sides, and Neil Katz. Also to Karen Widi, who suffered my many requests on extremely wide-ranging topics.

A sincere thank you to the friends without whom none of this would have been possible these past two years: Irina, Nisa, Nathan, Larisa, and Ben. I'm grateful to my parents for their support, including my dad's own love of history—of which he told me the long arc is, slowly but surely, *up*. And far from last, to Craig Reschke, who shares my love of this story and so much more.

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"Nothing is so easy to see as the imagination of a genius
and nothing is as hard to see as the imagination of a company."

— Philip Johnson, for Mobil Oil advertisement

"Most architects do not dream, they are simply businessmen."

— David Riesman

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Introduction

The Second Discipline: Revisiting SOM's "American organizational methods"

In 1950, the Museum of Modern Art exhibited for the first time the work of an architectural office instead of a single designer. The exhibition's focus was Skidmore, Owings & Merrill, billed in MoMA's press release as the "largest group of architects working exclusively in the modern idiom."[1] The Museum Bulletin, an exhibition catalog prepared by director Philip Johnson, focused on this important turn from showcasing individual architects to showcasing a collaborative practice.[2] The buildings on view, according to Johnson, were "imaginative, serviceable, and sophisticated." Yet more important was how and by whom they were produced. The Bulletin's description of the firm reads: "The single designers who function within this organization have no fear of a loss of individuality. [...] They work together animated by two disciplines [...]—the discipline of modern architecture and the discipline of American organizational methods."

MoMA's decision to start featuring the work of collaborative practices, choosing as their first subject Skidmore, Owings & Merrill, represented a broader emergence of large architectural offices in the postwar period. MoMA, which had anointed the kings of the "International Style" in 1932, bracketed their decision to feature Skidmore, Owings & Merrill within this curatorial trajectory. "We are now rounding out the revolutionary cycle begun by the Chief Pioneers of the International Style," Johnson's Bulletin declared, "Their pioneering work is over but the concepts and principles which they introduced are today being employed by [...] architects throughout the world."[3] MoMA situated the work of SOM in the arc of architectural history, as carrying on the torch forward from the International Style—a linear architectural continuum transformed in its most recent stage by the "discipline of American organizational methods." Yet while an office like SOM was new for MoMA's catalog, the firm was also representing a trend amongst its contemporaries: the broader emergence of large architectural offices in the postwar period.

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[1] The Museum of Modern Art, "Press Release: Models of New Buildings on Exhibition," September 20, 1950, MoMA Archives.

[2] Museum of Modern Art (New York, Department of Architecture and Design), and Skidmore, Owings & Merrill. *Skidmore, Owings & Merrill, Architects, U.S.A.* (New York: The Museum of Modern Art, 1950).

[3] Ibid., 5.

Three years before, in 1947, architectural historian Henry-Russell Hitchcock proposed that architectural practice was rapidly diverging into two paths in his essay, "The Architecture of Genius and the Architecture of Bureaucracy."[4,5] At midcentury, Hitchcock observed on one hand, the lone 'genius' as epitomized by Frank Lloyd Wright. On the other, the 'bureaucratic' practice as exemplified by Skidmore, Owings & Merrill (SOM) and factory designer Albert Kahn. What separated these practices to Hitchcock was scale and authorship; in the coming years, he proposed, "individuals of established fame" would remain relevant in order to author "focal structures," say such as "churches, libraries and municipal buildings." The *Architectural Review* highlighted this type of practice with a photograph of the Guggenheim New York. Comparatively, the anonymous architects at the bureaucratic offices such as SOM would focus on "planning" and "efficiency" and on projects of "large-scale operations."

Both Johnson and Hitchcock were drawing attention to the postwar emergence of a new form of architecture practice: the "corporate" or "bureaucratic." Both chose SOM as their poster child. However, the historiography of SOM has since relied for the most part on an accounting of singular buildings. Monographs on the office, including their more scholarly introductions, rely on glossy images of its built projects; on the success of its curtain walls; on the office's stylistic and genealogical relationship to figureheads of modernism; on the firm's technical expertise—computational, structural, and "sustainable"; or on the role of the tall tower in the American city.[6] Despite Hitchcock's argument that "focal structures" are the purview of the genius architecture, the historiography of SOM has largely remained focused on the buildings the office produces. This thesis proposes to look closely at the methodologies and practices that produced these buildings, returning to Johnson's second discipline of "organizational methods" and put-

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[4] Henry-Russell Hitchcock, "The Architecture of Bureaucracy & the Architecture of Genius," *Architectural Review*, January 1947, 3–6.

[5] I was introduced to this text through my collaboration on OfficeUS, the U.S. Pavilion at the 2014 Venice Architecture Biennale. I was lucky to have the opportunity to work with Ana Miljacki and Michael Kubo on the exhibition's repository, which collected 100 years of United States offices and their work abroad, and on the post-exhibition book *OfficeUS Atlas*. I'm immeasurably grateful to have participated as many of the references throughout this thesis draw directly from research that was executed for the project, by the large team at MIT and elsewhere. My inability to note each time I drew from the repository each goes to show, I hope, the project's potential as a resource for future students and scholars.

[6] These monographs refer specifically to the 'complete works' set, recently re-issued by Monacelli Press with a new dust jacket in 2009. Each features an introduction by a significant architectural historian on the enclosed works. The first of the set is: Skidmore, Owings & Merrill, *Architecture of Skidmore, Owings & Merrill, 1950-1962*, 1st Monacelli Press ed (New York: Monacelli Press, 2009).

ting on hold, for a moment, the "discipline of modern architecture." Procedures have been part of the office's genetic code since its founding; Louis Skidmore and Nathaniel Owings, the office's eponymous founders, at their first collaboration at the Chicago's World Fair in 1933 learned the aphorism that drove the Fair's curatorial strategy: 'process, not product.' This thesis hopes to look beyond the photographs of buildings, more deeply into the protocols of both business and design that were developed by the office and subsequently shaped the spaces it designed.

This thesis investigates the work of Skidmore, Owings & Merrill through three stories that uniquely reveal moments in which the office's ongoing experimentation with the design of in-house logistics was subsequently implemented in the firm's architecture. The *things* at the center of these stories are not buildings. They are instead the byproducts of a large corporation constantly in the process of adapting the strategies of industry and business to architectural practice. I introduce the term "extra-architectural" to describe this surfeit of productive output that does not fall into the regular model of a client-initiated, fee-based building, introducing a broader taxonomy of work. These other typologies include advertising, computer applications, patents, experiments, exhibitions, research, and texts. These extra-architectural artifacts can be found in many phases of the firm's growth; they are authored by draftsmen and design partners alike, not a tradition but perhaps a symptom of a creative collaboration of thousands over decades. Broadly, SOM's extra-architectural production represents a rich secondary archive of alternative historical material from which to understand the office's practice. They also provide evidence that SOM, while developing frameworks of increased efficiency, also created a culture of experimental excess. The three moments selected for this text—chronologically disconnected—stand out because they reveal specific moments in which SOM's in-house experimentation with logistics, in the ordering of collective practice and its methods, resulted in a subsequent architecture with similar traits of efficiency, reproducibility, and optimization.

Chapter 1 begins in 1933, the design and management of spectacles and exhibitions at the Chicago's Worlds Fair, a Century of Progress, by Louis Skidmore and Nathaniel Owings before the office of SOM was founded. This chapter explores the fair against the backdrop of the Depression, which resulted in the unconventional training of two young brothers-in-law. It brings to light the extra-architectural

practice of temporary exhibitions, shows, and their advertisement of new building materials and assemblies. This chapter plies the office's origin story, extrapolating from it the yet-to-be-founded future firm's roots in operations at the urban scale, the exhibition of process, and the new role of the architect as negotiator of corporations including material manufacturers and industrialists.

Chapter 2 expands on the effect of World War II as a productive environment for the nascent firm of SOM. It begins by bringing to light a collaborative advertising practice in which SOM worked with material manufacturers to design experimental "paper architectures" to market new low-cost, prefabricated products targeted as defense construction. It then follows these relationships to their profitable ends as the print ads turned to full-scale prototypes under the aegis of the John B. Pierce Foundation, a non-profit group based in New Jersey. This chapter concludes by revisiting a series of defense housing projects executed by SOM during the wartime, mostly overlooked in the historiography, which took wartime federal funding and the regulated push for quickly constructed and mass-produced housing to test new methods of architectural production.

Chapter 3 jumps forward three decades to the '60s and '70s, investigating the procedures that undergirded the production of SOM's commercial tall buildings. It looks into the extra-architectural computational investigations in the two decades before drafting software became widely available at commercial rates. It traces SOM's early partnership with IBM, which blurred disciplinary lines, and looks at the early efforts at total simulation and architecture through data management—ultimately suggesting a different understanding of the building type that became the office's calling card.

These three stories, though the later two are separated by some decades, are key moments within the office's ongoing experimentation with the production of design. In each, the composition of the architectural office, drawing from both factory line and corporate organization resulted in the creation of spatial products that were large-scale, semi-autonomous and driven by data and flexibility rather than form or enclosure. What these three moments for SOM have in common is the testing of logistics which simultaneously organized designers within the office and architectural designs themselves: from the coordination of limited manpower to undertake a job like Oak Ridge in just two weeks; to the development of a

computer application to optimize—in its entirety—the now-ubiquitous large commercial office building. SOM, a battleship as architectural office, takes fine-tuning to persist in its forward motion: these three architectural stories begin with the metaphorical ratchet wrenches and security protocols. For evidence, this thesis takes as its evidence the residual traces of the firm's internal processes.

An anecdote from Chapter 3 suggests a way to interpret this collection of extra-architectural projects by SOM. In the 60s, SOM created an early computer application called the Building Optimization Program (BOP), which sought to find the most cost-effective office building solution to any site given certain parameters. In a paper on BOP, Neil Harper, one of the program's creators, mourned that supposing a given site, only a rare few architects were able to propose, sort through, and synthesize the vast number of possibilities for a building that any urban condition provokes.[7] These architects were few and far between. However, Harper saw BOP as a technology that could aid those who were not gifted with these rare talents. He wrote: "It is conceivable that these as yet unexplained human abilities can be extended and magnified if proper use could be made of appropriate computer techniques dealing with information processing." From Harper's perspective, with BOP, SOM had designed a kind of design prosthetic to enhance and broaden the scope of an architect's ability. The average designer—or in fact, a thousand of them—could, aided by procedure and technology, find genius.

SOM remained doggedly anonymous through the years. Other corporate architecture firms' names transformed as new partners took the helm through the decades; in comparison, SOM appears to have restricted individual equity partners to a maximum stake in the firm's holdings.[8] Its name, which changed only once from Skidmore, Owings & Merrill to the even more anonymous SOM, has elevated and retired four generations of partners since its founding. Technologies of all kinds—systems, procedures, computer applications like BOP alike—aided a multitude of designers in the exponential self-

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[7] G. Neil Harper, "BOP—An Approach to Building Optmization," in *Proceedings of the 1968 23rd ACM National Conference, ACM '68* (New York, NY, USA: ACM, 1968), 575–83.

[8] This was a suggestion inferred by historian Jay Wickersham, in conversation and confirmed in an email to me (December 5, 2014), which is supported by the continuous broad pyramid of partners at SOM that perseveres without the routine coups seen by their competitors.

propagation of a corporation, which remained indefatigably without figurehead, to an organization of thousands with international reach.

In 1947, Peter Drucker's *Concept of the Corporation*, a history of General Motors, provided a theory and background on the evolution of large industrial corporations at the turn of the 19th century; highlight strategies for personnel management and business practices like specialization and decentralization.[9] Looking through these lenses at SOM, the corporate firm *par excellance,* may begin to ply what these strategies mean when applied to the business of architecture. SOM was preceded by a history of Chicago and New York architectural firms: Chicago-based D.H. Burnham & Company, which emerged from the early collaboration of Daniel Burnham and Wellborn Root, employed hundreds of employees on complex projects including the Merchandise Mart (Chicago, 1930) and the Flatiron Building (New York, 1902). Within the office of D.H. Burnham & Company, the marks of corporate practice were already visible in the organization of the office's desks that grouped its employees into areas based on their specialization in management, administration, drafting, engineering, and construction administration.[10] In the essay, "Learning from Burnham: the Origins of Modern Architectural Practice," historian Jay Wickersham's also cites Burnham's association with trade organizations such as the WAA (Western Association of Architects) as significant to the office's ability to grow in scale.[11] Against the backdrop of Chicago's rapid growth during the late 19th century, Wickersham cites the WAA's initial regulations on architectural practice—including licensure, accountability, and contract documents—as regulations that undergirded the growth of the large successful firms that followed in the coming decades:

> Restricting architectural practice to a limited body of licensed professionals would strengthen their hand economically and support the push for a standard architectural fee schedule, to be set at 5% to 6% of the construction cost. And by improving the business prospects of the profession, architects would gain the influence and power they were striving for.[12]

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[9] Peter F Drucker, *Concept of the Corporation* (New Brunswick, N.J., U.S.A.: Transaction Publishers, 1993).

[10] "The organization of an architects office," *The Engineering and Building Record*, December 7, 1889: 83-84.

[11] Jay Wickersham, "Learning from Burnham: The Origins of Modern Architectural Practice," *Harvard Design Magazine* 32 (Spring/Summer 2010).

[12] Ibid., 21.

Also present in Burnham and Root's partnership was the equal division of focus on management and design; Burnham served as the public face of the office procuring jobs and dealing with clients, while Root led the draftsmen as a lead designer. Other large firms in the beginning of the twentieth century grew in scale and in the size and complexity of the projects they took on by adapting strategies from industry and business. Also in Chicago, the office of Holabird & Root grew its practice in the aftermath of the Chicago fire, testing new material strategies on increasingly tall buildings including implementing the first curtain wall at the Tacoma Building (Chicago, 1888) and the first use of a steel structure in a high-rise at Marquette Building (1895).[13] In parallel, in New York, the office of McKim, Mead & White employed 110 designers at the time of the Columbian Exposition in 1893. Throughout its eight decades of practice, the office produced almost one thousand individual buildings.

In parallel with the emergence of these large firms, the profession of 'architect' had itself been changing and being formed in parallel with the development of 'Organization America,' a term used by sociologist Charles Perrow to describe the late-19th century emergence of large-scale capitalist corporations in the United States.[14] Beginning in the 19th century, designers and builders moving from "craft to profession," as documented by architectural historian Mary Wood's book of the same name.[15] American architects were inheriting a model of professional practice from England; transformed by what Woods cites as US "capitalism" and "free markets." Transforming from loose organizations of building people—carpenters, artisans, builders in the 18th century—were the emergence of the first professional organizations for architects such as the AIA. Into these organizations were funneled a new type of "office-trained" architect, one familiar with architectural history, design and composition, and "professional etiquette." In parallel, shaping these changes in the architectural profession was a broader shift towards large businesses. According to Perrow, in 1800, no United States organizations of over 500 people existed; today, 50% of people work for such corporations. Perrow argued that it was in the 19th century witnessed a shift from a

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[13] More on the large early firms of Chicago in: Carl Wilbur Condit, *The Chicago School of Architecture: A History of Commercial and Public Building in the Chicago Area, 1875-1925* (Chicago: The University of Chicago Press, 1964).

[14] Charles Perrow, Organizing America: Wealth, Power, and the Origins of Corporate Capitalism (Princeton University Press, 2009).

[15] Mary N Woods, From Craft to Profession: The Practice of Architecture in Nineteenth-Century America (Berkeley: University of California Press, 1999).

"society of communities" to a "society of organizations." Facilitated by both legal systems that were re-worked in order to give large corporations more autonomy, in addition to the finalization of railroads that allowed for an economy of scale, industries bloomed in the late 1890s—over the course of 5 years, the emergence of 200 corporations that today still exist and dominate the market. Yet these corporations were mostly in heavy industry; architects, who had just become "businessmen," would take the following half-decade to develop large sustainable corporate firms.

Since the publication of "The Architecture of Bureaucracy & the Architecture of Genius," Hitchcock's predication about his growth of the bureaucratic office has in some ways come to pass. Pritzker Prize winners, those singular "geniuses" descendant from Frank Lloyd Wright's figurative lineage, appear to be relegated to the creation of dream worlds: shiny iconic museums and institutional projects to bolster ailing cities like the Guggenheim Bilbao and its offspring. Even those architects who have succeeded within this limited environment are all too aware of their limited reach; they wearily tell the assembled press that the remaining 98% of built space is "pure shit."[16] Fulfilling Hitchcock's other premonitions in relative obscurity are the corporate architecture firms that have been growing—slowly but surely—to behemoth scale.

SOM and its peer architecture firms have slowly acquired companies or expanded into adjacent disciplines like engineering, structures, construction and even development. With these mergers, these design offices have disturbed the static architect-contractor-client ironclad triangle—a postwar fixture of professional practice. Replacing these three seats at the table in corporate practice is a much more larger and complex network—one that activates temporally like a switchboard—joining banks, governments, institutions of all kinds, and lobbyists in less easy to diagram methodology of operation. In some ways, all buildings are subject to the actions of all these parties.[17] Yet the corporate firm has evolved *with*, harnessed

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[16] Elizabeth Hopkirk, "Frank Gehry Brands 98% of Architecture 'Pure Shit,'" Building Design, accessed October 27, 2014, http://www.bdonline.co.uk/news/frank-gehry-brands-98-of-architecture-pure-shit/5071733.article.

[17] This new condition I argue is in comparison with earlier 20th century architects; architects before the turn of the century professionalization had already functioned as jack-of-all trades; "Architects at midcentury hardly had the professional status to secure a livelihood based on design alone. Architects typically supplemented their income as land surveyors, real estate agents, property evaluators, building contractors and so on— a multiplicity of signatories capabilities." From Arindam Dutta, *The Bureaucracy of Beauty: Design in the Age of Its Global Reproducibility* (New York: Routledge, 2006): 179.

and methodized this way of working. Systems of flexibility and insurance trump signature styles. Orthogonal lines are replaced by data sets. Drawings by simulations. "Planning" by logistics. Perspective views by PR. A type of architectural practice emerges that is controlled not by formal regulating lines but by protocols for logistics. Shining new cities designed by the corporate architecture firm, built entirely from scratch on landfill, are concerned first and foremost with managing their carbon emissions—and giving the public ways to monitor their "sustainability" performance. Corporate architectural practices focuses on live-time control of systems rather than iconic forms.

SOM, which began as the partnership of two brothers-in-law in 1936, grew to 500 by the MoMA show in 1950, and then exponentially to over 1,600 by the 1980s. AECOM, the publicly traded mega-conglomerate, now employs over "10,000 worldwide."[18] Today, half of architects work for large firms of 50 or more.[19] These offices make up almost half of total billed revenue, while only representing 5% of offices[20] because of strategic acquisitions that have collapsed dozens of firms under a few mastheads. Yet, as Keller Easterling provokes in her book *Enduring Innocence,* we lack the vocabulary to describe such practices and their products.[21]

To begin to furnish that vocabulary, this thesis returns to MoMA's catalog on SOM from 1950. It appears that Johnson's text that focused on "organizational methods" over buildings got to the heart of the matter. The accompanying image should not have been this photograph of the Lever House. Instead, it should have captured the often non-visible, broader scope of tools and operations developed by the corporate office that have persisted through the decades. These tests in logistics aided a multitude of designers in the self-propagation of a corporation—one that remained without figurehead—to an organization of thousands within a few decades.

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[18] "AECOM - About - Fact Sheet," accessed October 27, 2014, http://www.aecom.com/News/Fact+Sheet.

[19] I'm interested in firms of, say, 500 or more but AIA's Firm Survey has only in the past few years included the new category of "100+" showing the continual focus on the small atelier-model practice.

[20] Kermit Baker, "Get on the Good Foot: The 2014 AIA Firm Survey Report Shows Design Activity Has Recovered from the 2008 Recession.," AIArchitect, September 26, 2014.

[21] Keller Easterling, Enduring Innocence: Global Architecture and Its Political Masquerades (Cambridge, Mass.; London: The MIT Press, 2007).

1.

Spectacles of Process: Chicago's Century of Progress Exposition, 1933-1934

1933: Above Chicago, higher than any building, passengers rode "among the clouds" in "rocket cars."[1] "A shining silver Goodyear dirigible" drifted by.[2] Nighttime would come to the fairgrounds next to the lake, but the Century of Progress World's Fair stayed illuminated. Two massive steel towers reached six hundred feet above the ground. Towering interbellum 'supertalls.' Suspended between them—at a length exceeded, at the time, only by the George Washington Bridge over the Hudson according to its marketing—visitors drifted across the temporary city below. The structure spider-webbed between the two towers: steel cable barely 1.5 inches thick.[3] Seventy percent of visitors to the fair had never flown before. Now, after having been lifted into the sky by Goodyear blimp and by seaplane during the World's Fair events, they try out the "Sky Ride." (Fig. 1.1) Beginning at ground level, visitors entered a bank of elevators that carry up to twenty people at once. It's safe, they were assured, robustly engineered to resist deflection. Structural members reinforced in the best ways that Inland Steel knew how. Otis elevators hurtled up and down, the conveying systems themselves on exhibit. Visitors exited the elevators and entered the gondola rocket cars: oblong in form, with four long glass windows, rippled aluminum cladding. Streamlined for aerodynamic aesthetics. They dipped off the platform edge and they were gone: hovering over the fairgrounds, peering out into the night. Through one window, Indiana and industrial steel factories; through another Chicago: the "Magic City." From high above, the swarming of visitor activity below was mostly invisible, including its darker underbelly of improvised workers, prostitutes, and others victims of the Great Depression; novelist Nelson Algren's "zigzag riot of fakery, a hash of hot-dog stands and shimmy shoes", featuring "nude dancers, wind-tunnels, [..] Dante's Inferno, Miss America, alligator-wrestlers."[4] A clustered mob of politicians, corporations, and citizens, wealthy and poor alike. Yet, from the Sky Ride, all one could see were the

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[1] *Chicago: A Century of Progress, 1833-1933* (Chicago, Ill.: Marquette Publishing Co., 1933): 31.

[2] Ibid.

[3] Nathaniel Owings, "Amusement Features of the Exposition," *Architectural Record*, May 1933, 355–62.

[4] Nelson Algren, *Somebody in Boots: A Novel* (New York: Thunder's Mouth Press, 1987).

lights of the fair below and the looming skyline of Chicago—waking up at last after 50 years of Louis Sullivan's predicated architectural slumber[5]—in the distance.

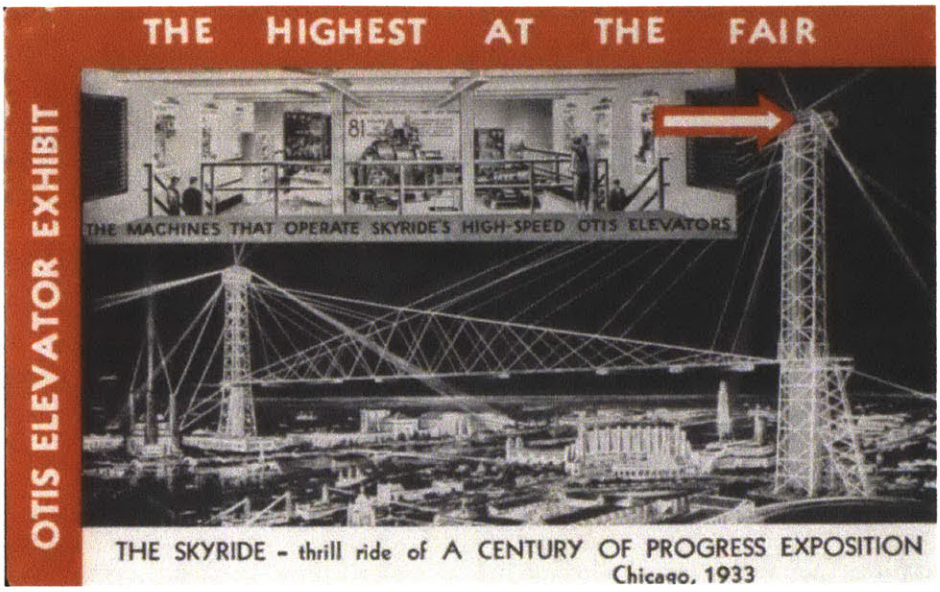

Fig. 1.1 Otis Elevator Exhibit postcard, 1933-1934

Below, perhaps, standing in the dark next to one of the towers are two young architects Nathaniel Owings and Louis Skidmore. They watch the rocket cars fly overhead. At ages 30 and 36 respectively, brothers-in-law, they were by their own accounts under qualified to lead the design of much the World's Fair architecture.[6] Nonetheless, they had become responsible in part for Chicago's A Century of Progress International Exposition: a successful World's Fair even in the midst of the Depression—concluding in the green with one hundred and seventy thousand dollars to spare[7]—and so popular it was extended a year beyond its original schedule because of its popularity. Taking place in 1933-1934, the first fair in Chicago since the Columbian Exposition in 1893, the Century of Progress explored the motto "Science Finds, In-

[5] Sullivan, a critic of the 1893 World's Fair, famously said: "The damage wrought by the World's Fair will last for half a century from its date, if not longer." From: Louis H. Sullivan, *The Autobiography of an Idea* (Dover Publications, 2012): 325.

[6] Nathaniel Owings' memoir serves as a useful resource on the work of the partners at the Chicago World's Fair. While his memory is not always reliable, and some of his stories are contradicted by other sources, Owings' perception of the two architects' role in the World's Fair serves as a document that reflects how he perceives the experience to have shaped his own training. See: Nathaniel Alexander Owings, *The Spaces in Between; an Architect's Journey.* (Boston: Houghton Mifflin, 1973).

[7] Lenox Riley Lohr, Fair Management: The Story of a Century of Progress Exposition (Chicago, Cuneo Press, 1952): foreward.

dustry Applies, Man Conforms." The Fair was planned to contrast with the previous exposition in both theme and architectural aesthetics, liberally applying color as the "Rainbow City" in sequel to the nineteenth century "White City." Planning for the fair began in 1928, when it was interrupted by the stock market crash the following year. The fair was forced to be re-considered in a lower-budget form: supplies would be purchased at lower costs, contracts would be re-negotiated, and wages of those hired by the Building Construction Employers' Association, responsible for most construction workers, cut twenty percent.[8] In some ways, the Depression was a boon to the Fair; Lenox Lohr, the General Manager, wrote that the project benefited from a "surplus of high-grade manpower and a dearth of construction projects which made each dollar do the work of two."[9] This less costly version of the fair also opened opportunities for inexperienced designers like Skidmore and Owings.

Beyond the fair, the Great Depression had abruptly halted the business of architecture, possibly driving the two young men to this unorthodox job in lieu of more conventional prospects.[10] In 1932, the year preceding the Century of Progress, architecture was at a near standstill: construction in the United States was down to one-seventh of what it had been before the crash of '29.[11] Architecture firms disappeared without work, decreasing from over nine thousand to just over five thousand in the course of three years.[12] Formal trends during these years seemed to turn dramatically one of two ways: either the conspicuously conservative or a rare moment in which to test the Modern, the novel, and eccentric.[13] It was against this backdrop that Skidmore, having just finished travels on the Rotch Scholarship after studying at the Massachusetts Institute of Technology, was named Chief of Design and Development for the Fair after the retirement of John Stephen Sewell. The more established designers on the architecture committee had been unable to resolve their divergent views; Paul Cret and Raymond Hood, who were leading the Architectural Commission, were interested in different kinds of architecture. In his memoir, *The Spaces in Be-*

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[8] John E Findling, *Chicago's Great World's Fairs* (Manchester [Manchester Univ. Press, 1994): 51.

[9] Lohr, *Fair Management*: foreword, 2.

[10] This idea is developed in depth in the following dissertation: Hyun Tae Jung, "Organization and Abstraction: The Architecture of Skidmore, Owings & Merrill from 1936 to 1956." (Columbia University, 2011).

[11] Thomas S. Holden, "How Many Architects Are Carrying on?" *Architectural Record* (July 1933): 34, 57-58. Cited in Jung, "Organization and Abstraction," 28.

[12] Ibid.

[13] A dichotomy elaborated on in: Jung, "Organization and Abstraction": 28.

tween, Owings remembers Hood as a kind of man who would "call the char-woman away from her broom" and "listen carefully to her [...] design ideas."[14] Cret—a Beaux-Arts trained architect who had made his career on government buildings and war memorials—was more of a historicist in Owings memory who remembered the older architect telling students "ivy is the architect's best friend."[15] Yet the two men were able to agree on Louis Skidmore as their proto-deputy. The other big names on the Commission—Edward H. Bennett, John A. Holabird, and Hubert Burnham[16]—assigned the Fair's large building commissions amongst themselves and left the rest to Skidmore as "Chief of Design." The central Hall of Science was designed by Holabird; Hubert Burnham, the son of Daniel Burnham, continued his father's legacy designing at World's Fairs by working on the entrance area and adjacent buildings.

"Skid," a nickname that stuck, worked on all other exhibitions of lesser scale and took care of day-to-day matters on the ground. This included the design of large-scale temporary pavilions, such as the Travel and Transport Building and Manufacturing Exhibit Building. Skidmore was also eventually transferred to the Exhibitions Department, where "all designs for exhibits [had to pass] for criticism, revision and final approval, in much the same manners as the plans for the buildings themselves were originally handled."[17] Skidmore brought on his young brother-in-law Nathaniel Owings, a recent Cornell University graduate, to run Concessions.[18] These responsibilities included the fair's unique architectural attractions—not associated with any commercial or regional representation—as well as choreographing performances and live exhibitions.[19] "I became an instant expert in a variety of fields," wrote Owings in his memoir of

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[14] Nathaniel Alexander Owings, *The Spaces in Between; an Architect's Journey.* (Boston: Houghton Mifflin, 1973): 46.

[15] Ibid.

[16] According to John E. Findling in *Chicago's Great World Fairs,* the original 1928 appointed board of architects were Harvey Wiley Corbett, Raymond Hood, Ralph T. Walker, and Paul Cret. The three Chicago architects, Bennett, Holabird and Burnham (son of Daniel Burnham) were appointed later. Nonetheless, after initial planning, according to Findling, "The commission delegated much of the routine work to a sub-committee composed of the three Chicago architects, and to Louis Skidmore, who was the fair's chief of design."

[17] Louis Skidmore, "Planning and Planners," *Architectural Forum,* July 1933, 29–33.

[18] Gordon Bunshaft, SOM's early iconic designer, in his oral memoir undermines much of Owings' claims about his work on the World Fair: "Owings leaves out the small print, but he didn't work on the design of the World's Fair. He sold space in the amusement area to companies. He had nothing to do with design. He wasn't a designer. These are facts. This isn't him writing a book." From: Betty J. Blum, *Oral History of Gordon Bunshaft,* 1990, Art Institute of Chicago Archives: 42. However, credits to Owings in official Fair documents (cited throughout) and published in architectural journals seem to support his role in the design of Sky Ride and other fair amusements, despite Bunshaft's dispute.

[19] Skidmore, "Planning and Planners," 32.

their work on the World's Fair, "[I] organized a drafting force for working drawings (having hardly ever drawn one myself), supervised construction, planned concessions, made up in enthusiasm what I lacked in skill, and developed a swinging crew. [...] It was always too late to go back."[20]

Though they were close friends and family by marriage, the two men were different in presentation. Skidmore was a networker and a "long-range planner"; those who didn't work well with him called him a "devious schemer."[21] Owings, the younger of the two was instead "superimposed on everybody's territory,"[22] parlaying "accidents of timing, luck and fortune"[23] onto spectacles like the procurement of lions and tigers for a Standard Oil carnival show. Skidmore and Owings had little experience before starting at the Fair; nonetheless even the two young men knew that the new skills they would acquire were vastly different from "conventional architectural practice."[24] Skidmore was learning management through his overseeing of numerous architects, buildings, and the infrastructure that connected them; Owings was learning how to spin an idea and engage advertising for his own ends.

The Century of Progress was the first architectural collaboration between Louis Skidmore and Nathaniel Owings. In the following years, Skidmore and Owings with a third partner, John Merrill, would go on to found the office of Skidmore, Owings and Merrill (SOM). The later exploits of the office are well known and chronicled. These include its growth, overtime, to be for many years the largest architectural office in the United States; its name synonymous with glass-clad office towers; and its current association with the design of superlative tall buildings like Burj Dubai and the new World Trade Center in New York. Yet this first work between the eponymous founding partners, while unlike in form to the sleek technical facades the firm would come to be known for, shaped the practice of these two young men and the office they would establish. The Fair's critics would cast the odd architecture of the Century of Progress as

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[20] Owings, The Spaces in Between, 50.

[21] Ibid., 47.

[22] Ibid., 51.

[23] Ibid., 52.

[24] Ibid., 61.

"symptoms of exhuastion and despair," "escape phenomena, flights from the realities."[25] However, more was at play than undirected formal experimentation. Undergirding the Century of Progress were modes of business and design that would form the foundation of SOM's unique architectural practice.

The mega-structure of the Sky Ride epitomized the unique way in which Skidmore and Owings designed and executed the architecture of the Century of Progress. Originally conceived by engineer William L. Hamilton, the Sky Ride project had been tabled early in planning for lack of funding and general feasibility.[26] The Commission had also tabled other speculations considered too large in scale or absurd in concept, such as the construction of two enormous mountains that the public would ascend in elevators and then experience exhibitions on the way down—an idea by Raymond Hood—or a 1,000-foot long pickle proposed by Heinz Corporation. However, something about the Sky Ride captured the imagination. Owings revived the project and ultimately cobbled together the Sky Ride from in-kind corporate donations.[27] He acquired, magpie-like, the "foundations, steel, cables, elevators, glass, concrete, paint, light fixtures"[28] from corporations, managing to create the tallest structures west of New York on a Depression-era budget. The attraction was ultimately a collaboration between five companies: Otis Elevator Company, Valley Structural Steel Company, John A. Roebling's Sons Company—engineers of the Brooklyn Bridge, Inland Steel Company, and the Great Lakes Dredge and Dock Company.[29] The project was successful financially, despite labor disputes that caused initial delays. The towers were popularly called "Amos" and "Andy," after radio show personalities, and became one of the most frequented of the Fair's features.[30] The Sky Ride foreshadowed SOM's future buildings in its behemoth-like height and scale: the Otis elevator would be critical to SOM's commercial office building designs. Further, Sky Ride foreshadowed a type of networking between corporations executed through management—Owings bargaining for resources in

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[25] Ernst John Russell, "A Letter from the President," *The Octagon: A Journal of the American Institute of Architects* (January 1933): 3. Cited in Jung, "Organization and Abstraction," 30.

[26] Findling, Chicago's Great World Fairs, 67.

[27] Owings involvement in the organization of Sky Ride is confirmed by the Fair's manager in his book: Lohr, *Fair Management*, 173.

[28] Owings, The Space in Between, 51.

[29] Century of Progress International Exposition Chicago and Kaufmann & Fabry Co. (Official Photographers), "Official Guide Book of the World's Fair of 1934," A Century of Progress International Exposition, 1934: 121.

[30] A. N. Gonsior, 'Report of the special features division,' 67-72, Century of Progress 15-102. Cited in: Findling, *Chicago's great world's fairs*, 81.

exchange for advertising and exhibition space—that would help advance the firm the two would form following the Fair's close.

The scale of the Fair marked a unique training ground for Owings and Skidmore. Constructed next to Lake Michigan, the Century of Progress Exposition was situated on a long narrow strip of land. (Fig. 1.2) Cret designed the rough organization of the Fair, zoning it into three large areas and instituted a longitudinal axis along the lake and a short one from the central entry across to the water. Built on 218 acres—almost 60 Chicago downtown blocks—of previously undeveloped land, the Fair was a city from scratch, an aspect Owings would dwell on in his memoirs: "From raw, man-made land on an alien strip of lakefront was to come a complete city [...] with facilities big enough to serve the expected annual total of twenty-five or thirty million visitors (possibly more) with sewers, water, power, roads, walks, landscaping, exhibition buildings, restaurants, theaters and rapid mass transportation."[31] Even the Sky Ride was intended to be more than a fun festival ride, a type of urban-scale transportation that had the potential to replace the automobile.

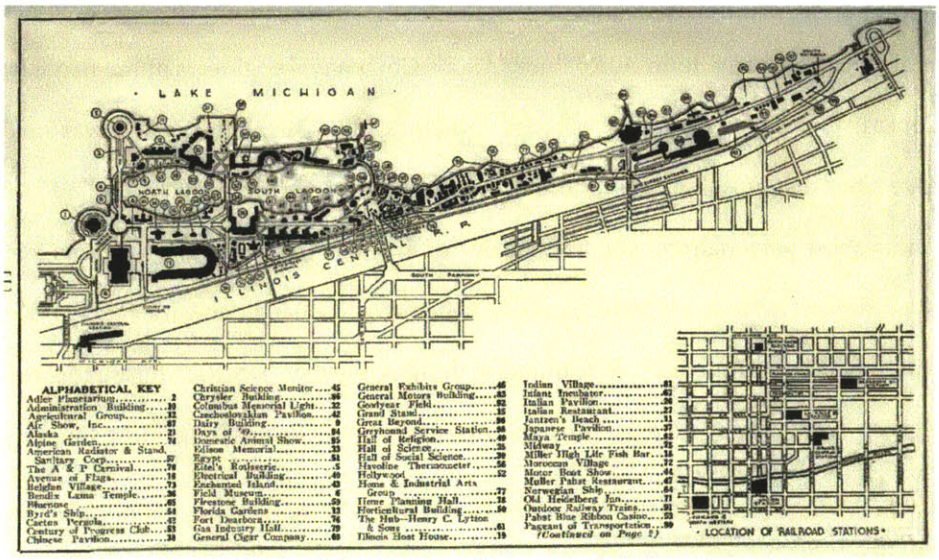

Fig. 1.2 Map of the Century of Progress fair grounds, 1934

Thematically, the Fair focused on a hundred years of progress in science and technology; in programmatic terms, its exhibitions and pavilions were varied in terms of funding, intention, and commercial

[31] Owings, The Spaces in Between, 48.

content. It included exhibitions on the sciences, including in mathematics, exploration, chemistry, geology and medicine—featuring a "Transparent Man" showing human anatomy. Transportation exhibitions focused on automobiles, including areas run by GM, Chrysler, as well as car part manufacturers like Firestone, and manufacturers of farming equipment like tractors. Further, there were groups of 'cultural' exhibitions including caricatured re-creations of Mayan Temples and Indian Villages, pavilions showing representations from the individual States, and pavilions of foreign countries. Some of these areas were entertainment- rather than education- focused, including the "Streets of Paris" area featuring Sally Rand, the burlesque dancer dressed only in feathers. Other carnival-like events took place including "Midget City," baby incubators, and parachuting.

The Sky Ride, a joint effort of five corporations from bridge engineers to steel producers, represented a broader financing strategy from the Fair. The Fair's second largest source of funding was from the sale of space to exhibitors. When the war broke out the following decade, Owings and Skidmore would come to rely on collaborations with material manufacturers much in the same way they had in the fair, but for new reasons: on one hand, the simultaneous boom in federal funding for testing of new materials and the rapid drop in private contracts for architects, on the other, the potential building contracts which these companies—such as Heinz and Westinghouse—represented. Owings, in his memoir, acutely saw that these relationships between the material manufacturers and designers that emerged from close proximity might foreshadow a new kind of way of working. "As a joint venture developed by a group of big corporations voluntarily joining together, was there a trend here for a future in private practice?" Owings asked in his memoir.[32]

For example, the "Home Planning Hall," a Fair exposition featuring 12 residences showcasing new materials as well as architectural design,[33] exemplified this kind of cross-corporate collaboration. Outside of the fair, often an architect's job was in part to select materials for construction, at the Fair this process

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[32] Owings, The Spaces in Between, 52.

[33] While this exhibition is called "Houses of Tomorrow" in secondary sources, the guidebooks referenced for this paper list it as "Home and Industrial Arts Group." This name was probably picked up from the exhibit's publication in architectural magazines including *Pencil Points* ("Chicago and Tomorrow's House?", June 1933), *American Home* ("Century of Progress Anticipates Home of Tomorrow" , June 1933) foreshadowing these publications later interest in pursuing this topic during the wartime and their ability to shape public terminology (such as "194X").

was turned on its head. "Most of the group [of houses] were produced by manufacturers to illustrate use of their materials," described the Guide Book, "yet architects and decorators have had full play in carrying out the theme of progress." The "Armco-Ferro Enamel House," was a prime example of a kind of cross-pollination between material manufacturers, designers, and the publishing industry. Robert Smith Jr., a Cleveland architect, designed the house with an interior selected by the *Ladies' Home Journal* and furnished by the Kroehler Furniture Company. The house was meant primarily to advertise a new house wall pre-fabricated assembly that avoided the use of steel studs and replaced the tradition exterior with self-supporting "box-like units," which integrated structure and cladding. Another example was the "Good Housekeeping-Stransteel House," which highlighted steel framing by Stransteel, marketed through a partnership with *Good Housekeeping Magazine.* The "Rostone House" exhibited a limestone tile; the "Masonite House" a new type of woven cellophane interior finish; the "Lumber Industries House" designed to prove that timber still had a presence in the modern home. These projects would register Owings and Skidmore in terms of both design and process; in the following years the two architects would grow their firm through a combination of partnerships with print publications and material manufacturers, collaborating with both to procure contracts and to sell them through strategic marketing spin.

A decade after the Fair, in 1942, SOM would publish a design called "Flexible Space"[34] in *Architectural Forum* in which two houses from the "Home Planning Hall" would appear: Leland Atwood's "House of Tomorrow" and The Brick Manufacturer's Association of America "Super-Safe House of the Future." Their hexagonal floor plans are crossed out on the advertisement by SOM in their design as "inefficient." (Fig. 1.3) While Owings and Skidmore may have found these houses' formal strategies unconvincing, they would pay close attention at the willingness of manufacturers to support design that featured or advertised their products in some way. "Hard-line national corporations and basic industries across the continent were given concrete proof that the building dollar could also be an advertising dollar," wrote Owings in his memoir. SOM's housing projects in the wartime time and postwar period, just a few years later, would rely on close relationships with manufacturers like Celotex, a company which made a pre-fabricated wall panel called Cemesto. Cemesto would become crucial in SOM's ability to win government housing con-

[34] Skidmore, Owings & Merrill. "Flexible Space," The Architectural Forum, September 1942.

tracts focused on low-cost construction; SOM in turn would contribute to Celotex's advertising campaign to market their products as part of a new post-war efficient and modern home.

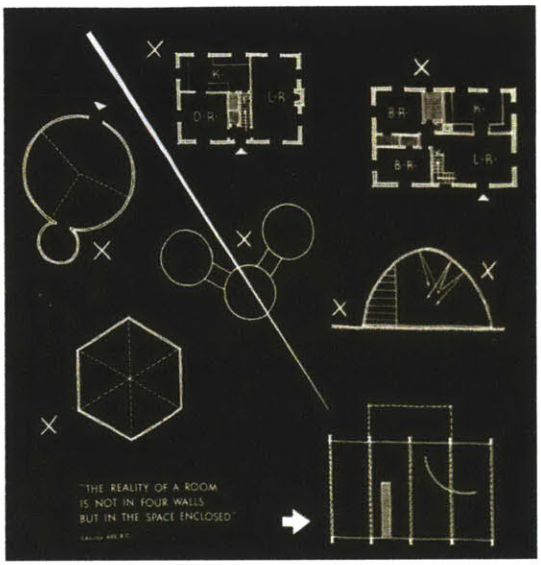

Fig. 1.3 House diagrams from "Flexible Space," 1942

The Fair also directly put Skidmore and Owings in the orbit of executives who might later become clients. SOM would design the now well-known Inland Steel building in 1958, going further and relocating its own offices to the new structure. Heinz Company—whom Skidmore had convinced out of exhibiting a 1,000-foot long pickle—would contract the architects for a factory in 1958, and their headquarters in 1965. In another example, Owings worked with Standard Oil to produce their exhibition at the Fair—a gaudy spectacular with "a lion and tiger act safe enough to provide [...] a live power show without bloodshed."[35] In the coming years, the Rockefellers would be a source of at least two lucrative overseas housing contracts for SOM at their oil refineries, in Indonesia and Venezuela, allowing the office to expand its practice overseas even as it just got its start. "The list of chairmen of boards, presidents and executive vice presidents of nationally known companies calling on Skid lengthened," Owings wrote in his memoir of the connections made his partner during the Fair.

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[35] Owings, The Spaces in Between, 52.

The Century of Progress continued the strategy of international expositions to focus on what historian John E. Findling of the Fair called "Process, not product." Yet unique to 1933, the Fair reflect a shift from a focus on national and state pavilions to corporate branding. Initially the Fair's board had hoped to develop a type of multi-ethnic "village," to house the exhibitions of different countries; earlier versions of which—according to Findling were largely "ethnological [...] with the implicit objective of demonstrating the superiority of the Anglo-Saxon race." However, in part because of the press of the Depression, only Belgium ultimately constructed an exhibition "village" and just Italy, Sweden and Czechoslovakia constructed traditional country pavilions. The fair also broke tradition and omitted state pavilions; in lieu, the board decided that just Illinois would be represented.[36] Replacing these exhibitions of national culture and identity were the use of architecture to brand and trademark companies and their products. John Stephen Sewell, the Fair's director of exhibits before Skidmore, emphasized that the focus on the "process, not the product of science and industry" was the best way for exhibitors to establish their brand, hiring on Chicago's Museum of Science and Industry—a neighbor to the fairgrounds—to consult. Findling summarized a memorandum from Sewell:

> Although the fair management is preparing the basic sciences exhibits itself, [Sewell] would say, industry will 'complete the story' with their exhibits. The products of industry are well known, but the 'story back of their creation' is not. If the process is brought out with 'dramatic showmanship,' the public will remember the name of the company.[37]

After Sewell's retirement, it became Skidmore's job to implicitly enforce this focus.[38] An example of this use of the World's Fair to highlight and brand corporate identity was the exhibition at the General Motors building, designed by Albert Kahn, which imported a complete Chevrolet assembly line. "Raw materials enter through one door," the official Guide Book informed, "by the time they have reached the opposite

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[36] Findling, Chicago's Great World Fairs, 55.

[37] Ibid., 100.

[38] In a text for *Architectural Record* in 1933 on the regulation of exhibitions for the World's Fair, Skidmore expresses his weariness on often repeating this tenet: "Perhaps he [the exhibitor] has a flashing sign, and defends it on the ground that a good exhibit requires action. Whereupon he is asked if he has ever seen any interest in a steam shovel as it moves down the street, and his reply is invariably in the negative. He has, however, seen the same steam shovel in an excavation pit with crowds of people watching it dig down into the earth, pick up its load, and deposit it in a waiting truck. In both cases the shovel is in action, but in the second instance the action is productive." From: Louis Skidmore, "Planning the Exposition Displays," *Architectural Record*, May 1933.

exit, they have become finished cars." General Motor's competitor, Chrysler, showed cross sections of motors on which they performed tests for "heat, cold and water resistance." GM and Chrysler's reveal of the "process" behind their manufacturing also gave a sense of Taylorization of their assembly lines, in which the complexity of building a car was reduced to numbered stations with relatively simple points of assembly. Some of this type of focus on "process" would translate into SOM's work in the wartime, in which pre-fabricated building materials became central to their construction of a mass-produced architecture. The combination of Fordist assembly lines and corporate branding spoke closely to the kind of firm SOM would become in the coming decade.

Albert Kahn—"the producer of production lines" and designer of the World's Fair GM pavilion—was already making headlines in architectural journals for transforming his office to reflect the efficient processes of factories it produced. Skidmore and Owings' focus on "process, not product," would manifest in the firm's eventual automation of detail libraries, spec writing, and even the design of an entire building. These adjustments and fine-tuning of the production of buildings resulting in all kinds of 'designs' which re-evaluated processes, instead of buildings: from the numerous patents filed by SOM over the years to the office's investigations in computer programming in the 60s and 70s. On the surface, the Fair's "Home Planning Hall" investigated mass-production in architecture, a common enough wartime strategy; SOM took the broader marketing and scientific focus from the Fair and transformed mass-production into a system extending beyond material pre-fabrication to office management.

Further, the Fair's exposition of process idealized scientific or technological research and invention. While this narrative was ostensibly for the visiting public, Skidmore and Owing's seem to have taken it to heart. The General Motors building, in addition to its public assembly line, featured a room for the "General Motors research laboratories." The designers were exposed to manufacturer's marketing of their 'research labs' and their discoveries—in the kitchen, and other examples. SOM would over the following decades, unlike other architectural offices, file for dozens of patents from the US government for detailing, furniture layout, structural systems, and more. These patents reflected on one hand the firm's interest in the methodology of architecture, but on the other also on the character of research.

Lastly, Skidmore and Owings also became familiar with the financial side of planning, budgeting, and operating at large scales; they witnessed firsthand how Rufus Dawes, the Fair's chairman was "scratching for money to build things like sewers, roads, water mains, public toilets, entrance gates, turnstiles, guard and police stations," for which he was at times reduced to "trying to mesmerize, beg, borrow and steal from corporation heads."[39] The construction costs of the Fair clocked in at over $12 million: over $224 million today. This need to fund construction through multiple sources directed the two young architects towards a range of different contract types; from a kind of crowd funding—$5 donation resulted in a reward of 10 tickets, to corporate donations, private donations, the sale of "Gold Notes" a government-insured bond, and the sale of individual exhibition spaces. This kind of wide net for funding would bolster SOM's early growth. Unlike the Fair, which claimed proudly to have not sought out any financing from "tax-paying bodies," Skidmore and Owings early projects in the followings year—like their contemporaries—would be bolstered by a influx of federal funding for defense contracts. Yet importantly, beyond these federal contracts, SOM's projects would also represent somewhat unconventional financial partnerships with other corporations and institutions.

After two years, the Century of Progress came to a close. "The brief city sprung out of the prairie and falling again into dust," wrote novelist Algren of the Fair's disappearance. The two young architects decided to start a firm together. "We found an attic meeting our several requirements standing two hundred and fifty feet above Michigan Ave, with the open angle of its pitched ceiling framing a magnificent panorama of Lake Michigan,"[40] wrote Owings. That first office had a significant vista; from 104 South Michigan Ave,[41] north along the lake between 12th and 39th, from the 25th floor (or around there) the two men could have perhaps seen down the shoreline to the site of the Century of Progress. Today's office, at 224 S. Michigan on the ninth and tenth floor, shares a similar view; despite intermittent development along the lakefront in the past seventy years, employees might peer out the window and see where Skidmore and Owings once erected the Sky Ride.

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[39] Owings, The Spaces in Between, 50.

[40] Ibid., 67.

[41] Adams, *SOM from 1936*, 20.

By some measures the fair was successful. It paid back the "Gold Notes" it sold during fundraising in full, in contrast to the past events that had paid back cents on the dollar. It left others skeptical. Critics panned the fair. Royal Cortissoz of the *New York Herald Tribune* called the project "merely deplorable," and overall "strained, odd, unlovely, and worst of all, almost incredibly uninteresting." Few seemed to take note of its buildings, even those by Chicago's biggest stars: Holabird and Burnham the younger. Certainly the Century of Progress had its own darkness. Nelson Algren, a Depression-era Chicago-based novelist, whose later career was made on capturing the underbelly and darkness of the city, described the fair in his first novel *Somebody in Boots.* Following the life of a young man, Cass McCay, as he travels American cities during the thirties, focusing on a life of increased violence and desperation, the text ends at the Fair using the Century of Progress' absurd spectacle to contrast with McCay's life which has—the novel has the reader understand—been lost completely to crime. The book's title points to the thematic differences between the privileged, well-heeled and rest of the crowd. Algren concludes with a Hieronymous Bosch-like finish:

> World's Fair spring in the big town by the lake. [...] There were college-trained men pulling jinrikishas past gyp gambling joints, there were hundred of Negroes scraping for tips, there were cane-sellers, peep-show houses, prostitute, trinket-venders, dinosaurs, punch-drunk pugs, a proboscis monkey... and a mayor, on top of a platform.

Despite the glittering prose of the Official Guide Book, the spreadsheets which total positive profits, and Owings nostalgic memoir, the two young architects were also in the thick of the sleazy side of the Fair. In his memoir, Owings reflects on being responsible for hiring a man who claimed to be a well-trained parachuter, who instead plunged to his death at opening events in what may have been a suicide. Naked women were such a reliable attraction that the Tribune noted an American Indian exhibit broke "paid attendance records for all exposition attractions that were not nudist."[42] The two architects experienced the "infectious air of carnival" in a fugue. At the pre-ball campaign, they ogled Sally Rand's fan dance of ostrich feathers, danced to radio music, waxed their moustaches and found "Old Chicago" to have suddenly become "unreal."

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[42] Ron Grossman, "Century of Progress," *Chicago Tribune,* May 26, 2013.

The 1933 World's Fair has for the most part been passed over by SOM's historiography. Skidmore and Owings' production lack any photographs with their future firm's technically expert, signature modernist style. Perhaps critique, years later, from the firm's own partners such as Gordon Bunshaft which undermined Owings' colorful legends about the office's beginnings cast a pall on this origin story.[43] Nonetheless, the Great Depression was ultimately fortuitous for the two designers: it gave them an opportunity to work on a scale that might never have been offered to them in boom time, and it struck a rift in architectural practice—in which many firms evaporated completely—leaving space to begin afresh. Chicago too, perhaps had been waiting: the first Chicago school had long ago quieted, the second—Frank Lloyd Wright and his protégées—were in eclipse. "Slowly the sleeping giant, Chicago, was stirring," wrote Owings, "On an uninhabited island, Skid and I were doing strange things. Were we only the outskirts of Chicago, or were we perhaps the reality and old Chicago but a dream?"[44]

In Rem Koolhaas' "Coney Island: The Technology of the Fantastic," he argued, "Coney Island is the incubator for Manhattan's incipient themes and infant mythology."[45] Its spindly peaks at the "City of Towers" represent both symbolically and literally the "'real' city," a phantom skyline lurking just beyond. For Koolhaas, Coney Island was an incubator for Manhattan in form and spectacle. It made manifest in its absurdity the architectures that would come to make the city. "In a laughing mirror-image of the seriousness with which the rest of the world is obsessed with Progress," Koolhaas wrote, "Coney Island attacks the problem of Pleasure, often with the same technological means." Yet the architectural forms of structures from the Century of Progress found little echo in Skidmore and Owings later work. Instead, the two architects learned something else for the World's Fair. Rather than Koolhaas' grand narrative of a city performed in absurd fashion on Coney Island, the Century of Progress was a rehearsal of the strategic inter-business networking, large-scale infrastructural, and process-based architectural practice that would come to define corporate architecture. While Skidmore and Owings no doubt learned a sense of spectacle and

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[43] Betty J. Blum, *Oral History of Gordon Bunshaft*, 1990, Art Institute of Chicago Archives.

[44] Owings, The Spaces in Between, 52.

[45] Rem Koolhaas, Delirious New York: A Retroactive Manifesto for Manhattan (New York: The Monacelli Press, 1997).

fantasy from the Century of Progress, what seemed to carry on to their new attic office with a view of the fairgrounds were tools of management and urban-scale architecture-as-business.

Hitchcock's "The Architecture of Bureaucracy and the Architecture of Genius"[46] rhetorically pitted Frank Lloyd Wright against SOM—the firm the Skidmore and Owings would form after the Fair—as the model practitioners of these two divergent types of practice. Even before their later established firms, Wright and SOM's founders early career trajectories reflect the eventual differences. In the beginning of his career, Wright worked at the office of Louis Sullivan where he ultimately left after a clash with his mentor. Wright had been 'moonlighting' after hours on the design of residential projects, commissions that Sullivan perceived to be in conflict with his own business and with Wright's contract. Wright's secretive afterhours work was discovered through his distinctive formal signatures once the homes were constructed.[47] Here lay the linear trajectory of the genius architect: a lone genius who killed his figurative father over the classic commission—the high-budget single family residence—found out through signature formal style. Skidmore and Owings, comparatively, began their practice anonymously, recruited into an "architecture-by-committee," working just as often on infrastructural scale issues like sewage and transportation as any singular building. In 1933, at the World's Fair, these architects' crossed paths and their differences were made clear: Wright's incongruence with the new kind of practice was made clear from his exclusion from the Century of Progress architectural committee. Raymond Hood argued that Wright was "too much of an individualist. Since the affair is to be built by a commission, I can not see how one with such individual ideas as Mr. Wright could work with it."[48] Yet the differences between the genius and the bureaucratic office extended to the kind of work the practices could take on, as well as the personas of the designers. For Hitchcock, a key difference between the genius architect and the bureaucratic office was the issue of the scale of the project; Wright and SOM's comparative beginnings in residential work and urban infrastructure, respectively, of the Century of Progress support Hitchcock's hypothesis.

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[46] Henry-Russell Hitchcock, "The Architecture of Bureaucracy & the Architecture of Genius," *Architectural Review*, January 1947: 3–6.

[47] The "bootleg" houses, as Wright called them, and the fallout surrounding them is documented in: Carla Lind, Lost Wright: *Frank Lloyd Wright's Vanished Masterpieces* (San Francisco: Pomegranate, 2008); as well as Frank Lloyd Wright's main biographies.

[48] Cited in: Findling, *Chicago's Great World Fairs*, 61, footnote 4.

Compared to a generation of artists trained in the Beaux-Arts ways or as apprentices in offices, at the Fair Skidmore and Owings became more intimately aware of the systems at play in the city beyond the design of individual buildings. From Owings's memoir, it becomes clear that, as the two young men began their careers, that their sentiments had already evolved from a perception of architecture as mere form making, to one of architecture as a node in a bigger network involving financial, structural, infrastructural, and social imperatives. Owings wrote about how it shaped his skill sets and the architect he would be.

> I had drifted so far from conventional architecture that an offer of a vaguely free-lance job with a Chicago meat packer didn't seem nearly as incongruous as it should have. The skills I had developed weren't identified with conventional architectural practice. For four years I had swung with the rhythm institinctive to the city editor on a big daily newspaper habitually concerned with deadlines, speed, snap decisions, the taking of calculated risks.[49]

In Skidmore's management of the many exhibitions and Owings' organization of large-scale amusements like the Sky Ride, the two not only had to negotiate architectural form but relationships to its corporate sponsors, potential for lowering cost through mass-production,[50] and relationship to newly constructed infrastructure. The beginning of SOM began with an architecture that was not rooted in MoMA's parallel battles on style or aesthetics, but instead the role of a building in relationship to temporal event planning, its location on the police man's walk, its proximity to the transportation they would also design, the cost of vehicular and pedestrian access, potential other corporations or manufacturers who might have a stake in its construction and so on. SOM's housing projects in the following decade, on which the office would make its name, would further investigate these similar design issues as those that Skidmore and Owings undertook at the fair, driven by wartime demands rather than the caprice of spectacle.

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[49] Owings, The Spaces in Between, 61.

[50] When presented with a conflict over national pavilions, Louis Skidmore proposed a more generic option that speaks to the firm's later mass production of architecture. According to historian Findling: "Skidmore, head of the design section, suggested that a generic pavilion of a 'simple, dignified' style could be built for foreign nations at about twenty cents a cubic foot, including some landscaping. As an alternative, he proposed that preliminary designs could be prepared in the foreign country, or by ethnic groups from that country who were in the United States, and then sent to the Century of Progress for approval."

2.

Print and Prototypes: SOM advertising practice and contracts on the home front, 1940-1945

"For Sale... *Tomorrow's 'Miracle Home'* with War Bonds Bought Today!" In 1943, Celotex, a Chicago-based manufacturer, ran an advertisement in *The American Home* magazine which featured a house which could be constructed using a variety of their pre-fabricated products, including wall boards, insulation, and roofing.[1] (Fig. 2.1) Skidmore, Owings & Merrill, a nascent six-year old architectural firm at the time of the advertisement's publication, was responsible for the design of the building featured in the advertisement. SOM's design for the 'Miracle Home' was a one-story, two bedroom space, with some stylistically modern touches. The plan showed architectural elements aligned to a grid, whose rhythm was expressed on the facade elevation as well as in plan. The grid was dimensioned to the scale of the mass-produced 4'-wide Cemesto panel, Celotex Company's flagship product, allowing for easy installation. All parts of the home aligned with these regulatory lines: stairs, room sizes, and furniture. Incongruously, even traditionally narrower doors line up with the grid in service to the ad's rhetoric. No materials would need to be cut or customized, the plan seemed to imply, only assembled. In the floor plan shown in the advertising, the grid appears to be infinite—extending past the walls of the home to be cut off only by the edge of the drawing. Other houses, it seemed to suggest, could just appear adjacent to this home aligned to the same system.

Despite the modernist sensibility of the regulated plan, SOM's design for the Celotex 'Miracle Home' advertisement is similar in design and presentation to other houses used by the company to advertise its products in print magazines as well as promotional pamphlets.[2] In SOM's advertisement rendering, lush trees surround the home and a manicured lawn unfolds in front of the house, the perfect image of post-war suburbia. A large chimney-like core rises above the roof: clad in an irregular, decorative stone

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[1] Celotex and Owings & Merrill Skidmore, "For Sale... Tomorrow's 'Miracle Home' With War Bonds Bought Today," *The American Home*, February 1943: 41.

[2] The Celotex Corp, *The Celotex Book Today's New Homes: 22 Architect-Designed Homes of Moderate Cost* (Celotex Corp., 1955) and Celotex Corporation, "The Celotex Book of Home Plans: 20 Charming Homes of Moderate Cost," 1953; and Celotex Corporation, A Wartime Guide to Better Homes. (Celotex Corp., 1944). All available through http://archive.org.

not representative of a product sold by Celotex. The advertisement's text captures the wartime ideals of mechanization and patriotic rhetoric. To purchase Celotex was to be in service to the nation: the 'Miracle Home' would "provid[e] jobs for millions" and its materials were "produced by American industry, the free enterprise of free men."[3]

Fig. 2.1 Celotex Company-SOM advertisement, 1943

Celotex Company, a Chicago-based manufacturer, was the producer of an asbestos-based wall-board called Cemesto.[4] This "Miracle Home" advertisement, driven by profits and patriotism, reveals the effects of United States involvement in World War II on the building industry. This unique environment for architects swept up and supported the office of SOM in its first years. The wartime conditions increased focus on housing, growth in research and production of new materials, and a rhetorical anticipation for "194X"—a hypothetical period after the end of the war. Celotex and SOM's advertisement choice

[3] Celotex, "For Sale," 41.

[4] "POSTWAR: The Cemesto Future." *Time*, May 31, 1943. http://content.time.com/time/magazine/article/0,9171,851734,00.html.

to feature an American home reflected a national rise in demand for housing; over the course of the war, one in five Americans relocated to new industry centers of defense production, following well-paying jobs for the first time since the Depression. The federal government's funding for housing for these workers would further support new construction. The reference in Celotex-SOM advertisement's title to '*Tomorrow*' also pointed to a broader anticipation for revived business after the war. First, restrictions on private and commercial building contracts during the war[5] resulted in a focus on a future when the limitation orders might be lifted and supplies more plentiful;[6] second, the industry was also anticipating soldiers returning would from the war who need homes for their new families.[7] Lastly, the Celotex-SOM ad reveals how World War II stimulated industrial research in new building materials, because of the limits to steel and aluminum which were diverted for wartime production. New lower-cost materials and assemblies, like Cemesto wallboard, were also pursued because of the restrictive federally imposed budgets for defense housing.

This chapter investigates a series of extra-architectural artifacts from the first decade of SOM's practice during the US involvement in World War II from 1941 to 1945. These artifacts comprise an advertising practice that undergirded the office's emergence in the wartime period and revealed experimental collaborations between SOM and building material manufacturers. It will relate the advertisements in print journals such as *Architectural Forum* and *Architectural Record* to the development of full-scale, constructed "prototypes" which tested and exhibited new products and assemblies. Lastly, it will follow these experimental advertising projects to their profitable ends: a series of government-funded contracts for defense housing in the United States, including at Oak Ridge, Tennessee, one of the sites of the Manhattan Project. These contracts brought architectural logistics developed in print to towns hur-

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[5] "One of the key limitation orders was L-41 of April 9, which placed severe restrictions on any sort of private or commercial construction. Any residential remodeling or building project costing more than $500 required a permit; for farms the limit was $1,000, and for businesses $5,000." Donald Albrecht, Margaret Crawford, and National Building Museum (U.S.), *World War II and the American Dream: How Wartime Building Changed a Nation* (MIT Press, 1995): 51.

[6] History on the anticipatory marketing practices of manufacturers in wartime can be found in: Andrew Michael Shanken, 194X: Architecture, Planning, and Consumer Culture on the American Home Front, Architecture, Landscape, and American Culture Series (Minneapolis: University of Minnesota Press, 2009): 96.

[7] This concern about postwar housing came to pass, according to historian Gwendolyn Wright: "Two and a half million reunited families and recently married couples had to double up with relatives. [...] Senate investigations found hundreds of thousands of veterans living in garages, trailers, barns, and even chicken coops." From: Gwendolyn Wright, *Building the Dream: A Social History of Housing in America* (Cambridge, Mass: The MIT Press, 1983): 242.

riedly constructed from scratch for the war effort. Celotex Company was a key player with whom SOM collaborated in print and built prototype, and whose pre-fabricated products formed the basis of high-speed design and construction methods through which SOM secured these lucrative defense contracts.

At the Century of Progress, Louis Skidmore and Nathaniel Owings used architecture to exhibit of corporate products and material assemblies: a new formulation of professional practice in which the architect served as negotiator and specifications writer, rather than manual craftsman. During World War II, SOM would continue to pursue these partnerships with material manufacturers. The first decades of the firm's practice would reveal how these collaborations with industrial corporations evolved into a series of in-house design systems and methods, which applied tactics learned at the World's Fair to large-scale, state-funded projects. Over the course of this period, the office of SOM grew to over 500 employees. Throughout this trajectory from which the firm of SOM got it start, these previously uninvestigated advertising projects reveal how the wartime federal government's influence on and control of the building industry impacted SOM's architecture. SOM's design of experimental homes grew from Lanham Act restrictions on budgets and materials, and defense spending bankrolled the office's first housing projects.

The logistics developed through advertising collaborations reveal how SOM's practice represented a broader professional shift from craftsmanship to material assemblies; from individual building designs to the choreography of a total "city" as in the practice of 'planning'; and from individual, inspired authorship to the deployment of faster design-construction workflows and drafting production. All would be tested on a large-scale when bolstered by defense contracts in need of building services supported by speed and flexibility, resulting in the development of procedural and design-based architectural logistics.

I. Experiments in Print: Journal advertisements and SOM's paper architecture

During World War II, a long-held prohibition on architects preventing them from advertising their services was beginning to give way. Dodging a 19th century ban from the American Institute of Architects—the professional body that governs professional licensure, architects began to 'piggy-back' on

material manufacturers' print advertisements.[8] In the Depression, architects had already begun to challenge the AIA's policy that, according to historian Andrew Shanken, encouraged architects to "favor [...] reputation, as opposed to self-promotion."[9] This prescription for professional behavior included a restriction on marketing of services, amongst other regulations such as 'fee schedules' limiting the percentages an architect could charge as profit on top of construction costs. In the view of the AIA, architects were ostensibly in the business of providing an expert service for their clients rather than competing in a raucous race to the bottom by undercutting and price-gouging their competitors with increasingly lower rates. Consequently, advertising—in trade journals, magazines, newspapers, or on the radio, a tactic available to engineers, remained off limits to architects at the risk of losing one's license.[10] To evade these regulations, architects during the Depression turned to collaborative advertisements with material manufacturers in architectural glossies including *Architectural Forum, Pencil Points, Architectural Record, Brick Builder* and other trade publications.

Collaboration through advertising became abruptly more lucrative for architects and certain manufacturers during the wartime. Companies whose products included new materials such as plastics, composites, and pre-fabricated assembly systems were afforded a place in the industry limelight. Some traditional materials for building, such as wood, were also re-configured into new assemblies such as advances in plywood technology and heavy timber structural systems. Government funding supported much of this new research during the wartime; in 1942, Herbert Whittemore of the National Bureau of Standards, the government agency responsible for building codes, declared: "Unusual materials, designs, and methods of fabrication not used in normal times are entirely justified under prevailing conditions."[11] Often these new types of materials were driven by the kind of large-scale assembly line practices ramped up during war production; these factories were funded by the governments as they were converted into

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[8] For more on the emergence of the AIA and the professional "gentleman," see Mary N Woods, *From Craft to Profession: The Practice of Architecture in Nineteenth-Century America* (Berkeley: University of California Press, 1999).

[9] Andrew M. Shanken, "Breaking the Taboo: Architects and Advertising in Depression and War," *Journal of the Society of Architectural Historians* 69, no. 3 (September 1, 2010): 406.

[10] The most comprehensive history of this prohibition, its effects, and an appendix of many ads and the associated architects can be found in: Andrew Michael Shanken, *194X: Architecture, Planning, and Consumer Culture on the American Home Front, Architecture, Landscape, and American Culture Series* (Minneapolis: University of Minnesota Press, 2009).

[11] Quoted in Albrecht, *World War II,* 54.

plants for wartime uses. The government, for example, directly funded two-thirds of the $25 billion spent on industrial facilities during the war.[12] Between 1939 and 1943, United States-based industry was responsible for up to two thirds of the Allies' military equipment.[13] As a consequence of this ramping up of home front production, many of architects involved in collaborative marketing also became experimenters with new types of products, often using magazine advertisements as testing grounds for their ideas.

As the war broke out, SOM was operating two small offices in Chicago and New York. In 1936, Louis Skidmore had opened a branch of the firm in New York City when the client for the design of a display at the Radiator Building requested that SOM open a local office.[14] While the firm had become better known through its involvement with the New York World's Fair in 1939, as the war broke out, the office was still looking to establish a reputation for architectural expertise outside of displays and temporary exhibitions. Collaborative advertisements helped the office to spread its name and portray align itself with technical and material expertise to the journals' readership. In one representative ad in *Architectural Forum* from 1944, Nathaniel Owings designed a lighting detail and interior perspective of a sleek high-tech home for a General Electric (GE) advertisement.[15] The orange-and-white advertisement was part of a series for General Electric featuring the designs and vetting of various architects. Owings' smiling face is prominently featured on the ad and a brief text, whose authorship is attributed to the portrayed "outstanding architect and designer," runs below. In Owings' vision of an elegant postwar home, "No lighting fixture source should be visible to the eye." His architectural detail, called cove lighting, features a General Electric light bulb recessed above the ceiling to cast light on an adjacent wall with only the illumination—and not the fixture—visible to the room's occupant. The interior illustration provided by SOM shows a modern-style home with a wall gently aglow. The wartime drive for efficiency in construction and also for low-cost assemblies in the 1943 Celotex house advertisement is also present in the General Electric ad's text: "We suggest the use of a few pre-fabricated lighting units." The advertisement also details how a

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[12] Gerald T. White, "Financing Industrial Expansion for War: The Origin of the Defense Plant Corporation Leases," *The Journal of Economic History* 9, no. 2 (November 1, 1949): 156–83.

[13] Ibid.

[14] Nicholas Adams, *Skidmore, Owings & Merrill: SOM Since 1936* (Phaidon Press Inc., 2007): 21.

[15] Nathaniel Alexander Owings, "General Electric Advertisement," *Architectural Forum*, June 1944.

reader can learn more by ordering a pamphlet authored by Owings, called *The Whole House a Lighting Fixture,* available in the fall of the same year. In this GE-SOM advertisement, the light bulb and fluorescent tube on sale are not advertised based on their cost-effectiveness, durability, or light quality. Instead they are framed within the expertise of the expert architect and his vision for a home of the future. Readers are not invited to order a pamphlet on the product, instead, on architectural design. From one perspective, in order to dodge the AIA's marketing restrictions, SOM was piggybacking on GE's advertisement. Yet also at play is a mutually beneficial marketing tactic in which General Electric's products are hung on the technical expertise of architects, in this ad as embodied by Nathaniel Owings.

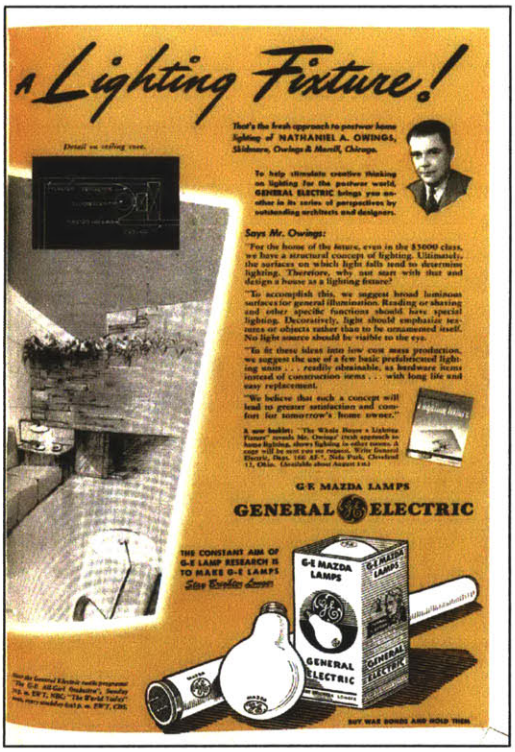

Fig. 2.2 GE-SOM advertisement, 1944

In 1945, Louis Skidmore contributed text and an architectural design, as well as his name and face, to an advertisement by the Pittsburgh Plate Glass Company, a Pennsylvania based company.[16] "There is a new trend in store design," headlines the advertisement. Beneath it, SOM's design for the facade of a

[16] Pittsburgh Plate Glass and Owings & Merrill Skidmore, "There's a New Trend in Store Design: Skidmore, Owings and Merrill's Conception of a Grocery," *Architectural Forum*, March 1945.

twenty-foot wide grocery store is shown in an exterior perspective. The year previously, in an issue of *Pencil Points,* SOM had published the same store design with more descriptive drawings without officially endorsing any products.[17] In this earlier expanded iteration, the SOM design of the grocery features an interior illustration as well as exterior window wall details, shelf details, and an interior plan. The design of SOM's Grocery Store features the quality of its plan that long and linear, with shelves aligned at forty-five degrees to the wall making them immediately visible to the those entering. In comparison, the representation of this grocery store design in the Pittsburgh Plate Glass Company advertisement the following year focuses on the exterior wall: the architectural element featuring the company's glass product. "The old type store window with its 'display' and 'Specials for Today' plastered all over the glass serves only as a barrier," reads Skidmore's text in the ad, "A window is a thing to look into, not at. In our plan, the whole store is the display." Just as in the Celotex advertisement, SOM's design shows a possible implementation of the building material and also lends an air of expertise, of "new trends" in architectural design.

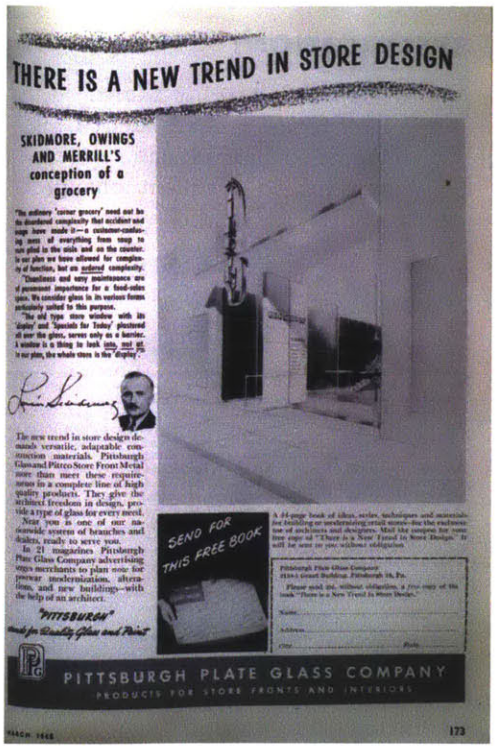

Fig. 2.3 Pittsburgh Plate Glass-SOM advertisement, 1945

[17] Skidmore, Owings & Merrill, "Grocery Store—20 Feet Wide," *Pencil Points,* August 1944.

Shanken, in his book *194X,* proposes that these advertising collaborations between architects and material manufacturers, often featuring new assemblies, had the double effect of both serving as an architectural testing ground and also resulting in the public becoming more habituated to contemporary design:

> Architects [...] found themselves in league with one of the major forces behind home front morale and postwar anticipation: magazine advertising. The alliance boosted architecture's prospects in small but significant ways. It created commissions for paper architecture in high-profile magazines and the trade press, and more importantly, it gave a particularly generous airing to progressive architecture, which leaped from its narrow base in mostly elite cultural circles to a wider public.[18]

Shanken argues that the "paper architecture" resulting from these advertising collaborations—projects that never individually meant for construction—in fact allowed for growth of "progressive architecture" through this unexpected medium. SOM would expand this relationship based in print advertising to a broader collaboration with material manufacturers, specifically Celotex during the wartime; within this period, SOM would develop designs for worker housing in architectural journals which would become manifest as full-scale prototypes and eventually federally funded defense communities.

II. SOM's Design of defense housing in print: *Architectural Forum* and "Flexible Space"

It is no coincidence that the subject of most of these paper architectures by SOM, with the exclusion of the grocery design by Skidmore, marketed the architecture of the American home. SOM designed these advertisements against the backdrop of a restricted wartime building industry, when often the most lucrative contracts were for defense housing. Beginning in World War I, the United States government supported urban developments in the name of the war effort, beginning with the housing communities near shipbuilding industries in places such as Vallejo, California. By the 1930s, various agencies and legislative measures were responsible for the funding and initiation of a "sizable segment of American housing" according to architectural historian Gwendolyn Wright.[19] During the Depression, New Deal policies

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[18] Shanken, *194X*, 96.

[19] Wright, Building the Dream, 217.

established some of the agencies that would transform in the wartime to support defense housing. This included the creation of the Federal Housing Administration (FHA) in 1934 that allowed consumers to mortgage up to 80% of their homes' cost, up from 40-50%.[20] The housing market was beginning to rally after the new FHA policies, bolstering the weak construction economy—the same one that led Skidmore and Owings to their odd jobs at the World's Fair. However, when the United States joined the war, the growth in the private housing sector was abruptly suspended and architects switched their focus to the possibility of government contracts.

The wartime economy ended the lull of the Great Depression. Industrial centers grew and were created anew; eager to participate in the war efforts through whatever products or materials they could contribute for profits and patriotism. Architects were also caught up by this tide of federal support for industry through the need for housing new workers at industry centers, many of which were constructed from scratch in an effort to spread out targets from prime centers. A wartime directive that banned most private and commercial contracts, in a limitation order called L-41, corroborated this defense housing focus for architects. Seeking defense contracts was also furthered by a Congressional restriction against "elaborate or expensive design or materials," preventing architects from securing such high-end private contracts.[21]

Legislation increased funding for these projects, including the 1940 Lanham Act, which designated funds for war housing and additionally for "home-related services." When the Lanham Act first passed, it designated $150 million to the Federal Works Agency. As the United States entered the war, President Roosevelt called specifically for a heightened focus on the problem of an "acute shortage of housing"; by 1943 the defense-housing budget had expanded to $1.3 billion. In total, during the war, 2 million units of federally funded defense housing were constructed. This funding for defense housing, however, was not without restrictions; it included a maximum budget for each home built with funds from the Act to be limited at $3500, another cause for research into less expensive building materials.[22] The Federal Public

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[20] Find this footnote in Wright or Albrecht.

[21] Ibid., 229.

[22] Albrecht, *World War II,* 19.

Housing Authority, a wartime incarnation of U.S. Housing Authority, kept defense housing projects close to the chest and was often involved with projects and served as a go-between amongst local agencies, architects, and contractors.

Architects were drawn quickly into this defense housing war effort. In 1941, the Division of Defense Housing was established which commissioned designers to work on housing. Led by director Clark Foreman, for a brief period this agency hired significant designers including Walter Gropius, Marcel Breuer, George Howe and Louis Kahn to develop schemes for low-cost housing. Most notable was Frank Lloyd Wright's design of the Cloverleaf House, in 1941, a system that was ultimately never realized. Originally intended to be deployed as 1,000 units of low-cost housing in Pittsfield, MA; his design offered a critique of what he called the "cracker boxes without spirit or sense."[23] Yet at the conclusion of Wright's design, the Division of Defense Housing was shut down, its director criticized for hiring 'out of state architects' for local projects.[24]

Like other firms, SOM strategized on how to get involved with these federal housing contracts. According to Gordon Bunshaft, a partner in the postwar period, Nathaniel Owings and Louis Skidmore sought out their third partner in 1939, John Merrill "to help get public housing in Chicago" because of Merrill's personal connections.[25] During the wartime, SOM was successful in landing a range of federally funded housing projects for both workers of industrial production and also directly for the government. Only one of these housing projects—Oak Ridge, Tennessee—registers in SOM's complete works monographs. It is likely that more exist, yet to be uncovered.[26] For industry, SOM's wartime contracts included the design of the neighborhoods of Stansbury Estates and Aero Acres in Maryland (1941-42), for the aircraft manufacturer George L. Martin Company. Another project was sited in Willow Run in Dearborn, Michigan (1943) for the Ford Motor Company. SOM also worked directly for the Army Corps of Engi-

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[23] As cited in Albrecht, *World War II,* 18.

[24] Ibid., World War II, 19.

[25] Blum, Oral History of Gordon Bunshaft, 52.

[26] Nicholas Adams, for example, in his introduction to *SOM since 1936* refers to the office's design of projects in Norton Farms, Alexandria, Virginia and Granite City, Illinois, though I could not find other references or verification of these projects.

neers at the town of Oak Ridge, Tennessee (1942) one of the three sites of the Manhattan Project; and for military bases in Guam; Okinawa, Japan; and Morocco.[27] Outside of housing typology, SOM also was awarded government contracts in the wartime period for meteorological stations and aircraft warning sites.[28]

Two of SOM's "paper architectural" publications in journals directly focused on defense housing. In November 1940, SOM had developed a "Defense House" for *Architectural Forum.*[29] The journals editors, in their introduction, call for Skidmore, Owings and Merrill to design a low-cost defense house that prioritized standardization of buildings materials in order to reduce costs for builders and manufacturers. "The defense housing program needs such a house," the text reads, "It also needs standardization, for, above all, it demands low cost construction, lots of it and in a hurry." Foreshadowing the types of restrictions architects would face as war mobilization began, *Architectural Forum* also asked SOM to adhere to FHA restrictions.

The project, commissioned by the journal, began with a unique design heuristic. The journal's editors, in search of and advocating for a superlative low-cost and standardized house which would not require specialized skills from builders across the nation, presented SOM with a collection of low-cost building plans from across the US. SOM was then asked to resolve this into one design, not necessarily better than, but somehow synthesizing into a final outcome. SOM's response was to undertake an analysis of the provided plans, from which they concluded that variations mostly stemmed from the adjacencies and orientation of the bedroom and bathroom, for which they provided a diagram. SOM's "Architectural Forum Defense House," ultimately, appears disarmingly conventional and anonymous in its design: a basic pitched roof scheme with square plan divided into quadrants, and options for extensions in the attic. The result, as one might expect from a "controlled" merging of many low-cost building plans, appears to

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[27] Little information can be found on these housing projects for military bases; Okinawa continues to be an Air Force base today suggesting that many of these documents may still be unavailable. References however can be found in both secondary sources and Oral Histories of SOM architects from the period [add notes.]

[28] Adams, *SOM since 1936,* 23. Adams also cites (pg. 23, footnote 50) that "Further wartime work included the development of eighty types of plans for army installations for four climate zones, planning services for the construction of dormitories to house 15,000 women, a Veteran's Hospital for Toledo, Ohio, for Elmendorf Air Force Base in Alaska, and so on."

[29] "The Architectural Forum Defense House by Skidmore, Owings & Merrill, Architects," *Architectural Forum,* November 1940: 444-449.

be beyond normal but almost extra-normal. SOM declares this a success of their design agenda to follow "the general pattern being followed by low cost builders the country over." Unique from the other defense housing projects SOM would do in this period, the "Architectural Forum Defense House" is also imagined as urban row-house condition in one of the drawings.

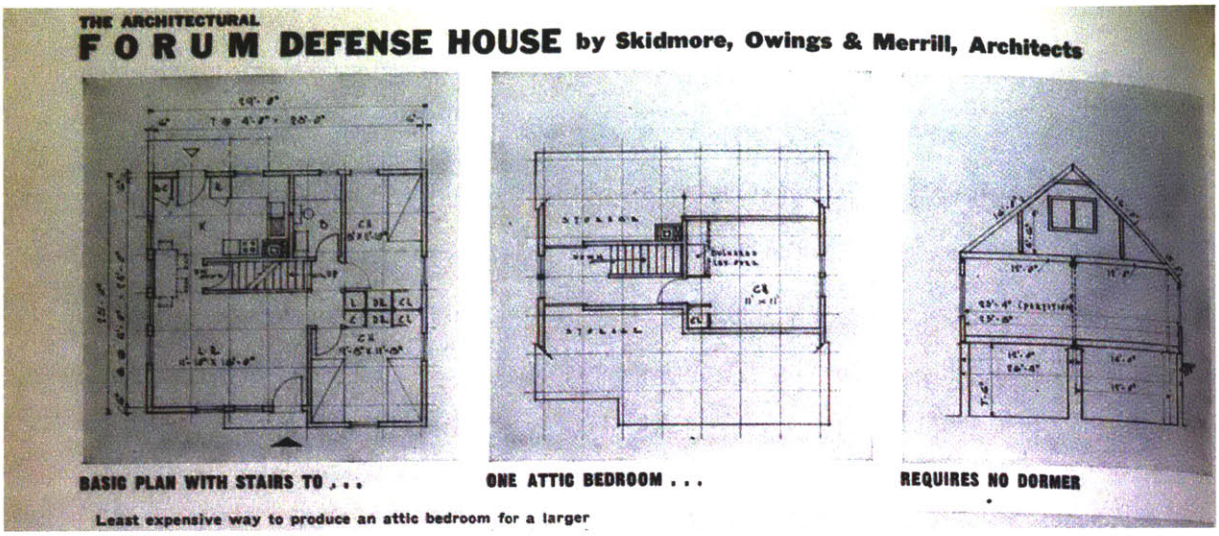

Fig. 2.4 Clip from SOM's Architectural Forum Defense House, 1940

To offset this potentially unglamorous outcome, SOM also designed for *Architectural Forum,* with more of a "free-hand," a "Basic House Improved For Rational Living." This home takes on a more modern style, with a one-direction pitched roof and elegant horizontal cladding; its plan expresses the vertical panel pre-fabrication model. Its text too, suggests that this might be the home that forms and reflects a more contemporary condition of living, one in which "living spaces have been zoned to facilitate desk work at home, study or reading, conversation, dining and entertainment." The "Basic House Improved" also features further flexibility in which extra space may be enclosed or opened to become a guest room or rental space. The rendering of this home is shown isolated in a lush field, surrounded by trees.

Two years later, in September 1942, SOM would re-visit the design of the defense house, merging ideas from the *Forum* defense house on pre-fabrication, conventional style, and flexibility. This improved version, which appeared to collect the more successful elements of the two extreme proposals from 1940,

appeared again in *Architectural Forum,* in an issue titled "The New House of 194X."[30] *Architectural Forum* featured projects solicited from 43 architects, including George Fred Keck—who had designed the "House of Tomorrow" at the 1933 Chicago World's Fair—Richard Neutra, Ralph Rapson, and Edward Durrell Stone. SOM's contribution was titled "Flexible Space," and aimed to use a broadly spanned structural system and modular components to affect both ease and speed of construction along with customizable space. The memorandum from *Architectural Forum*'s editors to the solicited architects listed "problems the postwar designer must solve" and sought to provoke "new avenues of approach." The memorandum includes a short narrative about a "Mr. and Mrs. Smith" who were troubled with their prewar home in a time of technological advancement; Mr. Smith at present found his bathroom unnecessarily cluttered with his "wife or daughter's lingerie" and poorly ventilated causing an unpleasant post-shower mist. Mrs. Smith, on the other hand, was frustrated by lack of conveniences in the kitchen, and looked forward to a postwar kitchen that would be a "real workcenter."[31]

In "Flexible Space," SOM's design, the accompanying text begins by describing how this design for the postwar home is different from more "conventional [...] plans." The scheme leveraged pre-fabricated parts to make the case for flexibility and difference within mass-produced architecture. To provide contrast, the architects' also contributed a diagram of such undesirable plans. According to SOM, it was "radical designers" who proposed these undesirables, characterized by "fixed"—and therefore rigid—"geometrical forms." The accompanying drawing of the bad alternative housing schemes are diagrammed in plan view and then slashed out with a large white line. Among the schemes critiqued in SOM's proposal appears to be a plan resembling the well-known wartime housing project Dymaxion Deployment Unit by Buckminster Fuller, on exhibit at the Museum of Modern Art during the same month that "Flexible Space" was published.[32] Both Fuller's hexagonal "4D House," a precursor of the Dymaxion Unit, and later circular plans for the Quonset Hut appear as not-to-do's in SOM's contribution of "Flexible Space." The project text criticizes projects like Dymaxion that "sacrificed" "internal relations" in favor of "outward

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[30] Skidmore, Owings & Merrill. "Flexible Space," *The Architectural Forum*, September 1942.

[31] The Forum's Editors, "Memorandum to Designers of the House of 194X," *Architectural Forum*, September 1942.

[32] *Buckminster Fuller's Dymaxion Deployment Unit* [MoMA Exh. #151, October 10, 1941-April 1, 1942]

form." SOM's design begins by positioning itself directly opposed to "cursed static design," suggesting instead a system of parts that is more how-to manual than fixed floor plan.

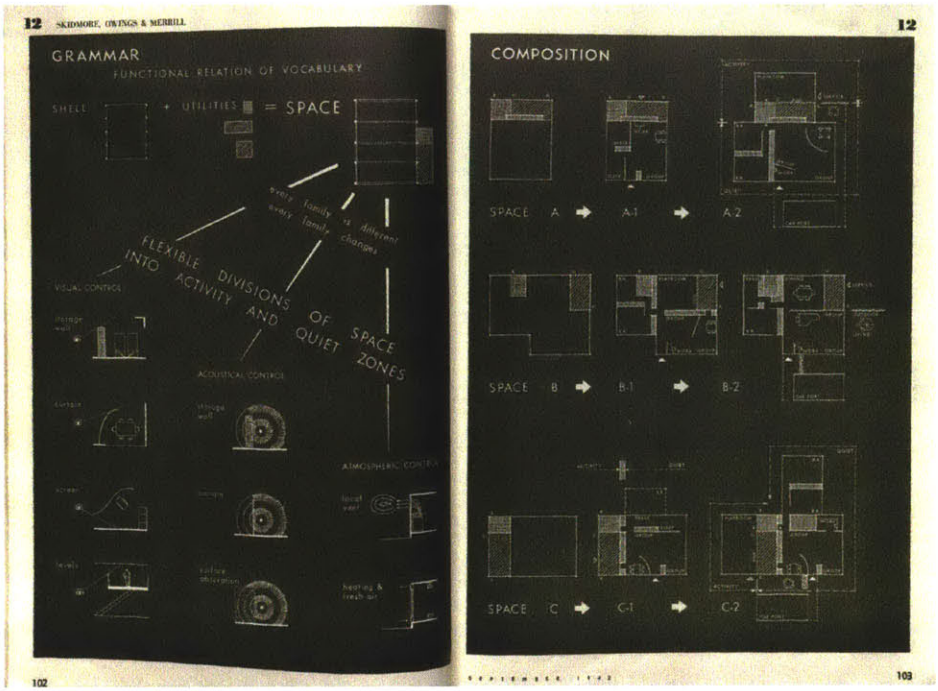

Fig. 2.5 SOM's "Flexible Space", 1942

SOM describes their variable design for "Flexible Space" as a "Vocabulary." The system is based on a fully-spanned structural frame, called a "Shell," leaving the interior space open for variation. The drawing then proposed a series of modular appliances, wall types, and furniture: both built-in "thing furniture" and seating called "body furniture." On the following pages, in two white-on-black drawings, different iterations of "Flexible Space" show how the proposed architectural components could be combined into unique configurations. A mathematical, almost constructivist, aesthetic frames the floor plans of possible outcomes. SOM's designers hedge their bets by concluding in the descriptive text, "No attempt has been made to do a complete design job of any of the units or spaces." When compared with the SOM-Celotex "Miracle Home" ad from 1943, the projects are remarkably similar. Both projects show a "system" of these pre-fabricated parts. In the small interior perspectives of "Flexible Space," the same pervasive grid that underlays the "Miracle Home" is also visible: ceiling tiles show a grid that lines up with the interchangeable wall panel units and with the mobile "Thing Furniture." Lastly, both capture the sense of a post-war do-

mestic ideal used for marketing purposes: the lush trees and symbolic chimney in "Miracle Home," and the incongruous floral curtains in "Flexible Space." Flexible Space also made an argument for its possible deployment overseas. The project text includes the proposition that Flexible Space "could be fairly well standardized for construction in different regions." A provision for regional differences was accommodated in the project through "the attachment of accessories: porches, garages, etc., as well as through color and texture design." This almost post-modern attachment of localized "accessories" to a mass-produced architectural object would become central to SOM's ability to sell their defense housing designs as more than simply low-cost but also culturally specific.

Ultimately, the influence of SOM's speculative defense housing projects extended beyond the magazine page. Capitalizing on relationship made with manufacturers through advertising, SOM also developed full-scale "prototypes" which exhibited building materials at full scale. The 1942 "Flexible Space" feature and the similar 1943 Celotex "Miracle Home" advertisement reflected in fact a more expansive relationship between SOM and the Celotex Company which was occurring outside of print journals. The experimental systems of pre-fabrication, large-scale assembly, and possibilities for design specificity through 'accessories' for defense housing were also being tested at full-scale at the New Jersey "testing grounds" of the non-profit group the John B. Pierce Foundation.

III. Full-Scale Prototypes: The "Experimental Houses" and partnership with the Pierce Foundation

In 1939, as part of SOM's work on the New York World's Fair, the firm was responsible for the design of the Westinghouse pavilion, for the Pittsburgh-based electric company. Joseph O'Brien, employed at Westinghouse, worked with SOM on World's Fair project; when in the following years, O'Brien moved to the John B. Pierce Foundation, a non-profit research organization, he brought on SOM as consultant architects in his new position.[33] The Pierce Foundation was established by the eponymous industrialist of the American Radiator Company in his will. Its overall mission at the time was dedicated to

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[33] Hyun Tae Jung, "Evolution of the 'Experimental House': Mass Production of the House and SOM during WWII" in ACSA Annual Meeting, Dietmar. Froehlich, and Michaele. Pride, *Seeking the City: Visionaries on the Margins: 96th ACSA Annual Meeting* (Washington, DC: ACSA Press, 2008).

"promote research for the increase of knowledge to the end that the general hygiene and comfort of human beings and their habitations may be advanced."[34] During the wartime, two non-commercial entities became centrally involved with the issue of pre-fabricated housing. In Boston, the Albert Farwell Bemis Foundation and the Pierce Foundation based in New York and New Haven. "Pre-fabrication," a term that emerged in the 1930s with the increasing standardization and rationalization of building parts, covered a broad range of building assemblies and associated products which reduced the crafting of specific materials in the field. Before the war, Bemis Industries under Albert Farwell Bemis, had been testing mixed materials in modular homes and expanding on his ideas established in *The Evolving House: Rational Design,* published in 1933.[35] In parallel, the Pierce Foundation during the Depression appointed director of Robert L. Davison who had studied pre-fabrication and low-cost housing at Harvard. Davison led research on the low-cost housing that at the outbreak of war took on new urgency. By the time that O'Brien brought on SOM as a consultant architect, the Pierce Foundation was already deep into its research into modular housing and pre-fabrication: Davison had already expended up to $80,000 on low-cost housing research, according to *Architectural Forum.* The wartime accelerated interest in pre-fabrication through regulation for budget materials and fast assembly; while the public was reluctant to embrace some of pre-fabrications tenets, modernist architects embraced its vision of rationality. Antonin Raymond wrote, "The limitations of the Lanham Act [...] have brought about a radical change toward better understanding the value of simplicity and direct solutions." Through collaboration with the Pierce Foundation, SOM would join the ranks of architects engaged in these products and would design two "Experimental Houses" for the non-profit testing new material assemblies for housing projects.

In 1940, SOM's defense housing experiments began through built prototypes. Funded by the Pierce Foundation, SOM developed two research houses on the Foundation's New Jersey testing grounds, a farm owned by one of the directors. Small in scale, low-cost and almost ungainly, these proto-suburban houses are divergent from the office's later reputation for sleek steel-and-glass vertical buildings. However, in combination with the print advertisement experiments, they represent an early foray into the logistics of

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[34] "The John B. Pierce Laboratory» About Us," accessed January 6, 2015, http://jbpierce.org/about-us/.

[35] Albert Farwell Bemis, *The Evolving House.* (Cambridge, Mass: The Technology press, Massachusetts institute of technology, 1933).

design and deployment that would characterize the firm. The first, "Experimental House No. 2" clocked in at $2600 including furniture for a three-bedroom space, and was a plywood-based wall construction.[36] Published in *Architectural Forum* in both the April and May issues, it was described as a "distinct improvement over the Foundation's preceding experimental house," a test executed in 1939 on top of the Starrett-Lehigh building in Manhattan.[37] The Foundation's relocating of its research site to a farm in central New Jersey, owned by its director Davison, ushered in a more successful iteration of the low-cost home. In addition to its low cost, the Pierce-SOM's "Experimental House No. 2" was praised for the speed of its construction. Photographs in the May 1940 *Architectural Forum* article show an almost choreographed performance of the house's construction hour-by-hour. Pierce and SOM's design of the house's method of assembly as significant as the effect of the completed space. At 8:10 am, the house's columns are erected; by noon exterior wall panels are raised; by 4:55 in time to go home the house is enclosed on four sides and its roof. The texts promote the house that could be ready for occupation in ten days total. The plan is a simple rectangle; in elevation the house is capped by a traditional gable roof. Many of the products selected for the "Experimental House" were collaborators of SOM in their print advertising practice; the insulation was from Owens-Illinois Fiberglas Co., for whom SOM would develop a full-scale "Fiberglas" building in 1948[38]; and its paint from Pittsburgh Plate Glass Company.

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[36] Robert L. Davison, "Research Develops a $2,600 House in Sixteen Years, Builds It in Ten Days," *Architectural Forum* 72 (May 1940): 365–69.

[37] "Experimental House No. 2 : John B. Pierce Foundation : Skidmore, Owings and Merrill, Consulting Architects," *Architectural Forum* 72 (April 1940): 226–27.

[38] "Fiberglass Building: Owens-Corning Fiberglass Corporation, Skidmore, Owings and Merrill, Archts," *Architectural Record* 103 (February 1948): 140–41.

Fig. 2.6 Pierce Foundation-SOM Experimental House No. 2, 1940

The next year, SOM served again as Consultant Architects on the creation of a second prototype house at the Pierce Foundation's New Jersey farm. Unnamed at the time, this second test was called the Pierce-Cemesto house later on, because of its primary development: replacing the plywood exterior wall with the Celotex Company's pre-fabricated Cemesto wallboard.[39] Similar to the previous year's "Experimental House No. 2" in scale and overall footprint; the Pierce-Cemesto plan is simpler, grouping utilities, bathroom and kitchen in a central area and then surrounded by bedrooms and living rooms. The house itself was a nearly square plan, at 24' x 28'. It was designed with a load-bearing perimeter wood structure, allowing for an open interior spanned by wood trusses. The unit featured two bedrooms.

While the previous iteration had used plywood as its exterior wall material, this new prototype house involved the Celotex Company and deployed their Cemesto wallboard that integrated cladding and insulation. *Architectural Record,* which published the prototype house as part of a larger feature in 1941, cited the use of Cemesto as a "curtain wall system," in which pre-fabricated panels snapped into place in a

[39] This second prototype house does not merit its own feature in any of the architectural journals but is mentioned in a later article on the Aero Acres and Stansbury Estate development: "Houses for Defense: Private Enterprise Prefabricates 600 for Bomber Builder Glenn Martin," *Architectural Forum* 75 (November 1941): 321. It is dubbed the "Pierce-Cemesto" house by one of its few chroniclers: James Breihan, in his application to the National Register of Historic Places.

structural exterior which was no load bearing allowing for faster installation.[40] Panels were to be limited by 4' x 12', and the plan was aligned to this dimension. Compared to the advertisement for Celotex, these panels were installed horizontally on the facade. In addition to testing the materials on the form and usability of the house, the John B. Pierce Foundation conducted a series of tests on the Cemesto material including for structural stability (racking and compression) and permeability (rain and thermal tests).

Fig. 2.7 Pierce-Cemesto House, 1941

SOM also re-thought the architect's role in the construction process, namely the responsibility for providing drawings for construction. For the Pierce-Cemesto house, SOM proposed a new type of drawing set. The architect's drawings were themselves "pre-fabricated," rather than the usual immense stack of construction documents which separated out overall plans from sections and details, the drawings prepared by SOM for the prototype house prioritized ease of construction oversight and installation. *Architectural Record* described this new drawing set, "Detailing of the house for large-scale production required

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[40] "Houses for Defense: Private Enterprise Prefabricates 600 for Bomber Builder Glenn Martin," *Architectural Forum* 75 (November 1941): 321.

the development of an entire new type of drawing, combing architectural, structural and shop drawings, specifications and erection manual."[41] Overall, the sixty sheets of the set were divided into seven sections, each printed on a different color paper. Each section would be given only to the trade responsible and contained within them, presumably, all information that was needed to execute that subcontract. These included: "Foundation," "Exterior erection," "Interior erection," "Rough lumber," "Millwork," "Shop details," and "Contract drawings." This drawing set reflected the organization of a house into individual elements rather than a crafted whole shown in SOM's design of "Flexible Space" in *Architectural Forum*; for the Pierce-Cemesto house, SOM designed the logistics of the architect-contractor relationship and streamlined them toward the goal of expediting the construction of the mass-produced home.

One of the "experts"—and potential clients—invited to view this prototype house using Celotex panels at the Lebanon, NJ farm-and-testing grounds was Jan Porel, a manager for the Glenn L. Martin Company, an aircraft manufacturer. The Martin Company had just expanded their factory facilities in Middle River, Maryland, subsequently expanding their workforce from 17,000 employees during peacetime to 45,000 at the end of 1941. According to *Architectural Forum,* Porel had already considered a few dozen pre-fabricated housing models. The Pierce Foundation, to further convince Porel, built another replicate of the Celotex prototype house on the Martin Company's property in Maryland in 1940, in addition a prototype apartment building, at 1 and 3 Cypress Drive. Convinced by the house, *in situ*—though not the apartment building—the Martin Company ordered 607 exact duplicates to be constructed in Maryland under the company's own Housing Division.

IV. Bomber Cities: Middle River, MD, Ypsilanti, MI and Oak Ridge, TN

A. Aero Acres

In 1940, in anticipation of the United States entering the war, Roosevelt commissioned 50,000 military aircraft and provoked a mobilization of worker housing construction in defense centers of airplane production. SOM's Pierce-Cemesto House's first large-scale deployment, constructed between 1941-1942,

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[41] Ibid.

was located at the new Glenn L. Martin Company factory. The development to support the new factory comprised two neighborhoods: "Aero Acres," with 297 units, followed by "Stansbury Estates," with 310 units, an expansion funded in part by the Farm Security Administration.[42] Beyond their significance in SOM's own history, these communities planned by SOM are cited as "one of the only pre-Pearl Harbor defense housing projects remaining in the US" and an early model for the suburban neighbor plan.

Deployed in its exact form, photographs of these neighborhoods after construction reveal identical clones of the Pierce-Cemesto house deployed across the landscape. SOM was also responsible for the planning of the two neighborhoods. For the housing of the "Bomber Builders," each unit was situated on a lot 48x100, and arranged into double-loaded superblocks. Streets were named after aircraft parts, such as "Cockpit Street" and "Fuselage Avenue."

An *Architectural Forum* feature on the project highlighted both the speed of the installation and its low-cost, continuing the narrative established on the "prototype" houses by SOM which highlighted the performance of speedy construction as much as its design effect.[43] At Aero Acres and Stansbury Estates, six houses were assembled per day. In *Architectural Forum,* an almost theatrical description is given of the 150-person "erection crew" who quickly assembled these defense houses in assembly line fashion, overseen by the Martin Company's own management. Ten groups of different fabricators from the different trades worked under isolated tents, methodically producing just the parts and areas for which they were responsible based on SOM's trade-specific drawings. Ultimately, according to *Forum,* the houses cost less than the original estimate of $2,250 each.

While the Martin Company privately funded the first iteration of the project, the houses adhered closely to federal standards in an effort to conserve funds and "in keeping with the spirit of the home front movement."[44] During the war, the Federal Works Administration regulated defense housing with the

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[42] James R. Breihan, "National Register of Historic Places Registration Form: Pierce-Cemesto Houses," n.d. (Provided by the author.)

[43] "Houses for Defense: Private Enterprise Prefabricates 600 for Bomber Builder Glenn Martin," *Architectural Forum* 75 (November 1941): 321.

[44] "Per Martin's wishes, SOM largely following [sic] the defense housing standards set forth by the United States Housing Authority, which meant that they were adhering to clearly delineated regulations with regards to what they could and couldn't include when forming the overall architectural design of the units, and the planned layout of the neighborhood,"

document *USHA Standards for Defense Housing.* The guidelines developed by the United States Housing Authority regulated construction and design across scales. This included on the urban scale—the quantity of houses per acre, the cost of each home, the amount of plan variations, and how much community space should be accounted for—as well as each unit's construction, such as the demand for standardized building materials. For the most part, SOM's "Experimental House" was already adhering to these *USHA* standards. For Aero Acres and Stansbury Estates, the Cemesto prototype house that SOM had developed on the Pierce Foundation's testing grounds was barely modified.

Fig 2.8 Pierce-Cemesto House at Aero Acres, 1941

After the war ended in 1946 the houses in Aero Acres and Stansbury Estates were sold to individual owners. In this first deployment of the Pierce-Cemesto house, SOM tested the possibility of an architecture of logistics at large-scale. Adopting the strategies of mass-production, as did many of their peers, SOM applied pre-fabricated materials to house design; more uniquely, the office developed a series of trade-specific drawings which transformed the architect's relationship with the builders with same efficiency-driven Taylorization that had transformed the building materials themselves. This defense housing

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from Elyse Marguerite Marks, "The World War II Defense Housing Community of Aero Acres: Case Study for the Future Preservation of Historic Planned Suburban Communities," Columbia University Master's Theses, 2012. It is not clear whether the Farm Security Administration's funding required the housing to adhere to USHA Standards, however, the original units appear to have been designed with these regulations in mind.

project for the Martin Company connected the office to two further contracts; the bourgeoning office of SOM was quickly finding a niche in defense contracts that uniquely required the cost-effective and speedily produced buildings, and parallel logistics in the architectural design process itself.

B. "Bomber City"

After the deployment of the Experimental House at Aero Acres, SOM looked to deploy their defense housing designs for worker housing near Detroit, Michigan. However, SOM's design was never constructed due to tensions with the United Auto Workers (UAW). In 1941, Roosevelt's earlier order for 50,000 new aircraft was deployed as a "letter of intent" from the Army Air Corps to Ford Motor Company to fabricate B-17s and B-24s, heavy and long-range bomber planes. In 1941, Ford began construction on a Bomber plant in Ypsilanti, forty miles west of Detroit, designed by Albert Kahn and at the time, the largest defense factory ever built.[45] Ford had chosen this location because his perception of increased control by the Union Auto Workers (UAW) in Detroit. The National Housing Administration funded this site for Ford's new factory, colloquially called "Bomber City," and announced in 1942 planning for 6,000 permanent homes in a community built for the Willow Run workers.[46]

Planning and work on " Bomber City" was undertaken in part by the Mutual Ownership Defense Housing Agency in collaboration with hired architect. Eliel and Eero Saarninen were tapped to design the town center, including shopping mall and other community buildings to serve the workers. Five other teams of architects were hired to plan and design the homes for five adjacent neighborhoods to house 1,200 units each: these included Mayer & Whittlesey, a New York City architecture and city planning office; Stonorov & Kahn, a brief partnership between Oscar Stonorov and Louis Kahn which would end in 1947; and Skidmore, Owings, Merrill & Andrews.[47] SOM was one of the teams selected to design a hous-

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[45] Albrecht, Margaret Crawford, and National Building Museum (U.S.), *World War II*, {PG}.

[46] Sarah Jo Peterson, Planning the Home Front: Building Bombers and Communities at Willow Run (University of Chicago Press, 2013).

[47] Five teams are noted in most sources, and three names in the *Forum* text. For more on the brief moment in which SOM might have been SOMA: Nicholas Adams, "Three's Company: The Early Years of Skidmore & Owings," in *SOM Journal 4* (Hatje Cantz, 2006), 161–66.

ing neighborhood. According to Walter Metschke, an architect who at the outbreak of the war was working for the Mutual Ownership Defense Housing Agency and was assigned to the project, SOM "was selected to do the six thousand multiple-family planning. The other four firms were dropped."[48]

However, tensions between Ford and the UAW simmered in the background as the architects began their designs. Planning commenced at Bomber City before a title had been secured from Henry Ford, who perceived he may lose influence over the town with an influx of new union workers whom the housing would accommodate. "Ford wouldn't give us permission to enter the site for survey purposes. He had personnel posted there with shotguns to keep us out," wrote Metschke in his personal memoir, "He also gave us ever-changing employment figures to frustrate our analysis of the number of housing units required. He objected to the project, which would house union workers, giving them a better bargaining position."[49] Ultimately, the architect-designed schemes were terminated in October of 1942, because the UAW objected on stylistic grounds, despite previous approval of the project. The Federal Public Housing Administration ultimately constructed a series of temporary dormitory-style apartment buildings, some of which were designed in part by the Saarinens.

Little remains of the original design for the five neighborhoods encircling a town center.[50] Architectural historian Eric Mumford cites the failure of Willow Run as a "clean turning point for modernist planning and perhaps for American suburban master planning in general", after which "following the Willow Run project, architects, because of their allegiance to modernist planning ideals, would not be allowed to shape the form of the new decentralized American city."[51] Yet a feature from *Architectural Forum* in 1943 shows the designs and plans of the five architect teams and argues the opposite—that Willow Run, "most significantly, [...] establishes the level on which planners, builders, realtors and investors will have to compete in the postwar period." For the office of SOM, Aero Acres and Willow Run, the two

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[48] Betty J. Blum, *Memoir of Walter G. Metschke*, Chicago Architects Oral HIstory Project, 1997, The Ernest R. Graham Study Center for Architectural Drawings, Department of Architecture, The Art Institute of Chicago.

[49] Ibid.

[50] The project is also mentioned in: Eeva-Liisa Pelkonen and Donald Albrecht, eds., *Eero Saarinen: Shaping the Future* (New Haven: New York: Helsinki: Washington, D.C.: New Haven: Yale University Press, 2011).

[51] Eric Mumford, "National Defense Migration and the Transformations of American Urbanism, 1940-1942," *Journal of Architectural Education* 61, no. 3 (February 1, 2008): 30.

"Bomber Cities" served as a turning point. At the Chicago World's Fair, two young architects had been exposed to urban-scale planning and the architecture of mechanization and exhibition. However, it was not until these defense housing contracts that SOM's growth rapidly accelerated: the architecture office, itself, in its number of employees and partners, and the scale of the projects it was developing expertise in executing.

When in 1942, as the contract in Michigan was falling through, SOM was brought onto a new government defense housing contract shrouded in mystery. Walter Metschke, who had developed a relationship with Nathaniel Owings during their brief collaboration at Willow Run, joined Owings at the new project: Oak Ridge, Tennessee, one of the sites of the Manhattan project.

C. "Atomic City"

In the beginning of 1943, two years after Aero Acres, six SOM architects agreed to meet unidentified employees at New York's Pennsylvania Station and board a train to an unidentified location where they were to design a town for 13,000.[52] The architects had originally queried the Corps about the commission, asking about its size, its location, and site. Only with reluctance did the Army Corps ultimately provide some limited topographical photographs. When the Corps finally agreed to a site visit, these six architects were not told their destination until they boarded the train and received location in sealed envelopes: Oak Ridge, Tennessee, the site of the future "Atomic City", one of the three sites of the Manhattan Project. At a conference in February, SOM signed on with a plan to the Manhattan Engineer District (MED), a subset of the Army Corp of Engineers, to plan, design, and construct a city from scratch. "To make possible the total destruction of Hiroshima and Nagasaki, another complete city was conjured up from nothing on the other side of the globe," headlined *Architectural Forum* in 1945 in a retroactive feature on SOM's design of Oak Ridge, after it had been de-classified.[53] The MED had originally hired the engineering office of Stone and Webster Engineering Corporation to design the buildings and planning of the community. However,

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[52] Charles W. Johnson, *City behind a Fence: Oak Ridge, Tennessee, 1942-1946* (Knoxville: University of Tennessee Press, 1981): 14.

[53] "Atom City," *Architectural Forum* 83 (October 1945): 103–17.

Stone and Webster's plans were found to be dissatisfactory, without "no originality or innovation."[54] Further, the Army Corps of Engineers, the parent agency of Manhattan Engineering District was managed, was concerned that the houses design by Stone and Webster had were wrongly estimated and would actually come in above restrictions limiting the cost of each unit at $7500 for military reservations.[55] Consequently, the MED turned to the Pierce Foundation, because of its reputation for low-cost housing established at Aero Acres; the Pierce Foundation, whose collaboration at Aero Acres comprised a similar scope of services, brought on SOM to the project.[56] At Oak Ridge, Tennessee, SOM's newfound experience from "Bomber Cities" in the acceleration of planning, design, and construction itself was put to the test. At an interview to secure the job, SOM and the Pierce Foundation claimed that in "two weeks" they could develop "complete plans and specs" for "any size town."[57] Nonetheless, the project was a jump in scale; the estimations for occupation grew totaling 75,000 expected residents and a $160 million budget that "dwarfed" past project costs according to historian Nicholas Adams. SOM was required to undertake a mobilization of its own, moving staff to Tennessee and even pushing Owings to "hir[e] architects off the street and sent them to Oak Ridge the next day."[58] The lessons in which architectural logistics that SOM had tested with new types of drawing sets at Aero Acres with the Pierce-Cemesto House continued, expanding to the office's needs to adjust its own organization.

Oak Ridge, Tennessee, and the two other sites of the Manhattan Project—one near Hanford, Washington, and another near Santa Fe, New Mexico—furthered a long effort to develop an atomic weapon in the United States. Concern had emerged in the late 1930s that Germany was developing such a project; as the potential for US involvement in the war increased, Roosevelt mobilized research on the home front. This launched the creation of a series of dedicated agencies and associated funding. Beginning in

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[54] Johnson, *City behind a Fence*, 12.

[55] Ibid., 17.

[56] Ibid., 14. Johnson's timeline disagrees a bit with Nicholas Adams', in *SOM since 1936*, who cites SOM as having been involved with the Oak Ridge project since 1942. However, Adams does not cite a relationship with the Pierce Foundation. Johnson's reference for the official decision to bring on SOM dates to a February 6, 1943 conference, cited below.

[57] "Conference with J. B. Pierce Foundation with Reference to Town Planning and Housing Development," January 29, 1943, File MD-337, J. B. Pierce Foundation, Box 29, RG 4nn-326-85005, The National Archives and Records Administration (NARA); as cited in Jung, "Evolution of the 'Experimental House,'" 599, footnote 10.

[58] Adams, *SOM since 1936*, 24.

1941, Office of Scientific Research and Development was founded and in 1942, Manhattan Engineering District (MED) was formed as a targeted arm within the Army Corps. Advanced in the sciences that would lead to an atomic weapon also accelerated: in 1942 the potential for a full-scale bomb became more tenable after a successful uranium reaction at the University of Chicago. The construction of Oak Ridge, which was the largest of the three sites, occurred within a shroud of secrecy including the odd relationship with SOM during the projects early planning. Originally called "Site X", the Tennessee site was selected because of proximity to the Tennessee Valley Authority (TVA) that could supply the needed electricity from hydroelectric plants. Upon its construction, the MED's intention was to develop a bomb in three years time; its primary focus was the production of Uraniaum-235, a material necessary for the development of a full-scale bomb.

According to historian Charles Jackson, "The military never believed they were building an ideal community, nor for that matter even a permanent one."[59] However, the concerns and conditions under which SOM was hired seem to belie this argument.[60] The Army Corps, after rejecting Stone and Webster's original plan, revealed some of its hopes for the architecture and urbanism of Oak Ridge which went beyond temporary shelter and utility. Colonel James C. Marshall for the Army Corps expressed his concern over the original design stating that: "Resident comfort and attractiveness of the surroundings should be matters of primary concern."[61] Consequently, while SOM and the Pierce Foundation leveraged their expertise in low-cost, rapid deployment, they also emphasized architectural features that aimed to transform the Oak Ridge housing into more vernacular, permanent, or traditionally appearing spaces. The first deployment of 1,000 of the Pierce-Cemesto houses at Oak Ridge came in under the budget of $7500 per unit. The extra money went to "livability": SOM added drawings to their mass-produced house with a fireplace

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[59] Jackson, *City behind a Fence*, xxi.

[60] Further, Nicholas Adams writes that in 1944, the community was declared to be a permanent one, changing the pace of SOM's designs for the community buildings. Additionally, after the war, SOM was hired to develop a master plan looking at the future of Oak Ridge. A report of this project is held by the MIT Limited Access Collection: Owings & Merrill Skidmore, and Atomic Energy Commission U.S., *Report to the Atomic Energy Commission on the Preliminary Master Plan, Oak Ridge, Tennessee* (New York: Skidmore, Owings & Merrill, 1948).

[61] Johnson, *City behind a Fence*, 17.

and porch to all size houses[62] for effect though the Army Corps own papers claim that the climate called for neither.[63] "Skidmore and Pierce offered the District a brilliant amalgam of forward-looking and deeply conservative themes," wrote historian Peter B. Hales.

At Aero Acres in MD, the Martin Company simply deployed over 600 versions of a singular model of the Pierce-Cemesto house that SOM had designed for the Pierce Foundation. Comparatively, at Oak Ridge, SOM was developed a series of options and variations on the mass-produced building reflecting the "flexibility" the firm had argued in 1942's "Flexible Space" in *Architectural Forum.*[64] Additionally, SOM developed housing typologies outside of the Cemesto house; these include larger scale apartment and dorm-like buildings. Walter Metschke, transitioning from his work at Willow Run, was brought in to work on the project by Nathaniel Owings; Ambrose Richardson was also responsible for architectural design. In total, SOM oversaw the construction in the first phase of 3,000 single-family homes: types A, B, C, D, E, F, G. In the Oak Ridge configuration of the Pierce-Cemesto house, the plan module was changed from 12' horizontal bays to a 4' vertical module allowing more variations without sacrificing ease of assembly, not unlike the house shown in the SOM-Celotex advertisement from 1942. These Pierce-SOM homes were located in the center of Oak Ridge's community.[65] Type A was the smallest house, a two-bedroom similar to the original experimental house; the sizes went up sequentially with Type B adding a rectangle to the square plan; Type C into an L-shape plan with another 'wing'; Type D being the nicest of all single-family options which combined A and B into a ranch-house like design.[66] SOM's design also allowed for different interior finishes of various luxuries, in order to help differentiate between the hierarchy of the homes' residents, despite the houses overall similarity. Despite these opportunities for variation, just

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[62] Peter B. Hales, *Atomic Spaces: Living on the Manhattan Project* (Urbana: University of Illinois Press, 1997): 83.

[63] Lenore Fine and Jesse Remington, *The United States Army in World War II: The Corps of Engineers; Construction in the United States* (Washing, D.C., 1972), 669; as cited in: Johnson, *City behind a Fence*, 17, footnote 14.

[64] A thesis from Columbia University looks at the Cemesto house at Oak Ridge, and was cited by Elyse Marks in her own on Aero Acres, however I was not able to access this document in time to include it: Emily Anne Gunzburger, "The Cemesto House in Oak Ridge, Tennessee," Thesis (M.S.), Columbia University, 1997.

[65] Neighborhoods were segregated; plans existed for a "Negro Village" also of Cemesto houses and dorms, though never constructed.

[66] Hales, *Atomic Spaces*, 83.

as in Aero Acres, speed was of the essence; the rate of construction increased from six homes daily to 30-40 daily.

Fig. 2.9 "House B" at Oak Ridge, TN

Historian Adams recounts an anecdote about SOM's development of Oak Ridge which characterizes its effect on the firm: "Louis Skidmore [...] tells how he brought his old friend Carl Landefeld to see the volumes of the statistical program for Oak Ridge, prepared before architectural drawing began. Landefeld, reports Skidmore, looked at the volumes and said: "There is the architectural rendering—1943 model."[67] SOM had replaced the traditional expressive architectural rendering with volumes of numerical and logistical data, a fitting description of architecture in 1943—an age of mass-production and statistical operations.

V. Conclusion

During this period, SOM's extra-architectural production took the form of collaborative advertisements in print and built prototypes. But what undergirded this odd handful of experimental projects published in architectural journals was the undercurrent of a larger shift in the practice of architecture, culminating at

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[67] Ibid.

World War II, of the shift from Fordist factory lines to the large corporation resulting in new roles for the architect, at which SOM both stood at the center and epitomized. The housing defense projects that grew from these advertising practices—state-funded, often cookie-cutter collections of housing, pre-cursors of mass-produced suburbia—did not set the stylistic tone for SOM's future practice, which would soon take a dramatic turn towards sleek technical detailing in steel and glass. However, these defense projects did represent a type of logistics practice that, emerging from wartime needs for speed and low-cost, and combined with a broader public acclimation to "progressive architecture" cited by Shanken apropos experimental advertising, that would in the comparatively more decadent post-war period broken a signature method of practice for SOM.

In 1947, the same year that SOM was commissioned to do a master plan for the future of Oak Ridge, Henry-Russell Hitchcock would write the text "The Architecture of Bureaucracy and the Architecture of Genius" referenced in the Introduction.[68] In this text, Hitchcock points to a post-war fork, at which architects of singular genius would take one path and the corporate, collaborative, anonymous office another. In Hitchcock's text, the Oak Ridge project of SOM is used to capture the quintessential traits of the corporate practice. In one interpretation, bringing to light these housing projects by SOM during the wartime could suggest that—as large firms grow their practices by establishing an expertise—the typology "housing" might in fact by SOM's under acknowledged beginnings, an unglamorous issue no longer part of the firm's portfolio. Comparatively, another interpretation could suggest that these housing projects, and the advertising experimentations that serve as their residue, represented not a specialization in a certain architectural typology but rather a new kind of architectural practice of logistics both in the office itself and on the drawing board. Odd items from throughout this chapter—the new drawing set organized by trade on different colors of paper at the Pierce-Cemesto house; the "rendering" of Oak Ridge in 1943 which was a stack of statistics; the pitch by SOM to the MED that they could design anything in just two weeks—characterize a firm which sought to establish itself not on knowledge of one type of building, but on a new means of practice.

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[68] Henry-Russell Hitchcock, "The Architecture of Bureaucracy & the Architecture of Genius," *Architectural Review*, January 1947, 3–6.

Certainly the effects of the Fordist assembly line influenced the firm's practice during this period, both in the Taylorization of SOM's drawing sets and the mass-production of the Pierce-Cemesto Houses and their pre-fabricated materials. Yet Hitchcock acknowledges that there is something more at play: "[Albert] Kahn had been building large aircraft engine plants for many years, and no one ever built a city for 75,000 in the space of a few months." But in 1946, Peter Drucker in the *Concept of the Corporation* asked his readership to shift their gaze from the assembly line to the more nebulous but equally influential practices of management, human resources, and the large organization established by General Motors.[69] For SOM, the launch of the firm's practice in World War II on a tide of federally funded housing projects, in collaboration with material manufacturers, sat at this important pivot from industrial efficiency to organization management in which logistics of building began to effect and shape the architecture office itself.

[69] Peter F Drucker, *Concept of the Corporation* (New Brunswick, N.J., U.S.A.: Transaction Publishers, 1993).

Chapter 3

Data Dreams: The Computer Group and architecture by spreadsheet, 1967-1984

In 1967, SOM's Chicago office was asked to design an office building near the city's international airport. "A client came [...] with a funny request," said David Sides, an architect with the office at the time.[1] "He had just bought a piece of property near O'Hare airfield. His requirement was a building that could be built on that site to give a maximum return on [his] investment. He had no other requirements." The project was not a complete blank slate; it was restricted by height because of the airport's fly zone. However the client had no opinions on architectural form, only on his financial return. SOM took this almost unexpectedly simplistic problem to its in-house architects-turned-programmers, a team nicknamed "The Computer Group," that Sides led in the San Francisco office. Was it possible to design a building on cost alone? "We [...] quizzed architects in the Chicago office," Sides said about the Computer Group's response to the O'Hare problem, "on how they went about estimating usage, estimating return. How did they go about deciding what a building was worth, what they could build on the lot, what clients wanted, and what [would] it cost?"

The Computer Group's solution to the problem, after a four-week research blitz, was a "crude"[2] computer application that they called the *Building Optimization Program (BOP)*.[3] Text-based, without graphic interface, run on IBMs the size of refrigerators, *BOP* operated on a simple premise. "The practical problem of building design can be formulated, in a general way, as an optimization program," wrote G. Neil Harper, who collaborated with Sides on the project, in a conference paper from 1968.[4]

The Computer Group, a team which spanned across SOM's offices but focused in Chicago, was the name given to a studio of architects and systems engineers working intermittently between 1963 to

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[1] C. David Sides, *Interview with David Sides*, Phone interview conducted by the author, November 11, 2014.

[2] G. Neil Harper, "BOP—An Approach to Building Optimization," in *Proceedings of the 1968 23rd ACM National Conference, ACM '68* (New York, NY, USA: ACM, 1968), 575.

[3] This anecdote is also described in: C. David Sides, "Notes on Computers an Architecture," in *Reflections on Computer Aids to Design and Architecture*, ed. Nicholas Negroponte (New York: Petrocelli/Charter, 1975): 128.

[4] Ibid., 575.

1986, with different leaders and members through the years.[5] In this period, before the widespread commercial availability of drafting software, large architectural firms including SOM undertook their own research on computer integration. Harper saw that the O'Hare client's interest in financial return was a computational opportunity. In his paper, Harper argued that thus far computer applications in the building industry had been tailored only to "isolated disciplines."[6] The programs in existence at SOM and in other offices worked primarily on structural equations or construction scheduling. In contrast, Harper believed in the future possibility of computing the "synthesized whole of the project," which was—in fact—the "true nature of architecture and engineering."[7]

What was the "true nature of architecture," according to SOM? "A building is a 3D spreadsheet," answered the Computer Group.[8] O'Hare Plaza, completed in 1970, manifested as a group of three stark concrete-structure buildings, one 10-story and two 4-story, with regular openings. (Fig. 44) This first building executed with *BOP,* for a client whose interests were in the figurative bottom line, represented SOM's attempt at design automation in its purest form. O'Hare Plaza was a first foray into SOM's dream of architecture by bits. When passing the building on the highway to the airport from Chicago, it is easy to overlook. It's appearance today conveys not even a sense of "normal" but the *extra*-normal; its form almost a caricature of the mundane office building. Yet it is in fact the epitome of such projects; O'Hare Plaza's calculated shape, facade, and floor plan was the first output of *BOP,* the odd text-based computer program developed in search of the most cost-effective commercial architecture.

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[5] Much of this research draws from this first text which covered the work of the Computer Group, and also led to a SOM symposium reflecting on similar contents: Nicholas Adams, "Creating the Future (1964-1986)," in *SOM Journal 8,* ed. Peter MacKeith (Hatje Cantz, 2013); also: Skidmore, Owings & Merrill, *Digital Design at SOM: The Past, Present and Future,* Streaming video (Arts Club of Chicago, 2012), http://vimeo.com/100126982.

[6] Harper, "BOP", 575.

[7] Ibid.

[8] Adams, "Creating the Future", 136, note 68.

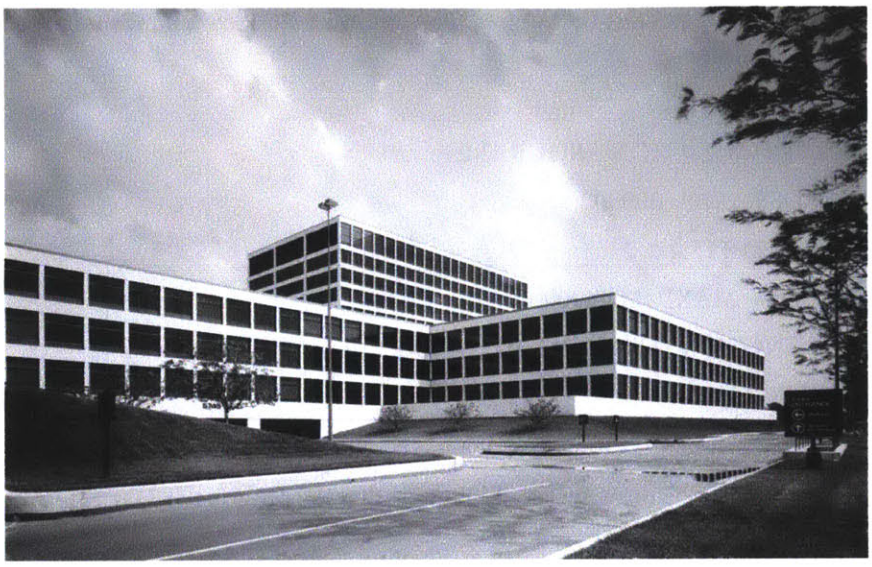

Fig. 3.1 O'Hare Plaza, 1970

BOP was developed in 1967 and used as late as 1990 primarily by SOM's Chicago office. Bruce Graham, a second-generation design partner at SOM who became a champion of computer integration, pitched the program as "[coming] close to revolutionizing the way we practice architecture."[9] Harper and Sides' research for the O'Hare project used early computation to synthesize what the firm had already established in its experience with commercial office buildings. *BOP* hinged on four key financial factors in a building's design: structure, exterior wall, mechanical system, and elevators. For any given site and project, the cost relationship of these four variables could be explored through automatically generated alternatives. For example, in-house architects estimated that the increasing size of window wall openings resulted in higher HVAC costs. *BOP* codified this relationship into its algorithms. Or, alternatively: a regular lease span—the distance from the core to the window wall—on a square tower would also reduce the cost of the structural system because of its simplicity. In this period SOM was tasked—and continues to be today—with the core and shell design of large office buildings, leaving the interior fit-outs to tenants. Harper, in his paper on the program, explained how the program worked:

> [S]uppose that early discussion with a client has indicated a need for a gross area of about 300,000 square feet, with about 13,000 to 16,000 square feet per floor. The site is in the center of the city,

[9] Yale Conference on Computer Graphics in Architecture and Murray Milne. "Computer Graphics in Architecture and Design; Proceedings." Yale School of Art and Architecture, 1969.

and has dimensions of 125 feet by 150 feet. The following BOP commands might be used to describe this information:

JOB NAME, 'CLIENT X';

BUILDING OPTIMIZATION PROGRAM;

TARGET GROSS AREA, 300000;

FLOOR AREA LIMITS,

MINIMUM 14000 MAXIUM 16000;

BUILDING LENGTH LIMITS, MAXIMUM 150;

BUILDING WIDTH LIMITS, MAXIMUM 125;[10]

After this series of commands, the designer would request that the program "BLOCK OUT GEOMETRY." The results would be output in an array of numerical and text-based data. Each option would include specifications for "Lease Span", "Floor Dimensions," "Core Dimensions," "Gross Sq Ft Per Floor," and more. Ultimately the results output by *BOP* of most interest to the firm were: "Building Cost," "Unit Cost," "Return on Investment." *BOP* would also provide a summary and the literal bottom line. "Optimum Solutions" listed out options for the lowest cost, the lowest cost per square foot, and the maximum return on investment.

BOP's authors were certainly aware of its limitations, of its reduction of architectural design to four numerical variables. Harper hedged in his paper, "The important point to remember, however, is that these selected solutions [...] fell within given limitations."[11] For a client like the one from O'Hare Plaza, the limited solutions of highly cost-effective buildings were the only architectural outputs of interest. The Computer Group worked to add complexity and variable to the program; one iteration of *BOP* presented by Sides and his colleagues to the partnership included factoring some odd costs from construction including the $40,000 which the SOM Chicago architects estimated was necessary to bribe the police to bring in concrete trucks.[12]

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[10] Harper, "BOP," 576-577.

[11] Ibid., 578.

[12] "We got very far into Skidmore's estimating system. So much that it was coming along pretty well and the NY partners wanted to know what was going on. [...] We went through what we had done and how we had the estimated costs broken down. One of the costs we had written in was a $40,000 dollar bribe to policemen to get concrete trucks. Not one partner batted an eye," from Sides, *Interview*.

The reach of *BOP* in the Chicago office of SOM was wide; any office building designed by SOM's Chicago office between 1968-1990 including a *BOP* analysis[13], including projects as outwardly dissimilar iconic Hancock Center (1965) and One Shell Plaza (1971). (Fig. 3.2) Yet what they had in common was the efficient layout of the central core, the window wall, and regular structure: features grounded in *BOP*'s variables. Throughout this period, rising in the city centers of dozens of large cities in America and abroad were structures of glass and steel, elevated off the ground level by a tall lobby, then unrolling as a repetitive orthogonal grid of disappearing curtain wall units which at their tops faded into the sky. So pervasive that they became unavoidable, SOM's commercial office buildings became the firm's calling card, drawing both praise and critique for their ubiquity. What drove the shape, form, and organization of these buildings? During this period, SOM went through a profound internal change within the office as it integrated computers into the drafting room. This change manifested itself externally in the buildings the office designed—that O'Hare Plaza's stark form authored, in part, by a digital application reveals the outcome in a most visible case. As one of the first firms to integrate the computer into the architect's office, SOM embarked on two decades of architect-as-computer programmer *simultaneously* with their massive deployment of the office's hallmark tall commercial office tower.

Fig. 3.2 One Shell Plaza, 1971

[13] Adams, "Creating the Future (1964-1986),": 135, note 16.

This chapter illustrates that these two happenings were no coincidence. At the root of these office towers was the Computer Group. "SOM Systems,"[14] another name under which the team sometimes operated, created a variegated arsenal of early computer applications. They tended to fall into three categories: first, applications which attempted to resolve a specific issue like stair dimension calculation, hospital equipment layout, or truck turning radiuses; second, those which attempted to translate analog representational methods into digital form, such as *DRAW2D* (1975) and *DRAW3D* (1977); lastly and perhaps of most interest, early attempts at the inter-disciplinary synthesis of architectural data, what today might be called Building Information Management (BIM), such as *BOP* (1967), *SARAPI* (1972) and eventually *DRAFT/AES* (1982).[15]

I. A Willing and Capable Partner: SOM and the Computer

In 1968 and 1969, two significant conferences took place on computer integration in architecture, the first broadly attended, the second behind closed doors. The first in April '68 was a public gathering at Yale University on the topic of "Computer Graphics in Architecture and Design" and represented a cross-section of industry leaders in research, industry, and practice. The second conference, a year later in March '69 was a private, invite-only affair: a strategic planning meeting held by SOM leadership. Originally called the "Sterling Forest Meeting," this SOM meeting became jokingly known by its attendees and in its aftermath as the "Appalachian Conference," after a scandalous summit of the American Mafia, revealed to the FBI, a few years previously.[16] In attendance at both Yale and Sterling Forest was SOM's design partner Bruce Graham who first supported the development of new applications for architectural use

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[14] "SOM Systems" was a header used in a folio held by MIT Libraries: Skidmore, Owings & Merrill, *SOM Systems- SARAPI* (Skidmore, Owings and Merrill, 1972).

[15] It is hard to pin a date on the program most commonly known as *AES (Architecture Engineering System)* as it began as a project of individual tools eventually gathering together and rethought under the name *DRAFT*, though sold eventually to IBM under the name *SKYLINE* (Adams, "Creating the Future", 129). The program continued to be used and developed at SOM until the 1990s, according to an email from Neil Katz, and SOM employee since the late '80s when he joined as an intern running the plotter after school in the evenings. (Neil Katz, "Re: Hello! / Digital Design Question," September 5, 2013.)

[16] Sides, *Interview.*

at the office. The Appalachian Conference appears to have turned the partnership to his cause. These two conferences set the backdrop against which the Computer Group would emerge.

The 1968 Yale Conference was organized by Murray Milne, an architect and professor, to discuss a "potential [...] fantastic"[17] future at hand. The discussion of this future included promises of speedier, more cost-effective production of architecture and also 'softer' topics like the role of automation in design, its democratization, and the benefits to the city. Invited to speak at the conference were the men who in the following two decades would have a crucial role in the development of computer graphics. From its origins in a back room at the Lincoln Lab, computer graphics would travel into a host of adaptations and applications used in a variety of fields, and ultimately land squarely into the center of the architect's office. In his preface to the book documenting the conference proceedings, Milne paraphrased the critics who did not share his belief in the industry-wide paradigm shift at hand. There were those who, fearing the effects of automation, believed that the "design professions [were] headed for disaster." Others, wary of naive idealism, denounced the computer evangelists for believing that the "computer will solve all the designers' problems." Despite, or perhaps because of, these naysayers a sense of excited anticipation pervades Milne's introductory text to the conference proceedings. "The computer," he wrote, "is a [..] potentially willing and capable partner."

The "creaking lecture hall"[18] at Yale represented a broader shifts outside its walls. Soon-to-be-giant corporations like Digital Equipment Corporation (DEC), Tektronix, and IBM were mobilizing to develop commercial applications of military technologies more suitable and desirable for office-use. Nicholas Negroponte and his team at MIT were finishing *The Architecture Machine,* exploring the consequences of human-computer interaction.[19] Outside of the US, the engineering firm of Ove Arup was using computer programs to process structural calculations for Jorn Utzon on the Sydney Opera's curving shells. Early computers the size of refrigerators were carted into the drafting room to perform tasks that ranged from personnel management, to heavy-duty structural calculations, to the design of architectural

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[17] Milne, *Computer Graphics*, introduction.

[18] Ibid.

[19] Nicholas Negroponte, *The Architecture Machine: Toward a More Human Environment* (Cambridge, Mass: The MIT Press, 1973).

forms. Large architectural practices with fiscal resources to make long-term investments were going through a similar period of computational experimentation.

In the '60s and '70s, computer applications for architectural practice as we know them now—massively available, commercially priced, and available for personal computers—did not yet exist. Yet architecture firms, especially those large enough to take financial risks, were beginning to independently investigate their possible use. Caudill Rowlett Scott (CRS), a Houston-based firm, began by using computers for management and accounting in 1965, taking advantage systems developed for general office use.[20] The office also formed the "Computing Research Systems 2" (CRS2) that developed a suite of applications for in-house use and for sale, including streamlining cost analysis, project scheduling, and equipment specifications. Hellmuth Obata and Kassabaum (HOK) also developed a range of applications for internal use and for sale.[21] Other large firms also produced applications for their own use: this included Jung/Brannen, DMJM, TAC, and Albert C. Martin & Associates. Employees with computer expertise cross-pollinated information and ideas: informally—such as over drinks[22]—and when they switched employers between these offices.[23]

SOM was unique, however, in its development of software like *BOP* that drew from its existing expertise in commercial office buildings and then transformed that knowledge base through computing. In 1968, when the Yale Conference took place, SOM was already underway with its own research. Bruce Graham's presentation at the conference gave the audience a background for SOM's involvement with computers. Work was up, Graham said, pushing the office to the size of 450 people employing not just of architects but also diversifying through the hiring of specialists like "planners," traffic analysts," "hospital

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[20] K.K. Fallon, "Early Computer Graphics Developments in the Architecture, Engineering and Construction Industry," *IEEE Annals of the History of Computing* 20, no. 2 (June 1998): 20–29.

[21] ""Currently, we are marketing HOK Draw, HOK Space, Plot Database (report format), and Invest (lease analysis). By the end of the year, we will offer six more systems from stacking and blocking to an interface between HOK Draw and other CAD software." *Progressive Architecture*, vol. 66 (Reinhold Publishing Corporation, 1985): 141.

[22] "So much of the development and thinking happened on cocktail napkins. More on a personal basis than company to company," from Sides, *Interview.*

[23] William Sommerfeld, for example, left SOM to become the Director of Computer Applications at The Architects Collaborative; his name is credited as such on the paper "Computer Systems for Urban Design and Development," in *Journal of the Urban Planning Division,* April 1971.

and equipment specialists" and "furniture designers."[24] The contracts and scale of projects themselves had been increasing as well, and the firm was responsible for $500,000,000 in yearly construction costs. Yet the office was wrestling with this exponential growth. Graham found that his search for a more highly trained and educated work force was not enough; consequently, the office turned to a new type of worker: the computer. SOM was ready to "make the transition from the traditional practice of architecture to the methodology of the future."

In his talk, Graham went on to present programs that the office had already developed piecemeal by '68. Most were relatively small computing solutions for issues of office efficiency. One was *Auto-Spec* (1965), a program for reviewing specifications and reducing the time for both "writer and typist," a laborious task that Graham said was causing overtime issues and employee turnover. Another application was the *Truck Turning Problem*, to compute the layout for large trucks in parking lots and the design of curbs; similar was the *Auditorium Layout* to automate the curved and elevated section of seating areas to allow all audience members to see the stage. Other solutions Graham presented were more about visual representation; another was *View of the Road*, an application developed in collaboration with MIT developed to visualize the Chicago Cross-Town Expressway Project. Graham also presented *BOP*. These projects represented a cross section of all three types of computational programs being researched by the firm: solution-based, representational, and building data simulation.

However, despite Graham's show of a united front, within the office the path toward computer integration was not so clear. Walter Netsch, a design partner in the Chicago office, had tried to deploy computers in the design of the Air Force Academy in Colorado Springs (1963), but found them lacking. "I sort of hemmed and hawed," Netsch said about computer integration, "because after the Academy—and it didn't work for me then—I didn't see any relevance to spending a million dollars for the work I was doing."[25] A faction within the office leadership was skeptical about the pay-off for computer integration. Notes from office at the time suggest resistance was based in concerns about the "economic return" of

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[24] Bruce Graham, "Computer Graphics in Architectural Practice" (presented at the Yale Conference on Computer Graphics in Architecture, New Haven, CT: Yale School of Art and Architecture, 1968), 24–30.

[25] *Oral History of Walter Netsch*, interview by Betty J. Blum, 2000 1997, Art Institute of Chicago Archives: 127.

such a venture, and also a more vague anxiety that the "automation of physical functions [...] would not improve appreciably the decision-making or design process."[26]

Yet momentum had begun. G. Neil Harper, hired 1964, had previously worked at IBM as a liaison to SOM. In the mid-sixties under E. Alfred Picardi, the head of the Structures group in the Chicago office, and Fazlur Khan were deploying computers for structural engineering including on the Brunswick Building, Chicago (constructed 1965) for checking manual calculations.[27] Picardi and Khan worked to advance the use of computers in-house on their calculations for the structure of the tapering John Hancock Center in 1965; final calculations were outsourced to consultants with bigger computing power.[28] The computer was integral to Khan's structural design for Hancock; the potential of the computer grew. When Harper left in 1968, Lavette Teague was hired who had a background with systems engineering at Rust Engineering and also with two degrees at MIT in similar work. Further, computer advocates within SOM, including Bruce Graham, were bracing to move forward on their vision. Peter Little, an SOM employee, remembers a moment with Bruce Graham in 1988. "Bruce was in the elevator with a group of us," Little wrote, "In response to someone's query about people who were resisting computers in the firm, Bruce calmly announced that they would be fired."[29]

The year after the Yale Conference, SOM convened the Appalachian Conference in an IBM research facility in Sterling Forest, NY, now cited as "architecture, engineering, and construction industry's first strategic technology planning session."[30] Very little documentation of this conference is available.[31] "The partners listened [and] had their own private discussions," Sides said of his memory of the event, "They never published any result."[32] Yet an early memo from Lavette Teague to the participants of the

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[26] C. David Sides, *A Transition in Architecture: Comments On Development of Architectural Information Systems*, March 22, 1969. Report provided to the author by Lavette Teague, meeting organizer; memo was issued for reference and use during meeting.

[27] Yasmin Sabina Khan, *Engineering Architecture: The Vision of Fazlur R. Khan* (New York: W. W. Norton, 2004): 113.

[28] Ibid., 114.

[29] Adams, "Creating the Future," 136, note 71. Anecdote confirmed by Peter Little in email to author.

[30] Fallon, "Early Computer Graphics," 24.

[31] Information specifically on this conference was requested from the SOM Archivist, but none could be found. Most information gathered on this event are from interviews with Lavette Teague and David Sides, who were in attendance, and kept some personal documents which they authored or received.

[32] Sides, *Interview.*

Sterling Forest meeting, dated from February 28, 1969 about one month before the conference, reveals the scope of the ideas discussed.

> The first task is more than a matter of computer programs and hardware, although it assumes a central role for the computer. It involves a fundamental redesign of our entire design process in relation to current and foreseeable information processing technology. [...] It means taking a lot at the flow of information during the course of a project and the form in which the information is communicated to those who need it. Implicit in a different kind of design process are different kinds of personnel, procedures, and organization. The required information system must facilitate control not only over the result of the design process, but over the process itself. [33]

Teague's note to the participants makes clear the stakes of the Appalachian Conference: not simply the logistics of integrating the computer into SOM's office, but a total re-thinking and re-organization of the way the firm practiced architecture, based in the handling and communication of information.

Those attending the Appalachian Conference, based on Teague's memo, were a combination of key members from SOM's leadership and relevant experts or industry representatives brought in to brief those from the firm. From within the office, John Merrill, the son of the firm's eponymous founder; Walter Costa and Marc Goldstein; Bruce Graham and Fazlur Kahn—the Computer Group's two biggest champions; as well as David H. Hughes, Martin Growald, and Walter Rutes. The list of the experts to present to the partnership represented the cross-section of industry and in-house expertise. These included Steven Lipner, a civil engineer from MIT who had been the project manager of COGO, a project developed by MIT's Charles L. Miller to handle geometric calculations used by surveyors. Also present was a representative from IBM, Jack Sams, a company which had an interest in selling "timeshare" rentals of computer equipment to SOM as well as learning what kind of needs a large architectural firm—an open market—would have in the following years. David Sides, a future member of the Computer Group, was also present as a consultant. The specifics of the discussion remain unknown; however, Sides' paper that he issued for the conference and was distributed among the attendants, "Comments on Development of Architectural Information Systems," gives a glimpse into both the head- and tail-winds facing SOM in the transition towards computer integration at the office. "A vital element of this transitional period is the

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[33] Lavette Teague, "To: Participants in the Sterling Forest Meeting, March 21-22, 1969. Re: Agenda and Preparation for Meeting.," February 28, 1969. Memo provided to the author by Lavette Teague.

establishment of a new attitude towards the architectural process," Sides wrote.[34] This included revamping thinking internally about what decisions architectural designers made regularly and could be automated, as well as SOM's relationship with their partners and consultants.

After the Appalachian Conference, the Computer Group rapidly picked up steam. The office strategically hired Sides, who in addition to serving as a consultant at the conference had also been a colleague of Teague's at Rust Engineering. The office further added to the group with Charles F. Davis, Bill Kovacs, and Douglas Stoker in the early 1970s; a group of architects with a knack for what was then called "systems engineering." They together made up the core members of the Computer Group, with applications focusing mostly on small-scale specific solutions prioritizing efficiency. During this decade following the Appalachian Conference, the group also opened its doors to students and researchers interested in SOM's equipment for the sake of cross-pollination. "What did happen occasionally would be people would come into the Skidmore office who were students and faculty members," said Sides, "We would make a point to get them computer time. We did that independent of the architectural practice, but we came out ahead because they brought in ideas."[35]

In the early 70s, during a recession, early members of the group including Teague were let go from the office. Douglas Stoker replaced him as head of the Computer Group, taking charge of the group's identity and direction.[36] In April 1976, Stoker sent a memo to Fazlur Kahn asking for a rethinking of the role of the Computer Group at SOM. Stoker wanted the group to be more fully staffed and considered as a resource for the office just like the book and material library.[37] He called for the Computer Group to be turned into an atelier-style group with the freedom to develop an "open-ended research agenda." "What had hitherto been a collection of people answering to Fazlur Khan, sought independent status as an applied research studio for the entire firm," wrote historian Nicholas Adams on this shift.[38] Stoker hired Bill Kovacs, an architect without training on computers but with a knack for systems, who became central to

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[34] Sides, "A Transition," 11.

[35] *Interview with David Sides*, Phone conducted by the author, November 11, 2014.

[36] Douglas Stoker worked in SOM's Computer Group from 1970-1989 and was the Group's leader in the Chicago office.

[37] Adams, "Creating the Future," 123.

[38] Ibid.

many of the Computer Group's works. In 1980, Stoker issued a brochure chronicling the work of the Group and advertising its services; by then, the team was 24 employees strong and SOM boasted more than 100 computer terminals.[39] By 1983, the Group was at almost fifty people, had added more computers, terminals, and plotters to the office and linked their success to the success of the firm whose annual billing was reaching new highs.

The "computer group [...] treated [SOM's] design studios as if they were fourteen customers," explained *Architectural Record* in the 1980 feature "SOM's Computer Approach."[40] They billed the others studios for computation time and storage[41] and also offered the same services to outside offices.[42] During this fertile period, the Computer Group's design of new applications was varied and diverse. Stoker led the group with a sense of rapid discovery and with little apparent fear of failure; "If it works, change it; if it doesn't work; document it," he would say to his team.[43] Team members remember this period as a time of rowdy camaraderie and technological experimentation.[44]

It was no coincidence that SOM's own critical computer integration conference took place at an IBM research facility. Throughout the Computer Group's existence, IBM would be a constant presence, beyond its role as a provider of computer equipment. In 1933, Skidmore and Owings established a precedent for their future firm in their partnerships with material manufacturers such as Celotex or Pittsburgh Plate Glass Company. The right partner for the 1970s was IBM. "We have been called the IBM of architecture," noted partner Jeffrey McCarthy.[45] Both companies capitalized and arrived on a tide of data-driven organization: of architecture, offices, cities, and employees—a self-dubbed 'information explosion.'[46] Beyond this parallel trajectory, during this period both offices traipsed in the other's territory: IBM as a pro-

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[39] Skidmore Owings & Merrill, "Computer Capability," 1980, SOM Chicago archives.

[40] "SOM'S Computer Approach." *Architectural Record*, August 1980.

[41] Adams, "Creating the Future," 136, note 54.

[42] Fallon, "Early Computer Graphics", 24.

[43] Adams, "Creating the Future," 132.

[44] Ibid.

[45] Abby Bussel and Skidmore, Owings & Merrill, *SOM Evolutions: Recent Work of Skidmore, Owings & Merrill* (Boston: Birkhäuser, 2000): introduction.

[46] "The Information Explosion," advertisement, Advertising B7, 1960-1961, IBM. As cited in: Alexandra Lange, *Tower Typewriter and Trademark: Architects, Designers and the Corporate Utopia, 1956-1964* (New York University, Graduate School of Arts and Science, 2005).

to-architect and SOM as proto-programmer. The corporation IBM strategically involved design in its business practices and product rollout, including a relationship with the designer Eliot Noyes and collaboration with figureheads of the modern movement including Marcel Breuer, Mies van der Rohe, and Eero Saarinen.[47] SOM in parallel took a turn as computer engineer through the development of software. It was from within this almost inscrutably blurred environment of SOM and IBM's relationship that the Computer Group thrived.

The relationship between SOM and IBM began with a theft of sorts. In 1964, SOM hired Neil Harper, who had previously been IBM's assigned liaison to the architecture firm.[48] Harper transitioned his job as IBM's specialist on architects' needs to SOM's specialist on computer integration. That same year, under the leadership of Gordon Bunshaft, SOM was also employed on the design of the IBM World Headquarters, when the firm grew large and moved from New York City to Armonk, NY. Bunshaft's design was more system than restrictive plan; its proposal focused on "typical areas"—which assigned a system of furniture with associated color palette to generic spaces—and then special designs for unique spaces. The design manual for the IBM project emphasized this flexibility:

> Although it is recognized that the building must accommodate itself to change in personnel and methods of operation, the use of this manual will enable these changes to occur while at the same time maintaining the basic features of the design concept.[49]

SOM had also been hired to develop possible schemes for IBM's expansion within its Armonk campus, which continued this systemic strategy.

SOM and IBM leaders often intersected; in 1968, when Graham presented *BOP* at the Yale Conference, the opening speaker for the event was Frank Skinner, the Manager of Graphic Architecture for IBM. In the 1960s, IBM provided support and collaboration for SOM's architects-turned-programmers; on *BOP,* for example, Teague spent "many phone calls to IBM to determine how the embryonic PLAN

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[47] John Harwood, *The Interface: IBM and the Transformation of Corporate Design, 1945/1976,* A Quadrant Book (Minneapolis, MN: University of Minnesota Press, 2011).

[48] Adams, "Creating the Future," 121.

[49] Owings & Merrill Skidmore and Michael A. McCarthy, "Slide Photograph of 'Design Concept' Binder, IBM Corporate Headquarters King Street, Armonk, New York, 1963," n.d., #6306, Box 50, The Michael A. McCarthy and Skidmore, Owings & Merrill, LLP Collection at Cornell University Library.

[programming language] was supposed to work."[50] In 1969, SOM's Appalachian Conference was hosted at the IBM Research Facility in Sterling Forest, NY; Jack Sams attended to represented IBM. Sams was in part responsible for the second phase of *BOP*—which expanded its capabilities to larger buildings with more complex parameters—because of his development of the IBM's programming language with 1130s, SOM's in-house mainframe.[51] Throughout this period, SOM also developed AES with the help of IBM. In 1981, SOM was hired to create Customer Center Prototypes, an architectural project that—when paired with the original design of the IBM expansion—bookended the relationship of SOM and IBM over computer software.[52]

This partnership that supported the Computer Group also heralded its end. In 1984, negotiations for IBM to purchase *AES* began, re-branded as *SKYLINE*. In 1986, warning bells rang at the office Christmas Party: "SOM is Going to Town," the employees sang, to the tune of Jingle Bells, "You better watch out / Our forces combined / We're making a product / We'll call it SKYLINE."[53] This ominous jingle referred to the sale of *AES* to IBM, the crown jewel of the Computer Group's efforts which brought together past investigations in drafting and modeling into one holistic data management application. After its acquisition, it became quickly apparent that compared to the other products in the field, *SKYLINE* was too expensive and too comprehensive in its scope for the needs of other firms, never sold well, and was ultimately shelved.[54] However, SOM continued collaborating with IBM proving the offices' close relationship; in 1988, *InfoWorld* quoted SOM's Douglas Stoker in an article about the rollout of new products and cited SOM as "the architectural engineering firm codeveloping RT software with IBM."[55]

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[50] Sides, "Notes on Computers," 128.

[51] Ibid.

[52] SOM and Michael A. McCarthy, "IBM Customer Service Center Prototype," 1981, Series VII. Architectural Projects, Commissions, and Built Works 1964-1998 (SOM Years), The Michael A. McCarthy and Skidmore, Owings & Merrill, LLP Collection at Cornell University Library.

[53] Adams, "Creating the Future," 131.

[54] "AES was pricey: between $22,000 and $35,000 for a minimum to typical configuration. Limited though it was to two dimensions, AutoCAD, the "word processor for drawings," cost between $1000 and $2500," Adams, "Creating the Future," 132.

[55] Alice LaPlante and Jeff Angus, "IBM Promises Major Rollouts Will Continue," *Info World: The PC News Weekly*, February 22, 1988.

Within a few years in the mid-nineties, the applications SOM had helped to pioneer would return from the world outside, changed and re-packaged, and infiltrate the office and replace the now-anachronistic customized solutions of the Computer Group. This time side-by-side with their competitors rather than forging ahead, SOM relocated their practice completely from the drafting table to the interfaces of a suite of commercially available programs. Autodesk, today the reigning monopoly on drafting software, rose quickly to the top in early 1990s by targeting and reaching the very same small architectural firms which could not afford AES nor had the resources to self-author applications as SOM had.

II. "Building is a 3D Spreadsheet": Applications of the Computer Group

Over the course of its existence, SOM's Computer Group designed dozens of original programs for use in the office. No complete list exists; only the traces of a few remain through conference papers, references in industry literature on early computer graphics, or by word of mouth. They were created by the various members of the Computer Group during their tenure at SOM, under leaders in different offices including but not limited to G. Neil Harper, Lavette Teague, David Sides, and Douglas Stoker. Some of the applications were in collaboration with outside companies, these included a specification program with McDonnell Automation, a St. Louis based computer services company, and a drafting software with Dynamic Graphics Inc, a company which continues today in Alameda developing visualization tools for industries in "environmental sciences." Overall, these applications for the most part can be seen through three categories: solution-based, representational, and building data simulation.

The first category, solution-based programs, were developed by the Computer Group through the years represented how computing might address the daily minutia which occupied any architecture firm. They open a small window into the range of issue that SOM's architects and engineers were tackling during these decades. Teague's memo from '69 challenged the office to re-think the "design process," making change by implementing "different kinds of personnel, procedures, and organization"; however, a large quantity of early programming efforts remained in isolated disciplines, simply making speedier a task already at hand. They included the handful Graham presented at the '68 Yale Conference, such as *Auto-*

Spec (1965), *Truck Turning Problem, Auditorium Layout.* Others included a computational automation of the design of stair dimensions, given certain parameters, or the layout of fire sprinklers in a ceiling plan.[56] Others, which were developed for the management side of the office, included *Project Return on Equity Program (PREP)* and *Man Power Allocation and Personnel Program (MAP).* These programming projects often seemed to be an exercise in translation between architectural language and the computer's; "We did a lot of work on problem oriented languages," said Sides, "how to describe a problem in architectural terms and have a computer understand what you really meant." While these programs of this kind were unique to SOM and authored at the firm, similar tasks were being achieved at some of firm's rivals such as HOK and DMJM.

The office also tasked the Computer Group to develop a series of drafting and representational tools; these programs attempted to transition both the documentation and visualization of buildings to the computer screen. These included the *DRAW2D* (1975) developed by Bill Kovacs; *DRAW3D* (1977), its successor, developed by Nicholas Weingarten, and *DRAFT* (1981) by Mirsante and Huebner. These programs, in terms of their technical development, hinged most on the development of computer graphics occurring in parallel to SOM's research. Their scope spanned into the marketing wing of the firm, such as the creation of nine flythrough videos featuring the building designed by SOM in major cities including Chicago, New York, San Francisco, Portland and Boston. SOM's towers are wire-framed in sparkling blue; the rest of the city in a putrid yellow.[57] (Fig. 3.2)

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[56] Sides, Interview.

[57] Peter Little, *9 Cities by Skidmore, Owings & Merrill 1984.* Scanned from the Original 16mm Film, 1984, http://vimeo.com/93315120.

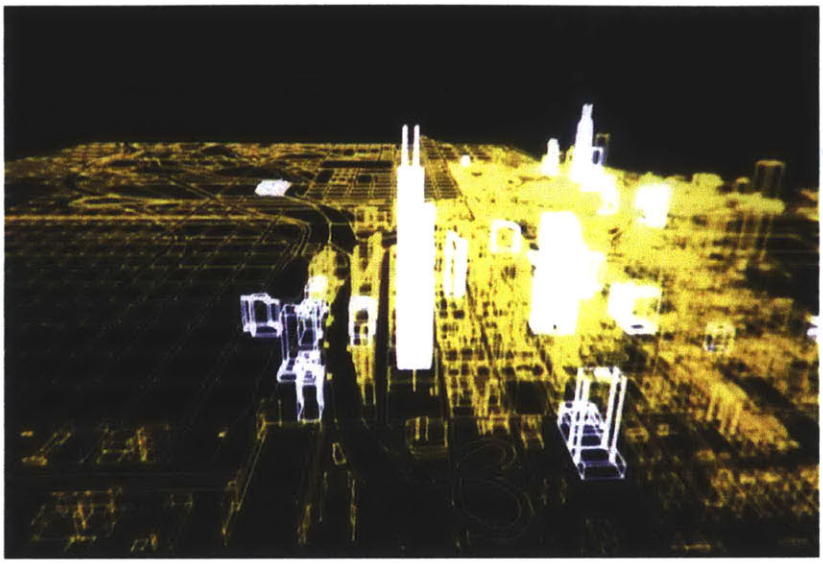

Fig. 3.3 Screenshot from "9 Cities," 1984

The applications that were most unique to SOM were those that reflected the office's ongoing work circling frameworks of efficiency and interest in the complete automation of a building's design. "A building is a 3D spreadsheet," was one of Douglas Stoker's aphorisms.[58] A series of programs developed by the Computer Group reflected ongoing research into not only how to make the process of design *faster,* but also to manage larger scales of information and their relationships at a speed and complexity unable to be done by humans alone. Twenty years before the Computer Group, one of SOM's eponymous founders had already begun to speculate on the possibility of design-by-data, specifically for the tall office building. "[The Office Building of Tomorrow] is arrived at through studying the behavior patterns," mused Nathaniel Owings in 1947 in *Skyscraper Management*, during SOM's period of collaboration with architectural publications. "[From] the actual physical and emotional cycle for each of the basic types of occupant—by this research we establish the criteria for the space, means of access to it and materials and mechanical devices that will serve it."[59] Owings believed that from statistical research on a building's future occupants would lead to a bettering of the "physical and psychological" well being of the tenant. In the following decades, the Computer Group, seeded with IBM's employees, hardware, and method of

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[58] Adams, "Creating the Future," 136, note 68.

[59] Nathaniel Alexander Owings, "The Office Building of Tomorrow," *Skyscraper Management*, September 1947.

thinking, brought information management to bear on architectural design and married it to Owing's dream of a corporate metropolis. In *Engineering Architecture,* Yasmin Khan, Fazlur Khan's daughter and biographer, reflects on how her father realized the potential for the computer to handle "complex illogical systems" did not mean those were the directions the office should take; instead, he argued for a "systems approach" which focus on optimization across disciplines.[60]

This approach began with *BOP* (1967), which went through a series of iterations including under Teague, who expanded it to work with larger scale buildings (above 40 floors) and to incorporate more mechanical and structural engineering factors. *BOP* was followed by a series of more discipline-specific programs, which nonetheless still attempted to play out architectural design through accumulation of data and synthesis. These were *Planning and Land Use System (PLUS)* (1969), which deployed BOP's analysis for urban-scale issues by breaking down taxes, mortgages and rental profits to find an optimized mix of programs on a large site.[61] A characteristic example of this kind of attempt to use computer architecture holistically was the program: *Storage and Retrieval of Architectural Programming Information (SARAPI)* (1972). *SARAPI,* a data management system for interior design, was designed to streamline the commercial office furniture layout and space allocation process. It also began to embody Owings' interest in individualized and flexible office space that he had expressed in his writings two decades previous. Developed by Computer Group members Lavette Teague, Turley, Breitman, Davis, Milliken, *SARAPI* was used during a phase called "Programming," in which SOM designers interviewed their commercial client's employees and developed a space plan in which to accommodate their needs. *SARAPI* mechanized the organization of this large data set. Teague had previously developed a similar program for hospital equipment layout, and adapted it to broader uses.[62]

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[60] Khan, "Engineering Architecture," 186.

[61] Teague, Sommerfeld, Sutphin, and Harper, "Computer Systems for Urban Design and Development," *Journal of the Urban Planning Division, Proceedings of the American Society of Civil Engineers,* April 1971.

[62] SARAPI drew, in part, from a program called *TABLE* that Teague developed at SOM as an "outgrowth" of his master's thesis. (Teague, "Memoir", 6).

A publication on *SARAPI* remains at MIT, the alma mater of some of its creators.[63] On the header of the *SARAPI* worksheets is a logo for "SOM Systems," a lingering trace that, for a moment, alongside Architecture, Structures, and Mechanical Engineering, "Systems" was a discipline in which SOM invested time and personnel. *SARAPI* was designed to compile the outcome of interviews from "selected people in the company" for "each workstation." Everyone in client's business was cataloged, from President, to Secretary, to Clerk Typist, even including, cyborg-esque the "Telex Computer Terminal[s]." Categories of data to be input by the architect included "Group Enclosure Type": with options of "Open, Semi-Enclosed, Semi-Enclosed Shared". Others were "Movability" and "Communications Function"; these included options such as "ANS: Answers telephone immediately"; "FIL: Filters call for someone else"; and "DAN: Default Answerer." *SARAPI*'s output cataloged square footages based on SOM layout "Types," featuring different workspace combinations. SARAPI reflected the ideology of corporate morale, of "human relations,"[64] that paired with optimization of office life with the organization of furniture and space planning. (Fig. 3.4)

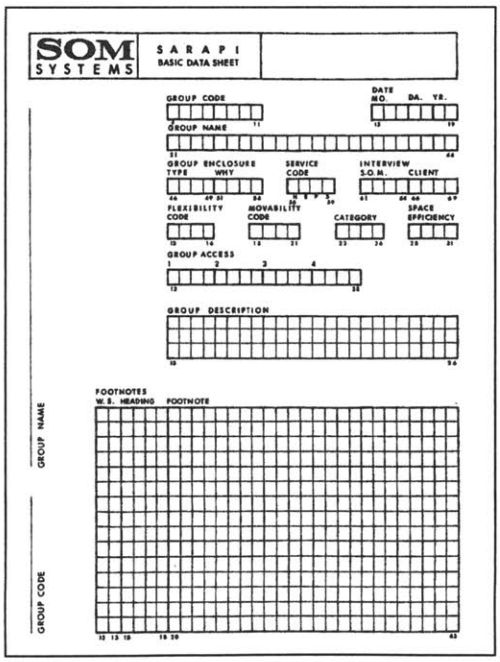

Fig. 3.4 SARAPI, by SOM Systems, 1972.

[63] Skidmore, Owings & Merrill, *SOM Systems- SARAPI* ([S.l: Skidmore, Owings and Merrill, 1972

[64] Citation from Org Complex about Harvard Business school research on affiliation with corporation

The design of the SARAPI tool responded to a need to quickly design highly flexible office spaces which could accommodate shifting needs of clients from the era: industrial (Inland Steel), government (Census Bureau), pharmaceutical (Boots), and more. On one hand, SOM likely invested in its development because it promised long-term efficiency and reduction of man-hours. However, with this efficiency came something else, a shift reflected by the changing office practices in SOM's clients. Graham perceived this shift in the desires of his clients:

> That's what happened to Sears. [...] when Sears got sophisticated they needed to get a higher quality of people. But when you have to compete for people with Tommy Reynolds's firm, Mayer, Brown and Platt, or Sonnenschein, Nath and Rosenberg, or Skidmore, Owings and Merrill, or the banks, then Sears couldn't make it.

As Sears moved downtown, literally, it hired SOM to create a "higher quality" office environment. SOM projected itself into a roster of companies that offered such luxurious workplace architecture. In *The Organizational Complex,* Reinhold Martin made an argument that in the post-war period, office efficiency became tied not only to cost and flexibility of the space but also to "human relations," "a name given to the attempt to improve productivity by appealing to the employee's sense of identification with the corporation."[65] *SARAPI* tool focused both on the efficiency of all interviewed workers in the layout of a space, as well as on their individual functions within the company.

Stoker's figurative spreadsheet, as the meta-data for tools like *SARAPI* shows, was not a reduction of a building's inhabitants to numerical values but rather an attempt to manage more complex architectural data to create a "vertical township," in which the employee lived in a thriving city of his company. In *The Architecture Machine,* Negroponte theorized about this kind of affordance: "Machines [...] are devices that can respond intelligently to the tiny, individual, constantly changing bits of information that reflex the identity of each urbanite as well as the coherence of the city," he wrote.[66] SOM's *SARAPI* software, as well as *BOP* and others, began the road towards BIM—the possibility of live-time, multi-nodal, architec-

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[65] Reinhold Martin, The Organizational Complex: Architecture, Media, and Corporate Space (Cambridge, Mass.: MIT Press, 2003): 91.

[66] Nicholas Negroponte, *The Architecture Machine: Toward a More Human Environment* (Cambridge, Mass: The MIT Press, 1973).

tural imagining which might allow a building's many variables to respond to a complexity of information stemming from its future users, its urban and governmental context, and material limitations.

III. Computational Logistics: Prosthetic aids for architectural optimization

Architects-as-programmers operating under the aegis of large offices came to an end in the late '80s, heralding the beginning of a new era of commercially available drafting software. Founded in 1982, Autodesk rose quickly in the market gap to the top with their flagship program AutoCAD by targeting and reaching the small architectural firms with limited budgets and drafting and documentation needs. Other independent software companies emerged to compete including McNeel, which an developed AutoCAD-based modeling that allowed for the modeling of free-form and curves-based surfaces, released independently in 1998 as the program Rhinoceros. SOM's Computer Group dispersed and continued to pursue digital applications for architectural design. This includes Maya, a program from Alias|Wavefront, a company responsible for movie "CG [taking] a leap forward" including science fiction films such as *Stargate* (1994). Wavefront Technology, which was acquired in 1995 to become Alias|Wavefront, was co-founded by Bill Kovacs a former leader of SOM's Computer Group.[67] Bruce Graham, in an oral history, remembered this with pride: "Faz got two young computer guys who were just terrific. The two of them quit us to work on *Star Wars*, after they were doing advanced graphics and other phenomenal stuff for us."[68] Graham's memory of science fiction films may have faltered—he likely meant Kovacs and *Stargate*.[69] However, this narrative that begins in the building industry and ends in the cinematic imagination overturns the popular idea that architects drew from Hollywood's tools for their own ends.

Yet with the onset of "big data," embedded once again in the conversation are the echoes of what was heard early in SOM's pioneering digital applications: a shift from mechanization to simulation on the bootstraps of computation. Architects appear, after a brief lull, to be re-taking the reins in creation of the

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[67] Quote from "Bill Kovacs, 56; Shared an Oscar for Work in Computer Animation." *Los Angeles Times*, June 4, 2006.

[68] Betty J. Blum, *Oral History of Bruce John Graham*, 1998, Chicago Architects Oral History Project: 154.

[69] Emails with Peter Little and interview questions to other Computer Group were not able to produce any names of employees who left SOM to work on *Star Wars*.

digital tools used in architecture production; their aims once again focus on moving beyond replicating analog methods in computer space. In 1994, when Gehry Technologies was founded, Frank Gehry critiqued architectural computer programs for remaining tethered to an analogous "paper-based, two-dimensional world."[70] The stakes, perhaps, also extend beyond architectural representation; Bruno Latour critiqued the architectural profession for remaining with analog "Euclidian space," deluded by static images in "glossy magazines" of buildings without recognizing their perpetual movement and complexity of behavior.[71] Captured in how buildings are produced are also how they are perceived and engaged.

SOM's early computer investigations, bolstered by IBM, were certainly limited. Yet it crystallized a moment in the office that revealed the experimental logistics that undergirded the office's prolific production of tall towers. In his paper on *BOP,* Harper mourned that only the rare few architects were able to propose, sort through, and synthesize the vast number of possibilities for a building that any site provoked. Yet he saw *BOP* as the next stage in the architect's evolution toward a perfectly optimized building. "It is conceivable," Harper wrote, "that these as yet unexplained human abilities can be extended and magnified if proper use could be made of appropriate computer techniques dealing with information processing."[72] The average designer, through computational logistics, could be elevated to genius.

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[70] "New Gehry Technologies Will Enable Many to Boldly Go Where Only Frank Has Gone before." *Architectural Record,* October 2003.

[71] Bruno Latour and Albena Yaneva, "Give Me a Gun and I Will Make All Buildings Move: An ANT's View of Architecture," in *Explorations in Architecture: Teaching, Design, Research* (Basel: Birkhäuser, 2008).

[72] Harper, "BOP," 575.

Post Script

Architecture Extra-Normal: Rethinking Tafuri and The Bureaucratic Avant-garde

Manfredo Tafuri's "Toward a Critique of Architectural Ideology"[1] was received, according to Michael Hays' introduction to the text, as the "pronouncement of the death of architecture."[2] Published in 1969 in *Contropiano,* Tafuri's text reveals a bleak view of architecture that, in the text, is facing a total dissolution into the capitalist city. Tafuri's "metropolis" in which the crisis unfolds is that of Georg Simmel[3]—consumerist, blasé, and driven by "accelerated rhythms of use"—a city that has become "a machine for extracting social surplus value" which reduces architecture, and its occupant, to "a mere moment in the chain of production." The architectural avant-gardes, to whom one might have looked for extraction from this metropolitan condition, are according to Tafuri part of the problem. The 20th century avant-gardes had become engaged in the task "internalizing" and accepting the "shock" of the city, embracing it as an "inevitable condition of existence."

Those powers responsible for shaping the capitalist metropolis were the product of conflicts between the individual and technology, and ultimately "the victory of technological progress." Tafuri's specific concerns in the twentieth century are captured in his description of the city as an "absurd machine." He argues that the "forms and methods" of industry—the "assembly line" and the "standardized part"—have become the invisible but formulaic blocks of the metropolis.[4] While Tafuri reaches back to the Enlightenment to begin his theory, he situates the beginning of the contemporary conflict at 1929: the moment when "the plan came down from the utopian level and became an operant mechanism."

1929 is also, in a way, the moment in which SOM's story began in this thesis. The same crisis, cited by Tafuri as finally concluding the prolonged battle between socialist utopia and capitalism, opened an odd rift in architectural practice at the Century of Progress, a chasm of spectacle and carnival, from within

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[1] Manfredo Tafuri, "Toward a Critique of Architectural Ideology," *Contropiano* 1 (April 1969).

[2] K. Michael Hays, *Architecture Theory since 1968,* (Cambridge, Mass: The MIT Press, 2000).

[3] Georg Simmel, "The Metropolis and Mental Life" (1903) in Gary Bridge and Sophie Watson, eds. *The Blackwell City Reader.* (Oxford and Malden, MA: Wiley-Blackwell, 2002.)

[4] "The forms and methods of industrial labor became part of the organization of design and were reflected in the proposed use of the object."

which SOM's practice was born. In the following decades of the practice, the office seems as if it would be to be a worthy target for Tafuri's critiques of architecture and its capitulation to the technological and capitalist city. Tafuri points to techniques of industry applied to the city; these echo with the influence of factory practices on SOM's mass-production of defense housing in World War II from Chapter 2. Tafuri also cites a new apathy towards architectural form. He points to the 19th century English gardens in which all types of landscapes and architectures are resurrected, like a zoo, samplings of Hindu and Gothic styles amongst the Romantic, an accumulation of "little temples pavilions and grottoes." He argues that architecture has reduced form to either "typology" or "*architecture parlante.*" This banal dichotomy of either the generic or the superficially expressive may for some also resonate with the strategies of SOM's World War II housing: the cloned house with an additive porch or chimney to signal a local feel, driven by the ideology of low-cost and efficient construction in the name of patriotism. The project described in Chapter 3, from the Computer Group called *PLUS*, which attempts to distribute land parcels most profitably according to occupancy, mortgages, rental rates and zoning, resonates with Tafuri's critique of the city as an "instrument for coordinating the cycle of production-distribution-consumption."

Tafuri picked up on Henry-Russell Hitchcock's opposition between the architecture of bureaucracy and the architecture of genius. "A true and proper 'architecture of bureaucracy' settled in everywhere," he wrote in *Modern Architecture* with Francesco Dal Co, "But this was no deliberate emphasis on elementals attended by a tragic self-awareness [...] The field came to be dominated not by individual architects intent on communicating their opinions of the world but by large studios in which the tasks were parceled out with virtual assembly-line standards [...] equipped to work at an intense speed of production and to fulfill demands for high technological levels in buildings as anonymous as the architectural concerns that build them."[5]

However, before resigning the practices of bureaucratic architecture to the desolation of the capitalist metropolis, perhaps we should look closer at Tafuri's note that this development was *not* attended by "self-awareness," tragic or otherwise.

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[5] Manfredo Tafuri and Francesco Dal Co, *Modern Architecture / 1* (New York: Electa / Rizzoli, 1991).

A term which appeared in both Chapter 2 and Chapter 3 which might ply the relationship of SOM to Tafuri's machinic city is: "extra-normal." In Chapter 2, it referred to a publication by SOM in 1940 in *Architectural Forum,* in which the editors of the journal sent the nascent firm a collection of typical low-cost house plans from around the United States and asked Skidmore, Owings & Merrill to "study" and "resolve" them into a single house. The editors' premise was: "If all the low cost house designers in the country got together, compared their floor plans and combined the best features of each in one composite plan, the result would be only slightly different from most of the originals but would certainly be worth building, worth standardizing."[6] The Architectural Forum Defense House prepared by SOM was not so different from the prototypes SOM created for the John B. Pierce Foundation, which served as a foundation for different iterations across the country. In Chapter 3, the idea of the extra-normal returned for the program *BOP,* which rather than focusing on low-cost and construction efficiency, proposed the use of computer automation to create the commercial office tower with the highest return on investment. Both efforts to optimize—in one case, the defense house, in the other the office building—resulted in projects that had an odd sense of being overly familiar to the contemporary eye. While in some ways these experiments were apathetic to form and style—*BOP* explicitly so—their results are buildings that seem to be an almost unbelievable average, a quintessential synthesis, of their type. O'Hare Plaza, *BOP*'s first output, is more camouflage than real thing: it is a building pretending or wearing the guise of what an office building should look like.

Tafuri's critique of the avant-garde is situated in the use of ideology. The "task" of the avant-gardes of the twentieth century, he writes, was to "remove the experience of shock from all automatism," and smooth over conditions of the city and instead to "involve the public, as a unified whole, in a declaredly interclass and therefore anti-bourgeois ideology." This use of ideology, in art and architecture according to Tafuri, to conceal the way that it, in fact—as paraphrased by Hays—"usher[s] into being the universal, systematic planification of capitalism, all the while concealing this fundamental function behind the rhetoric of its manifestos and within the purity of its forms." SOM's deployment of the extra-normal

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[6] "The Architectural Forum Defense House by Skidmore, Owings & Merrill, Architects," *Architectural Forum,* November 1940: 444-449.

could be read, however, as a potentially more subversive engagement with Tafuri's neo-liberal city, to use today's word. Rather than attempting to *conceal,* instead, the architecture of these projects are a black mirror which consumes, synthesizes, and reproduces in distilled form the conditions from which they emerge. For the architecture of the extra-normal—the bureaucratic avant-garde—the ideology at play is the ideology of the metropolis itself.

"The problem is now the only way left in the search for the authentic is the search for the eccentric," wrote Tafuri. Yet, just as in SOM's 1940 Architectural Forum Defense House, which intended to merge and re-configure a collection of low-cost house plans into one—not better, but *more* average—home; or in the *BOP's* bottom line, which attempted to parse all possible commercial office buildings to find the most financially productive one; SOM was not on the search for the "authentic" *or* the "eccentric." Instead, these tests throughout the decades of experimental logistics and the subsequent architecture produced through these protocols were in pursuit of the extra-regular and consequently, the optimized.

In Tafuri's conclusion to "Toward a Critique of Architectural Ideology," he writes: "This is why there can be no proposals of architectural "anti-spaces": any search for an alternative [...] is an obvious contradiction in terms." We cannot, according to Tafuri, look for anomalies, for avant-gardes who escape or operate outside of the status quo. What SOM's experimental logistics provide for us is way to analyze architecture that attempts to do leverage and deploy the machinations of the metropolis itself. The historiography of the firm often creates crisis from the "faceless glass boxes" now ubiquitous across our cities; a closer look asks if these ever-so-normal looking projects have in fact the unique ability to reflect upon their conditions with more poignancy than those who pretend to escape.

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