

Prefabrication and the Postwar House: The California Manifesto

MATTHEW W. FISHER
Iowa State University

In July 1944, a year prior to the cessation of World War II, the California-based journal *Arts and Architecture* published what was in essence a manifesto on the 'post-war house' and the opportunities and necessity for prefabrication. This was largely the work of John Entenza, publisher and editor of *Arts and Architecture* since the late-Thirties, and his editorial assistants, Charles and Ray Eames, with significant contributions from Eero Saarinen, and Buckminster Fuller, among others. Entenza and his editors were fully aware at the time of the pent-up demand for new housing that awaited the end of the war. Furthermore, they had come to realize that the post-war house, when it was finally built, would be produced in a fundamentally different way than the pre-war house given the social, economic, and technological changes that had emerged with the war effort. With the *Arts and Architecture* manifesto, and the subsequent initiatives of the magazine, including the Case Study House Program, Entenza and the Eames were trying to link the new technical possibilities, in particular that of factory-based prefabrication of new materials and assemblies, to the idea of the "modern house" in an effort to define the direction of post-war housing.

I. PREFABRICATION AND THE IDEA OF THE POSTWAR HOUSE

In his "Notes in Passing" preface to the July 1944 issue of *Arts and Architecture*, John Entenza introduced this manifesto on prefabrication and the postwar house, linking the idea of 'house' to the most basic of human needs:

"First, we must concern ourselves with the material facts of living. Among those facts, perhaps the most important, because it is the principal and most intimately connected with environmental conditioning

of human beings, is everything we mean when we say the word "HOUSE." It is here that we come closest to the heart of man's existence; it is here that he hopes for the satisfaction of his most human needs; it is here that he strikes the firmest roots into the ground; it is here that he achieves his strongest sense of reality not only in terms of things but also in terms of fellow human beings. It is first then to "the house of man" that we must bring the abundant gifts of this age of science in the service of mankind, realizing that in the word "HOUSE" we encompass the full range of those activities and aspirations that make one man know all men as himself."¹

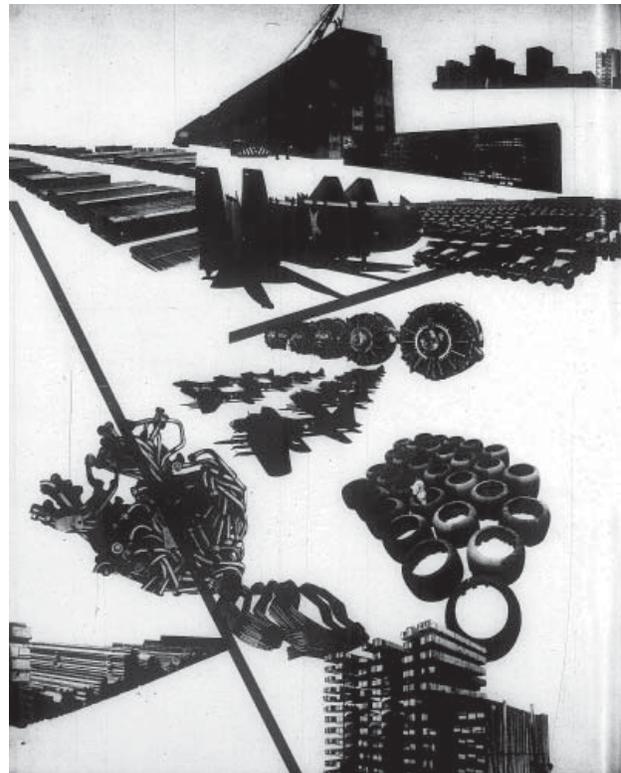


Figure 1. "Mountains of Material", from *Art & Architecture* July 1944, p. 26.

The single-family house had become a focal point by war's end for the hopes and aspirations of Americans,² having survived the Great Depression and then the mobilization of the country for World War II. A house of one's own would be the reward awaiting returning veterans and those who manned the production lines back home. The same resourcefulness and ingenuity that had served the country so well at war would be applied to the postwar house, transforming it into a modern, convenient, and affordable machine for living.

Entenza and Eames reached the conclusion by early 1944 that the idea of the modern postwar house would best be served by taking advantage of the new science and technologies emerging from the industries in the war effort.

"We are concerned with the house as a basic instrument for living within our own time; the house as a solution of human need for shelter that is structurally contemporary; the house that above all takes advantage of the best engineering techniques of our highly industrialized civilization. ... The point we make, at the moment, however, is that NOW is the time in the world when all necessary circumstances and conditions exist in such relationship to one another that we can attack, on an inclusive, over-all scale, the problem of mass housing with better than good chance for success."³

The key strategy in their thinking was prefabrication, the application of the same industrial technologies used to supply the war and save lives to the production of low-cost houses (Fig. 1). The war had created new production techniques, new materials, and new industrial expertise that could be marshaled in prefabrication to rationalize the construction of the postwar house.

"Prefabrication in the truly industrialized sense is a very special approach to the problem of the 'house' - an approach made possible NOW, for the first time, when industry, research and material exist in the right relationship to one another, making possible an intelligent application of these resources in the needs of housing."⁴

The prefabrication manifesto of John Entenza, the Eames, Eero Saarinen, and Buckminster Fuller, is thus a call to arms on behalf of the postwar house. The particular circumstances of the time - the development of new materials and technologies, the substantial need for housing, and the desire for a better, modern life in the wake of the war, created the opportunity and necessity to promote a new

approach to the design and construction of the house based on prefabrication. It wasn't intended to merely address short-term demand. It was going to be the way of the future:

"The big concept of industrialized housing is not to be considered in any way as a stop-gap or tide-over. It is a way of life, in which all of the genius and accomplishment of the past can come together for the purpose of expounding and enriching the life of each individual and each family."⁵

Prefabrication, in other words, would become the basis for a new architecture.

II. CALIFORNIA MODERN

It was to John Entenza's credit that he recognized the potential of these new technologies of production, in particular prefabrication, and its potential benefit to architecture in general, and housing in particular. It must be remembered, however, that there was already a tradition of experimentation with materials and construction among California architects, particularly in the Los Angeles region. This was evident in the early work of Rudolph Schindler and Richard Neutra, both emigres from Europe who arrived in Los Angeles in the early 1920s. Schindler's House on Kings Road (1921-22) was a groundbreaking work of modern architecture, whose innovations included the use of a tilt-slab wall system (an on-site prefabricated concrete panel system that Schindler had learned from local architect Irving Gill) and a new timber framing assembly to allow for large wall openings and clerestories, integrating the house with its gardens. Schindler would continue to develop the concept of modular building in later projects, and published an article on prefabrication in *Arts and Architecture* in 1943.⁶

The spatial and material experimentation of Schindler in the Schindler-Chase House set an early precedent for modern California architecture, one that would be followed by subsequent architects. Richard Neutra, in his first major work in Los Angeles, the Lovell Health House (1927-29), introduced lightweight steel framing arranged in a modular frame, allowing for the use of standardized window/wall units. "The frame was composed of 4-inch H-columns and open-web bar joists," notes Esther McCoy. "Into the frame was inserted factory-assembled wall units. The module was based on the standard steel casements 3-feet 3-1/2" wide;

space between the columns were the width of two triple casements.”⁷

The Lovell House was one of the earliest houses to incorporate steel in its construction, and through its usage to define a new form of architectural expression, emphasizing the structural frame. Neutra was committed to the use of steel for structure and other shop-fabricated components as means of making high-quality yet affordable buildings, but he was ahead of his time. Material options were greatly limited during the Depression, and Neutra was forced to turn his attention to more readily available materials through much of the '30s. Nonetheless, he continued to explore the usage of new industrial materials in designs for popular competitions and exhibitions, such as his 1936 Plywood Model Demonstration House, which was built as part of a building materials exhibition in Los Angeles. Incorporating plywood panels held in place with metal clips, the building was easily disassembled at the end of the exhibition and moved to a site in Westwood near UCLA.⁸

Following the examples of Schindler and Neutra, architects such as Gregory Ain and Raphael Soriano continued the exploration of new building materials and assemblies in pursuit of a modern, low-cost and high-quality architecture. Both had worked or studied with Schindler and Neutra before pursuing their own practices. Ain became interested in the design of low-cost housing in response to the Depression in California, exploring the use of prefabricated panels in plywood and concrete to construct modest, yet modern, dwellings. Soriano had also absorbed Neutra's interest in prefabrication and the use of the latest technologies, focusing in particular on the potential of steel framing and prefabricated panels in his house designs of the early '40s.

III. ARTS AND ARCHITECTURE

Under the new ownership and editing of John Entenza, the California journal *Arts and Architecture* became a champion of these efforts, publishing the work of California's best modern architects, as well as others from around the world. This re-focusing of the magazine on modern art and architecture can be credited to Entenza's own vision, and his proactive incorporation of some of the best modern architects in Southern California on his editorial board. These included Harwell Harris (1939),

William Wurster (1940), Gregory Ain (1941), and Charles Eames and Richard Neutra in 1942. Charles Eames in particular, in collaboration with his wife Ray Eames, was to have a significant impact on both the direction and look of the magazine.

With the onset of World War II, *Arts and Architecture* became increasingly interested in the issue of housing, and the potential impact of new materials and the emerging technologies of prefabrication. This was first evidenced in the announcement in April 1943 of the "Designs for Postwar Living" competition, explicitly framed as an exploration of emerging technologies in the design of a modest house. Entenza's interest in promoting this competition may well have been inspired by the 1942 competition sponsored by the New York based journal *The Architectural Forum*, "The New House 194X", announced in September of that year.⁹

Seven months later *Arts and Architecture* announced its own competition, "Design for Postwar Living", publishing the winners and other notable projects in successive issues beginning in January of 1944. Judges for the competition included Richard Neutra, Gregory Ain, and Charles Eames. The winning scheme was authored by Eero Saarinen and Oliver Lundquist; second place went to I.M. Pei and E.H. Duhart, fellow students at the Graduate School of Design under the direction of Walter Gropius, while third place went to Raphael Soriano. All three schemes incorporated prefabricated elements, but Pei and Duhart's and Soriano's schemes went farther in this direction. Pei and Duhart's entry incorporated a prefabricated service core integrating mechanical, kitchen and bathroom, as well as an unspecified prefabricated exterior panel system hung on a frame. Soriano's scheme was more controversial, proposing a prefabricated and additive building module with a wrap-around plywood skin that integrated a corrugated plywood truss. Although awarded third place, Ain was critical of Soriano's scheme, diverging from the jury who "evidently thought it good propaganda for prefabrication."¹⁰ Ain had been a long-time proponent of prefabrication in his own work and writings, but was concerned about the direction it would take within the profession. "We need no reiterations of the inevitability of prefabrication," he said, but "we do need plans worth prefabricating."¹¹

In July of 1944, only three months after publishing

the last projects from the 'Postwar Living' competition, Entenza and his editors published the prefabrication manifesto in *Arts and Architecture*. This was followed in September by the announcement of the magazine's "2nd Annual Competition for the Design of a Small House," sponsored by the United States Plywood Association. Once again, the magazine was looking for buildable projects incorporating the latest materials and technologies, prefabrication foremost among them.

Throughout this period in the early '40s Entenza published a range of projects and buildings in the pages of *Arts and Architecture*, acting as a strong advocate for a modern architecture that took advantage of the new materials and technologies emerging from the war industries. But the design competitions and the special issue on prefabrication were ultimately limited in their impact, given the weak state of the building industry during the war. By late 1944, however, it was clear that the war would soon come to an end, and that wide-scale house construction in the US would begin again. The question was: who would define the postwar house? If Entenza was going to have any significant influence on this question, it would be necessary to move beyond publishing and into the realm of action.

It was thus in January 1945, only a few months after publishing the call for the 2nd *Arts and Architecture* postwar house competition, and still seven months prior to the end of the war, that Entenza and his editors announced the Case Study House Program.

"Because most opinion, both profound and light-headed, in terms of post war housing is nothing but speculation in the form of talk and reams of paper, it occurs to us that it might be a good idea to get down to cases and at least make a beginning in the gathering of that mass of material that must eventually result in what we know as 'house - post war.'" ¹²

IV. THE CASE STUDY PROGRAM: RE-DEFINING THE MODERN HOUSE

The Case Study House Program has been well documented by numerous authors since its inception in January 1945. Under the leadership of John Entenza, the program would come to define for many the ideal of modern living in Southern California, presenting a series highly sophisticated, yet afford-

able, prototypical modern homes for the 'average' family. While limited in their overall impact on the broader housing industry in the period after the war, the Case Study houses came to epitomize the idea of the 'Modern', postwar house in this country, more so, I would argue, than the rarified houses of Mies and Johnson back East.

The idea of the 'Modern', postwar house among California architects was fundamentally rooted to the concept and strategies of prefabrication, including the use of new materials, new assemblies, and factory-based mass-production. Many of the houses that filled the pages of *Arts and Architecture* between 1949 and 1960, including the Case Study Houses, can be characterized by the incorporation these new technologies, and the modular arrangement of space, structure, and cladding that they required, in combination with the architectural characteristics of the pre-war modern California house as conceived of by Schindler, Neutra, Ain, Soriano, and others: open, flexible spatial arrangements, continuity between interior and exterior spaces, adaption to sun and climate, and the clear, straightforward expression of materials and structure.

The significance of this integration of new industrial materials, such as steel, glass, plywood, and plastics, with strategies of prefabrication and mass-production, and the familiar characteristics of Southern California modern architecture, can best be understood through comparison. Pierre Koenig's Bailey House, Case Study House #21 (1957-8) in the Hollywood Hills of Los Angeles, is widely considered to be the most refined and uncompromising of the steel frame Case Study houses. Considered in relation to Mies van der Rohe's Farnsworth House (1945-51), located in the flood plain of the Fox River, Plano, Illinois, reveals a fundamentally different vision of the modern house, whose implications reverberate still today.

The Farnsworth House is 'house' as a work of art in clear-span structure (Fig. 2). "Certainly the house is more nearly a temple than a dwelling," writes Franz Schulz, in his *Critical Biography*, "and it rewards aesthetic contemplation before it fulfills domestic necessity."¹³ Indeed the house makes few concessions to the demands of daily life, to the course of the sun, to the movement of air. It is primarily a vessel to look at, and look out from. Articulation of the structure is foremost: eight ro-



Figure 2. Farnsworth House, from *Mies in America*, p.347

bust wide-flange columns are arranged in a three bay, twenty four-feet by thirty-feet grid, supporting and separating floor and roof plates exactly nine-feet six-inches apart. The columns are welded to a robust steel-channel, which acts as a fascia wrapping the outer edge of both floor and roof, scaled to eliminate all visible deflection in the plates. This is further assisted by the decision to cantilever the floor and roof plates one-quarter bay beyond the end-columns at both ends.

The columns also serve to lift the whole structure more than five-feet above the flood plane of the Fox River, setting the building on an invisible podium of air. Enclosure is glass, floor to ceiling, set in barstock steel frames, with one double-door on the western face. But even the glass walls are conceived of in terms of structure. Mies wrote in 1933, seeming to anticipate this later work, that "the glass skin, the glass walls alone permit the skeleton structure its unambiguous constructive appearance and secure its architectonic possibilities."¹⁴

Case Study House #21 (the Bailey House), on the other hand, is 'house' as a work of industrial design (Fig. 3). "Case Study House #21 represents a form of culmination of development of the steel house," reads the description in *Arts and Architecture*,

"as it represents the epitome of architectural refinements in planning and execution, in a material heretofore considered experimental. By utilizing

readily available steel shapes and products in a carefully conceived manner, a finished product comparable to any other luxury home is achieved minus the excessive cost usually associated with quality and originality."¹⁵

Koenig had been investigating the potential of low-cost steel construction since his days as a student at USC, when he built his first steel house for himself, working closely with the steel, window, and other product manufacturers to rationalize the design and bring the costs down. He put this accumulated knowledge to work on CSH #21, a modest house of 1,320 square feet for a young professional couple. The structural plan is a simple rectangle, composed of four steel bents, 44-feet long and 9-feet high, which were manufactured off site and delivered complete for quick assembly. The bents were full rectangles, spaced 10-feet apart to form the main structure, with another three bents half as long added to create a carport and entry. The columns are 4-inch H-sections, while the beams are 8-inch I-sections. As Koenig notes, it is "a very pristine, clean design. Two details, one north-south, one east-west. One material for the roof, same one for the walls. Minimal house, maximum space."¹⁶

The house is sited according to the cardinal directions, with east and west sides fully enclosed with panels of steel decking for reasons of privacy and sun control, while the longer north and south faces are fully transparent with four sliding glass doors, two to a side, and welded directly to the steel frame. The south-facing doors are equipped with external Koolshade screens to reduce excessive sun penetration and heat gain, while the north-facing doors are clear. Services – two bathrooms and a mechanical closet – are encapsulated in a core volume running north south, separating the public spaces in the plan from the private bedrooms, and incorporating a small exterior court with a fountain. The water element is extended to the exterior, with a 4-foot wide channel pond that runs around the perimeter of the building, bridged by brick terraces at door openings that are continuous with interior floors. The water serves as a counter point to the crisp steel frame and cladding, and as part of an innovative environmental system which pumps water up to the roof level, where it falls back through scuppers into the channel pool, aerating the water and providing some cooling through evaporation.



Figure 3. Case Study House 21, from *Pierre Koenig*, p. 49.

Case Study House #21 thus succeeds in integrating a cleanly articulated structure, factory supplied industrial materials, and off-the-shelf components, with a thoughtful response to climate and context, an integration of building and landscape, and all in a prototypical design for the prototypical family. This is what so impressed Reyner Banham about the Case Study Houses, particularly the steel houses of Pierre Koenig: they were rigorously modern, but in an un-monumental manner, in contrast to the houses of Mies and Philip Johnson back East.¹⁷ Designed to meet the demands and opportunities of the postwar era, Koenig’s Bailey House nonetheless belongs to the tradition of the modern California house that extends back to the early works of Schindler and Neutra.

V. CASE STUDY FOR THE 21ST CENTURY

From our current perspective, however, what should be recognized about the Case Study Houses, in particular from the period 1948 to 1960 – including houses by Eames, Neutra, Soriano, Ellwood, and Koenig – is the extent to which they can also be considered to offer precedents for sustainable house design today. This can perhaps be clarified with a second comparison, this time between a very recent and notable work, the Loblolly House (2006) by Kieran Timberlake Associates, and that most well known house of the Case Study Program, the Eames

House (CSH #8, 1949), by Charles and Ray Eames. The Loblolly House, built on Taylor’s Island in the Chesapeake Bay region, is a groundbreaking realization of a new way of conceiving and building architecture on the part of Kieran Timberlake Associates. Drawing on the research that led to their book *Refabricating Architecture* (New York: McGraw Hill, 2004), Stephan Kieran and James Timberlake have designed and built a modest second home for Kieran’s family, relying almost exclusively on the use of prefabricated elements, coordinated and assembled in a process more closely resembling the manufacture of automobiles and airplanes than that of conventional houses. Using a shared parametric model with the suppliers and assemblers on the project, the Loblolly house is structured in terms of five divisions of elements: *site* elements, including foundation piles and utilities; *structure*, in this case an aluminum frame; *floor cartridges*, including floor and roof panels that integrate structural, mechanical and electrical systems, with enclosure and finishes; *blocks*, system intensive core spaces that include complete bathrooms with service connections, closets, and mechanical rooms; *wall cartridges*, including insulated wall panels with exterior and interior finishes, including windows; and lastly, *furnishings, fixtures, and equipment*.¹⁸ With the exception of the site elements, all of the others were manufactured off-site and assembled on-site according to the parametric model and its integrated supply chain in a four-week period.



Figure 4. Loblolly House, Western Face, from *Loblolly House*, p. 35

The house itself is a two-storey rectangular structure stretching North-South, with maximum transparency along the western face opening towards a view of the Bay (Fig. 4). Massing is divided into two parts, separated by a small gap that distinguishes guest quarters from the rest of the house, all of which is elevated a storey above ground by a rough grid of canted log piles. A rough cedar-board rain/sun screen wraps three side of the building, creating a veil over the aluminum scaffold/frame and wall cartridges. Set amongst the Loblolly Pines, the house seeks to create a dialogue with the trees through the patterns of its siding and the foundation piles.



Figure 5. Eames House Interior, from *Modern California Houses*, p. 58.

In its conception, production, and assembly, the Loblolly House is unlike any other house today, and yet it is rooted in the lessons of the Case Study Houses, in particular the Eames house, realized more than half a century ago. Design of the Eames house began in 1945, shortly after the inception of the Case Study Program, but proceeded slowly. The design underwent substantial revision, however, after Charles Eames visited an exhibition of Mies van der Rohe's work at the Museum of Modern Art in the autumn of 1947. Seeing a close similarity between his design and a sketch by Mies for a house, convinced Eames to consider a different ap-

proach. So as to preserve a meadow in the center of the site, the house was re-aligned to sit between an embankment on the western edge and a row of Eucalyptus trees, creating the now familiar interplay of trees and the building's skin.

"The 11.5 tons of steel frame was erected in a day and a half, its elements thin and spindly. Two parallel rows of 4in (100mm) H-columns, forming 7ft 6in (2.23m) bays, framed a space 20ft (6m) wide and 18ft (5.43m) high. 12in (300mm) Truscon open-web steel joists, strengthened at each end by the welded addition of a steel plate, supported the exposed Ferro-board steel roof decking."¹⁹ Like the Loblolly house, the building is a simple rectangular volume divided into two parts, here studio and living quarters, with a small courtyard between. Enclosure is achieved with a combination of off-the-shelf steel sash window and door units, intermixed with solid panels. The western wall, partially covered by the embankment, is largely solid for two stories, protecting much of the interior from the harsh western sun. A large overhang extends to the south to provide shade to the double storey living room in the summer.

The Eames House is work of architecture that seeks to take full advantage of the technology and materials of its day. Much like Kieran and Timberlake, Eames had studied the war industries in the mid-40's to uncover the best materials and techniques for building houses. What he and Entenza discovered was the potential of steel, glass, and plywood, and the benefits of prefabrication and industrial production. The Eames House embodies this knowledge, and integrates it with a sensitivity to landform, landscape, and the course of the sun, in much the same way as the Loblolly House endeavors to do so.

Like Pierre Koenigs CSH #21, realized ten years later, the Eames House succeeded in establishing a new paradigm for the modern house, incorporating both optimism in technology and the desire to integrate landscape in the interior and exterior experience of the inhabitant. This fusion of new materials, prefabrication technologies, light and landscape, characteristic of the best of the Case Study Houses, would produce in California some of the most iconic houses of the 20th Century, more than fulfilling the aspirations of the 'prefabrication manifesto' of 1944.

ENDNOTES

1. John Entenza, "Notes in Passing", *Arts & Architecture*, July 1944, p.21.
2. Thomas Hines, "The Search for the Postwar House", in *Blueprints for Modern Living: History and Legacy of the Case Study Houses*, Ed. by Elizabeth A. T. Smith (Cambridge, MA: MIT Press, 1998), p. 167.
3. Charles and Ray Eames, John Entenza, and Eero Saarinen. "What is a House", *Arts & Architecture*, July 1944, p.24.
4. Charles and Ray Eames, John Entenza, and Eero Saarinen. "What Prefabrication is Not", *Arts & Architecture*, July 1944, p.29.
5. Charles and Ray Eames, John Entenza, and Eero Saarinen. "Emergency Prefabrication", *Arts & Architecture*, July 1944, p.38.
6. Rudolph Schindler, "Prefabrication Vocabulary", in *Arts and Architecture*, June 1943, p. 32-3.
7. Esther McCoy. *Modern California Houses* (New York: Reinhold Publishing Company, 1962), p. 70.
8. Thomas Hines. "Case Study Trouvé: Sources and Precedents", *Blueprints for Modern Living: History and Legacy of the Case Study Houses*, Edited by Elizabeth A. T. Smith (Cambridge, MA: MIT Press, 1998), p.94-5.
9. "The New House 194x", *The Architectural Forum*, September 1942, p. 65.
10. Gregory Ain, *Arts & Architecture*, August 1943, p. 27, as quoted in Neil Jackson, *The Modern Steel House* (London: E & FN Spon, 1996) p. 47.
11. *Ibid*, p. 47.
12. John Entenza, "The Case Study House Program", *Arts and Architecture*, January 1945, p. 37.
13. Franz Schultz, *Mies van der Rohe: A Critical Biography*, Chicago: ?, 1984, p. 256.
14. Mies van der Rohe, "Was ware Beton, was Stahl ohne Spiegelglas? (What Would Concrete, What Would Steel Be without Plate Glass?)," unpublished typescript of contribution to a prospectus for the Verein Deutscher Spiegel-glas-Fabriken, 13 March 1933, Container 2, MvdR Papers, Manuscript Division, LOC; as quoted in Phyllis Lambert, ed., *Mies in America* (Montreal: Canadian Center for Architecture, 2001), p. 334.
15. John Entenza, ed., *Arts and Architecture*, February 1959, p. 19.
16. Pierre Koenig, interviewed by Neil Jackson, 13 July, 1988; as quoted in Neil Jackson, *The Modern Steel House* (1996) p. 98.
17. Reyner Banham, *Los Angeles: The Architecture of Four Ecologies* (New York: Penguin Books, 1971) p. 227.
18. Stephan Kieran and James Timberlake, *Loblolly House: Elements of a New Architecture* (New York: Princeton Architectural Press, 2008) p. 54-5.
19. Neil Jackson, *The Modern Steel House* (1996) p. 54.