Insulation and Modernism in America: 1900-1955

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Introduction

Much has been written concerning the impact of air conditioning on the development of modern architecture. This paper examines related developments in the insulating properties of the building envelope, specifically in residential architecture and building of the first half of the twentieth century. The industrial production and marketing of insulation products largely by-passed normative architectural practice until the general public and/or the government advocated or demanded its use, while progressive architects were the earliest to see its possible impact on the nature of the architecture itself. Nevertheless, the assertion in the popular press that International style architecture was unlivable overshadowed the achievements of proponents of environmental integration as an inherent part of functionalist architecture.

Industry: *Thermal Building Insulation and the Science of Comfort*

Until the mid-19th century, insulating strategies for houses had always relied on empirical methods, developed within a specific culture or climate[1]. Traditional European building techniques were inherently capable of thermal insulation in many cases; [2] whether masonry or timber frame in-filled with rubble, heat was kept in or out by virtue of thermal mass. North American light frame wood construction evolved from the rubble-filled timber frame to timber frame with wood studs used as nailers for siding—the substitution not recognized as affecting the thermal performance of the wall.[3]

Reyner Banham posited that "the history of environmental management by the consumption of power in regenerative installations, rather than by simple reliance on conservative and selective structures, is . . . a predominantly American one, at least in its pioneering phases. . . The problems were those of lightweight structures in extreme climates whenever Americans built in wood and the advantages were those of a lightweight culture that many Americans took westward with them into a zone of abundant power."[4] Lightweight structures required fuel consumption to be habitable, and as long as fuel was plentiful and cheap, it's use was not a problem; no matter that the heat seeped through the walls and roof—just put on another sweater and put another log on the fire.

As central heating and/or cooling became widespread in commercial settings the recognition of the costs associated with heat loss and gain grew. Insulating materials began to be of value, first for use in agricultural or food industries: breweries, ice and cold storage houses, dairy plants. Charles Manville, who would eventually found the company that became Johns-Manville, tried to find ways to insulate pipes from heat loss, finding that the materials that were effective also discouraged the spread of fire. By 1900, his company was manufacturing insulation materials for spaces as well as pipes. Scientific American published an article in 1878 promoting the use of mineral wool on the roofs of "ordinary city dwellings" to insulate against heat, an early advocacy of the use of the material for domestic purposes.[5] (Fig. 1)

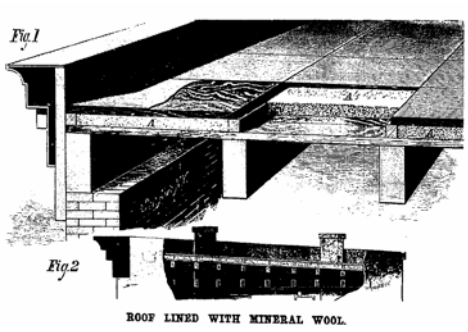

Fig. 1: Scientific American article encouraging insulation of urban residential roofs from heat. (1878)

Gradually, in response to factory conditions, definitions of human comfort criteria based on temperature, humidity, air movement and radiation were developed.[6] The American Society of Heating and Ventilation Engineers (ASHVE) began to publish a journal around 1910. Willis Carrier, usually credited with the successful development of air conditioning, developed the psychrometric chart in 1908, still in wide use as a means of identifying the human comfort zone. Temperature and humidity of air were crucial parts of that comfort equation.

Carrier's first installations of air conditioning were in response to industrial needs not human ones, however, from the materials used in production (tobacco in a cigar factory) to the productivity of the workers. The general public was first introduced to experience of air conditioning in theaters and department stores. By the time the first residential "air conditioning" units were introduced in 1928, the public was receptive, though the depression and the Second World War slowed production and sales. [7]

The increased use of mechanical means for "creating weather" and the costs associated with it spawned research into the means of maintaining the climate and conserving costs: thus the investment in insulation grew. In 1935 an American Chemical Society researcher completed a study of "synthetic weather progress" and concluded that, as the use of air conditioning grew, the problems of insulation, particularly those associated with glass, would command greater attention. "Even with the most efficient insulation of walls and roof, tremendous heat loss, both in and out, occur through the windows."[8] The inclusion of the glass as part of an insulated skin completes the definition of a dominant problem for heating, ventilation, and air conditioning engineers, and for the building industry: the performance of the building enclosure.

As in other industries, the effort to fight and win World War II generated research that contributed to the insulation industry. Glass technology improved the making not just of windows, through insulating double paned windows, UV filters, and glass blocks, but also the development of improved fiberglass insulation, which joined mineral wool and asbestos as insulating materials available to the public before the end of the war.[9]

Engaging the Public

Until 1920, very little was written about a need for energy conservation in the home. While central heating in houses produced more even temperatures, the futility of maintaining the heat was noted by Mrs. Theodore Roosevelt, saying of her new home, Sagamore Hill, that trying to keep a house comfortable was like "trying to heat a birdcage."[10]

Even after World War I articles such as "Efforts to Stop Wastage of Coal" [11] make no mention of the use of insulation as a means of energy conservation. By 1920, an ongoing conservation movement and progressively more data on how to more efficiently use fuel result in the recognition that savings are possible through construction. The average house is noted as using two to three times the quantity of coal necessary for heat because of "Poorly built Houses": "So long as many dwellings are built to sell and without much regard to the cost of heating them or to the comfort of those occupying them, heat insulation may not receive a great deal of consideration from the builder unless the public in general and prospective home-owners in particular know something of the economics of such insulation"[12]. The same article notes the issue as vital not only to the individual, but to the nation as a whole. The national interest proves later on to be critical in the promotion of insulation in residential settings.

Beginning in the twenties, through advertising and well placed information in daily news-papers, insulation manufacturers convinced the public and the government of the not just the need but also the desirability of insulation in homes. Throughout the second half of the

Fig. 2: Sample advertisements from the 1920's. Comfort, safety, economy land the same old house.

1920's there is an increase in appeals to the public, often generated through industry, to insulate. The Celotex Company, based in Chicago, placed full page ads regularly in the New York Times after 1925, asking such things as "Is the Heat-Leaking House going out of date?"[13] (Fig. 2)

Articles appear throughout the twenties and thirties admonishing readers to insulate to save fuel cost, citing "Scientific Methods" as an "Important factor in Building Construction"[14] Labor savings as well as cost savings are emphasized, since coal, with its implied shoveling, was the most common fuel in use at the time. The fireproofing capabilities of the insulation were also critical in this call, since the largest number of fires tended to happen on the coldest days, spreading rapidly through empty frame wall cavities.

The necessity for the economies of insulating became ubiquitous during the depression years, primarily in retrofitting since there was little new construction. The Federal Housing Administration (FHA) offered loans to home owners to "Modernize" including providing insulation for heat and acoustics in walls and ceilings among many other acceptable improvements. A consultant was stationed at Macy's to help prospective borrowers estimate the cost of improvements. The acceptance of insulation as an initial expense was further bolstered when Metropolitan Life Insurance Company, a major developer of residential construction, placed the largest order ever, in 1938, for 3,500,000 square feet of mineral wool from U.S. Gypsum for use in a New York apartment complex.[15]

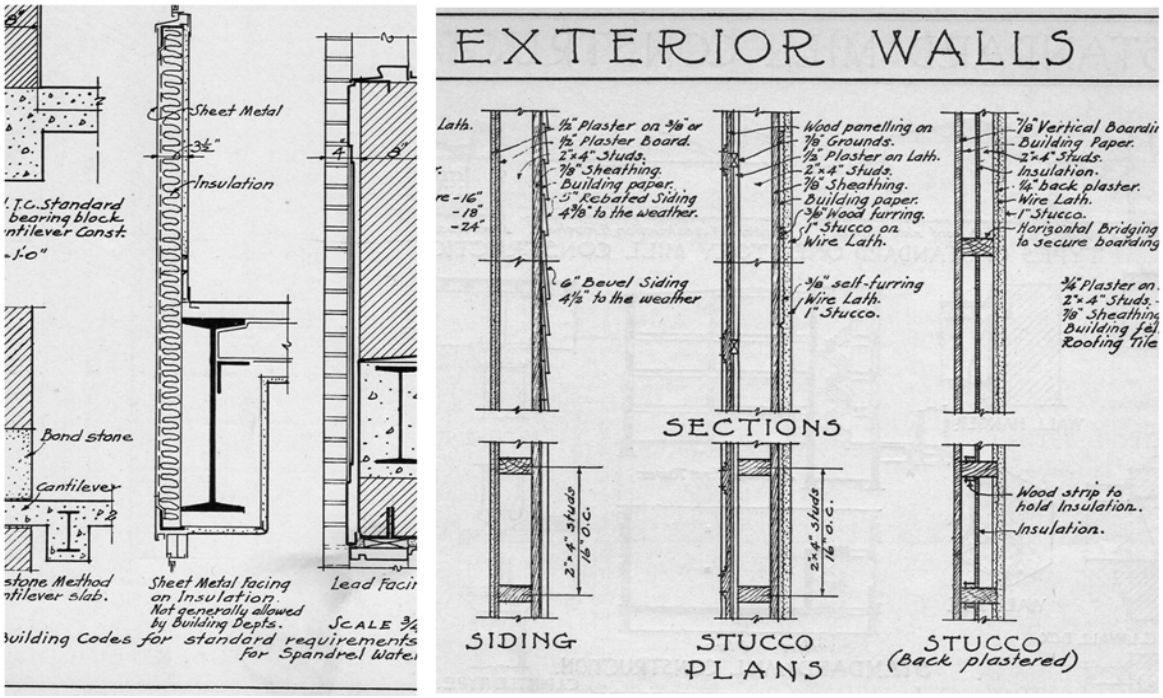

Fig. 3: The only two references to thermal insulation in the First edition of Architectural Graphic Standards. (1932) **Architecture:** *The Profession*

Periodically the New York Times continued to publish articles to educate the public about the uses of insulation before World War II. Early in the war, many construction materials were available only for direct use in the war effort; insulation was in short supply[16] During the War a shift occurs, from encouraging people to insulate for their own comfort and savings, ("Insulating Home For Living Comfort", May, 1941[17]) to insulating to conserve fuel for defense purposes: "Home insulation would help national defense" July 1941[18]. "Window conditioning" is mentioned in this last article as well to conserve fuel; the effectiveness of double-glazing, or the use of storm windows was more and more often recognized as part of the insulating envelope.

Saving metal through downsizing of equipment was the reason to insulate in May of 1942[19]; by August a shortage of fuel oil was predicted for the coming winter, featured on page one of the New York Times.[20] The war government finally gave the consolidating boost to the insulation industry when the supply of insulation was released in September, 1942 and the FHA again allowed credit to homeowners for insulating and adding storm windows[21] while such credit continued to be withheld for other, non-essential home improvements. Throughout the war thereafter, one often sees tips on saving fuel through the use of insulation, storm windows, weather-stripping, even bookshelves and window "blankets". Macy's even opened a special "Home Insulation Shop".[22]

By the end of the war, the need or desirability for insulation in houses was not questioned; not only was it patriotic, the investment was sure to pay for itself. As the use of air conditioning and the desire to control the climate increased exponentially, insulation became an essential and normal part of construction.

What was the role of architects in all of this? Very few references to insulation are found in architectural publications before World War I.[23] Those that exist were often generated from within the young industry, such as a brief article by the U.S. Mineral Wool Company published in The American Architect + Building News in 1901 to promote the use of its products. The next decades saw the fledgling insulation industry creating its market with the public and builders. By the 1930's, building

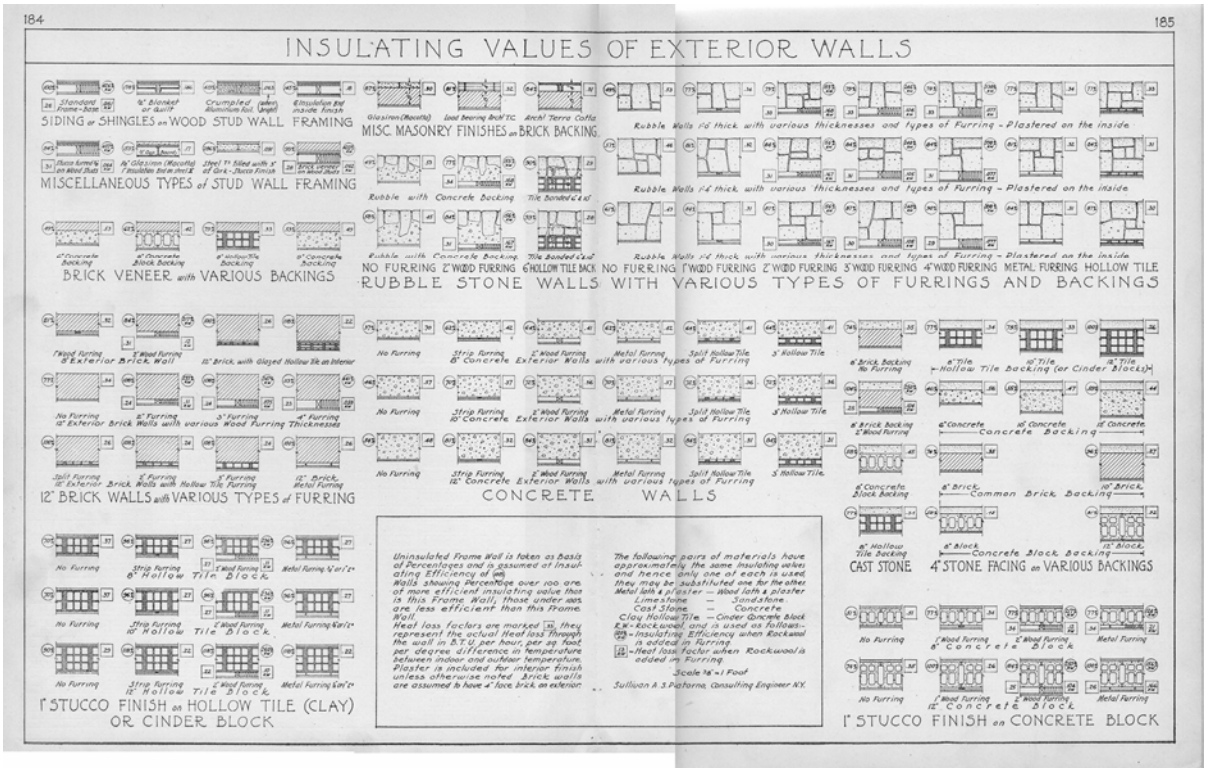

Fig. 4 Second edition of Architectural Graphic Standards.(1936) showing insulating values of various wall types.

professionals were being encouraged in the popular press to "Work With Science: Show the public how it can get more comfort and remodeling will follow." A rise in the use of glass "as architects realize what they can do with it" was forecast and "the opportunities of air conditioning, and the good results . . . obtained . . . by using some of the insulating materials now on the market" were cited by the Director of the Mellon Institute for Industrial Research in a New York Times article.[24] Nevertheless, the consideration of insulation was certainly not yet ingrained in general practice. The first edition of Architectural Graphic Standards, published in 1932 has only <u>two</u> references to insulation in a wall: an insulated metal spandrel panel, (which is noted as not being accepted by most building departments!) and what appears to be a piece of fiberboard insulation in a stucco wall. (Fig. 3)

Within a few short years, however that had changed. The Preface to the second edition of the book, published in 1936, lists among several new topics, "in consideration of air-conditioning, insulation has been covered." [25] A two-page spread showing insulating values of varying wall types was included. (Fig. 4).

By the third edition (1941), several pages regarding sound insulation have been added. (There were none previously.)

There is little to suggest that the spatial or stylistic nature of the architecture that used these wall constructions should be affected in any way by the potentials of insulation; that has never been the province of Graphic Standards. The insulation companies had made the point to the public that their houses did not have to "change" in anyway to take advantage of the benefits of the new technologies and most American architects were passive in their response to the possibilities. (See fig. 2, above: "Only one of these is a TRIPLE-INSULATED house!")

Advocates of Modernism

As might be expected, it is among supporters of a more progressive view that architects recognize the liberating potential of the environmental technologies. American

proponents of European modernism such as William Lescaze and Raymond Hood reflected a change to functionalism in the consideration of houses: *The New York Times* published an article in July, 1933, called "Visions of the Houses of the Future: Architects See Tremendous Changes Ahead, With Homes Designed for Happy Living Rather Than for Looks". In it, insulation is credited with no less than *enabling* modernism: in the new house, "the summer sun will beat upon the roof without raising the temperature of the rooms beneath. *The science of insulation makes it possible to scrap the attic* . . . Electric energy will heat it, cool it, ventilate, clean and light it." (My emphasis.)

Lescaze is noted as regarding modern architecture "not as the mere acceptance of certain forms and materials, but as a plastic expression of a philosophy of human life and human needs." "Why should the eighteenth century style of a house be more important than the comfort of the twentieth century people who live in that house?" [26] Elsewhere Lescaze reinforces the importance of "functional order as the essence of modern architecture" and says "cleanliness and health are achieved as they never were in the old architecture . . . Fresh air, sunlight, control of drafts, and insulation are part of the health program."[27]

Frank Lloyd Wright, whose work flourished during the depression, was not inclined to see the value of insulation; in his battle against the typical wood frame, waged through development of the Usonian House, he took away the space for insulation in the wall, and declared in 1936: "the insulation of the walls and the air space within becomes less important, with modern systems of air conditioning and heating you can manage almost any condition."[28]

Among the European emigrant architects in the United States, the acceptance and promotion of insulation as an important component of modern construction was varied. Edward Ford[29] says that Rudolf Schindler, seeing virtue in simplification, strips away the layers of construction whenever he can; at Pueblo Ribero (1925), the roof contains Celotex insulation, a very new product at the time, but the walls have no insulation or vapor barrier, with disastrous results. Rather than stripping away, however, Schindler probably never considered putting them in, since they were far from being common practice at the time.

A half generation later, in 1939, Gropius and Breuer, in their own houses, use insulation in the walls (3" of fiberglass and ¾" of Celotex, respectively[30]) and actively describe the houses as "well-insulated". Their use of standard wood frame construction, brought to bear on modern architecture, was one aspect of their work together that Siegfried Gideon called a "new regionalism"; the use of insulation in the walls and roofs brought the light wood frame wall system into a dialogue about comfort and architecture as it had never been before.

An interesting array of projects by architects for themselves was presented by the New York Times in 1941: six houses are shown, four of them modern, and two traditional. (Fig. 5)

In the brief captions one finds references to energy and comfort issues in three of the four modern houses (the fourth, by Wright, refers to chimneys, a symbolic presence of heat) and the other two refer mainly to "style": "French farmhouse", and "Connecticut countryside". The modern houses' captions, by Gropius, Lescaze, and Kenneth Kassler, discuss light, heating technology, shading devices—the means of providing physical comfort.[31]

The 1940's saw other progressive architects, including Carl Koch, reconsidering traditional framing using insulating materials. A system using a 4x4 timber frame with a "cement surfaced fiberboard" (Celotex, or something comparable) at the interior as the only infill is seen in projects published in Progressive Architecture.[32]

The predicted potentials and the problems of glass had come to the fore by the end of World War II. The technological improvements developed have been mentioned, but had yet to find their way into common use. Glass manufacturers themselves tried to promote the use of glass wisely; Libby Owens Ford (LOF) sponsored a 50 state competition in 1947 for a solar house, whose requirements included "overhangs, proper orientation, and the inclusion of Thermopane [a double glazing system developed by LOF]" in the projects.[33]

Fig. 5: Six Houses for Six Architects. New York Times, October, 1941.

By the early 1950's functionalism and the use of insulation was the norm in both architectural practice and building as evidenced by a series of technical articles in Progressive Architecture in 1952 and 1953. The initial installment states "buildings must *perform* (their emphasis) thermally speaking. They must be efficiently operating cost-savers and comfort-givers, not just inanimate shapes providing shelter from the elements."[34] In fact, this enhancement of the building skin had been in use long enough that the final two articles in the series deal with "The Problem of Condensation in Residences"[35], the beginning of another chapter in the story of insulation in architecture.

While the functionalist methods of *integrating* climate and architecture had proliferated through some modern design curricula, the assumption that building technologies would *accommodate* all comfort requirements had become the standard in others. Some proponents of the "International Style" were inclined to the attitude that energy was abundant and new technology allowed license with the building envelope for any number of formal reasons; others pursued an integration of building and climate that included the active use of the building envelope as an active part of the system of heating, cooling and ventilation. Either perspective has its merits and drawbacks, depending on the point of view; for the general public, however, the merits of the former can be difficult to perceive.

In spite of the promotion of the modern movement as comfort conscious in the pre-war coverage of architects noted above, the post war period saw a backlash. Elizabeth Gordon, in a "House Beautiful" article entitled "The Threat to the Next America" in April 1953, begins with the example of the Farnsworth house and eventually states:

> Does it work? The much touted all-glass cube of International style architecture is perhaps the most unlivable type of home for man since

> he descended from the tree and entered the cave. You burn up in the summer and freeze in the winter, because nothing must interfere with the "pure" form of their rectangles—no overhanging roofs or shade you form the sun; the bare minimum of gadgets and possessions so as not to spoil the "clean" look; etc.[36]

In the popular view, modernism of all sorts has often become associated with these issues, including the political one implied in the article's title. While architects like Breuer built many successful houses for well educated clients in the United States, outside of forgiving climates like California, the general public remained (and remains) fearful of the implications for comfort of the modern house.

Conclusion

The status quo on insulation established by the early fifties would remain unchanged until the 1970's, when the use of insulation was mandated by law following the energy crisis of 1973 and 1974. The assumption that our houses will keep us warm or cool is one that is taken for granted now, though with no assumption of efficiency. As with other aspects of current practices of building, that fact is the result of the confluence of developments in technology and engineering, the development of public desire and legislation of the benefits to both personal and national interests, and the progressive attention paid by a limited number of architects. The current climate of fevered interest in environmental issues, paired with important recent advances in material and construction technologies, and perhaps even our immediate national security concerns provide parallels to the post World War II era; an understanding of the successes and failures of the architecture of the 50's relative to these is worth a substantial reconsideration.

Endnotes

[1] Histories of heating, air conditioning and ventilation include:

Merritt Ierley, The Comforts of Home: The American House and the Evolution of Modern Convenience (New York, Random House, 1999)

Sigfried Gideon Mechanization Takes Command, A contribution to anonymous history (New York, Oxford University Press, 1948)

Henry J. Cowan, Science and Building: Structural and environmental design in the 19th and 20th centuries (New York, Wiley, 1978)

[2] A very good source for the history as well as current state of the development of thermal insulating materials is:

Richard T. Bynam, Insulation Handbook, (New York: McGraw-Hill Professional, 2001)

[3] Carl W. Condit, American Building: Materials and Techniques from the Beginning of Colonial Settlements to the Present, (Chicago, University of Chicago Press, 1982) pg. 6

[4] Reyner Banham, The Architecture of the Well-Tempered Environment, (Chicago: University of Chicago Press second edition, 1984), pp.25-26

[5] "Lining Roofs with Mineral Wool," Scientific American, May 4, 1878; Volume XXXVIII, No. 18, pg. 278

[6] Cowan, Science and Building: Structural and environmental design in the 19th and 20th centuries. Cowan makes the point that the design of the interior environment replaced structural design as the "principle scientific problem of architecture after the 19th century." (p. 217)

[7] Sze Tsung Leong with Srdjan Jovanovich Weiss, "Air Conditioning" in Chuihua Judy Chung, et al, ed., Harvard Design School guide to shopping (Köln : Taschen ; Cambridge, Mass. : Harvard Design School, 2001), pp. 92-121

[8] "Explains Problem In Air Conditioning" New York Times, July 7, 1935, pg. RE12

[9] "Aladdin's New Lamp", New York Times, October 3, 1943, pg. SM12

[10] Ierley, The Comforts of Home, p.125

[11] John Walker Harrington, "Efforts to Stop Wastage of Coal" New York Times, Aug. 25, 1918, pg. 35

[12] "Millions Wasted in Heating Poorly Built Houses", Current Opinion, Volume LXIX, No. 6 (Dec. 1920) pg. 870

[13] Celotex Advertisement, New York Times, April 11, 1926, pg. X15

[14] New York Times August 29, 1926,pg. RE21

[15] "Places Insulation Order: Metropolitan Life to Use Mineral Wool in Housing" New York Times, Sept. 14, 1938, pg. 41

[16] Robert Freidel "Scarcity and Promise" in Donald Albrecht, ed., World War II and the American Dream (Cambridge: National Building Museum and MIT Press, 1995) p.55

[17] New York Times May 11, 1941, pg. RE10

[18] "Insulation advised to conserve fuel" New York Times, July 20,1941 pg. RE2

[19] "Substitutes Save Vital Materials" New York Times, May 10, 1942, pg. RE4

[20] "Shortage of Fuel Oil receives New Emphasis", New York Times, August 9, 1942, pg. E 7; "Heating Engineers Push Fuel Savings", ibid., pg. F5; "Fuel Oil Rationing For East Planned If It Is Necessary", August 16, 1942, pg. 1.

[21] "Credit fuel curbs exempted" New York Times Sept. 13 1942, pg RE7

[22] "Bookshelves Grace the Room and Warm It Too", December 27, 1942, pg. D4; "The Home in Wartime", January 3, 1943, pg. D4; Macy's Display Ad, January 10, 1943, pg. 31; Insulating for Winter, September 26, 1943, pg. SM26; all New York Times.

[23] Searching the Avery Index of Architectural Periodicals online using the keyword "insulation" finds only *three* references before 1915.

[24] "Work With Science, Builders are Told" New York Times April 30,1936 pg. 39

[25] Charles Ramsey and Harold Sleeper, Architectural Graphic Standards (New York, John Wiley, first edition, 1932; second edition, 1936, third edition, 1941)

[26] L.H. Robbins, "Visions of the Houses of the Future: Architects See Tremendous Changes Ahead, With Homes Designed for Happy Living Rather Than for Looks" New York Times, July 9, 1933, pg. SM8

[27] William Lescaze "The Meaning of Modern Architecture", , The North American Review, Autumn, 1937, Volume 244, Number 1, page 110

[28] Frederick Gutheim, ed., Frank Lloyd Wright on Architecture (New York: Grosset and Dunlap, 1941), p. 155; quoted in Edward Ford, Details of Modern Architecture

[29] Edward Ford, Details of Modern Architecture, Chapter 10

[30] Ford, Details of Modern Architecture

[31] "Six Homes By and For Architects", New York Times, October 19, 1941, pg.SM16

[32] "Influence of Insulating Materials on Design: House, Winfield, Kansas." Progressive Architecture 30, (1949 Jan., 1949): 55-57.

[33] Leslie, Thomas, Louis I. Kahn: Building Art, Building Science (George Brazillier: New York, 2005) Pg. 38. All 50 projects for the competition were published in Marion J. Simon, editor, "Your Solar House" (New York: Simon and Schuster, 1947)

[34] Groff Conklin, "New Directions in Thermal Insulation", Progressive Architecture 33, (May, 1952), pp. 100-104 and "Snake Hill", Progressive Architecture 27 (Oct., 1946), p. 52-66

[35] "New Directions in Thermal Insulation", 1954 Mar., p.110-115; April, p. 124-129

[36] Elizabeth Gordon, "The Threat to the Next America", *House Beautiful* 95 (April, 1953), 126-30, 250-251; the quotations are on p. 250. Quoted in Alice T. Friedman, "Women and the Making of the Modern House: A Social and Architectural History" (Harry N. Abrams: New York, 1998) p. 140-141.