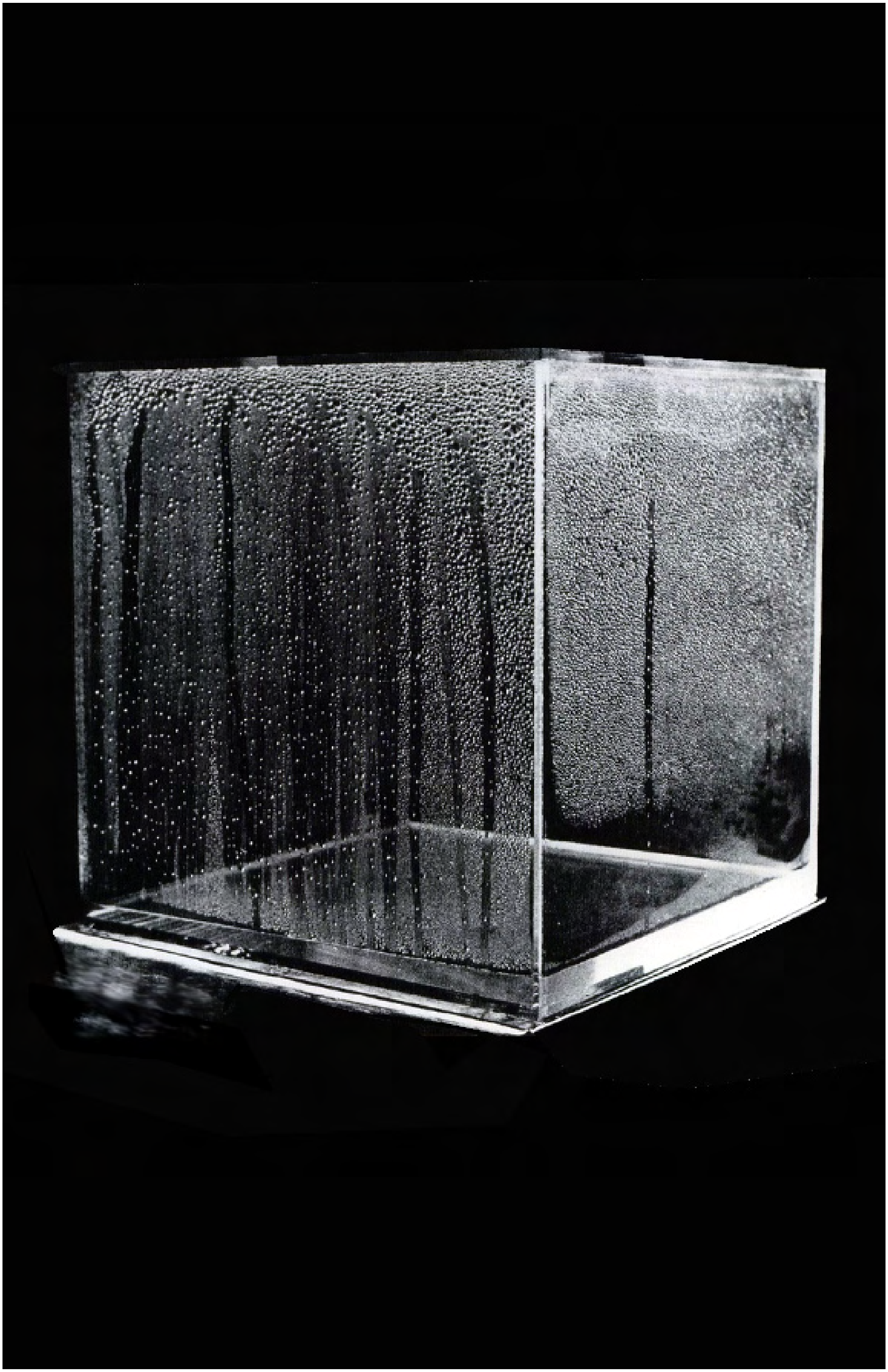

Hans Haacke, Condensation Cube, 1963-65.

HAACKE'S CONDENSATION CUBE:

THE MACHINE IN THE BOX AND THE TRAVAILS OF ARCHITECTURE

Mark Jarzombek

Hans Haacke's Condensation Cube (1963-65) is a hermetically sealed, clear acrylic plexiglass box, thirty centimeters on the side that holds about one centimeter or so of water.[2] Condensation collects against the inner surface of the plexiglass forming vertical streaks on the inside. How the condensation is created can be explained in the following way: Air can hold only a limited amount of water vapor and when that limit or dew point—a law of nature, which applies to all bodies of air all over the world—is reached, condensation occurs. In almost all art museums, the temperature is set at a cool 65 degrees Fahrenheit, which means that at a relative humidity of about 45 percent (the standard in most museums), the dew point is at 42 degrees. Because plexiglass is a bad thermal insulator, the air temperature inside the Cube is the same as the temperature on the outside, namely 65 degrees. But since the humidity is close to 100 percent, the dew point is much higher, and is, in fact, about 65 degrees, precisely the temperature of the plexiglass.

I will argue that the Cube sets in play a rather complex game of illusions between the museum and the architecture that defines its space. This revolves not only around the word "cube," but also around the status of condensation as a cultural construct.

The story begins in the mid-nineteenth century when, with the advent of mechanized, ducted heating systems in multi-floor apartment buildings, it was discovered that condensation appeared neither on the outside nor on the inside surfaces of the building, but within the wall itself. There it would lurk, creating mold and rot. Condensation endangered the life span of these new buildings and thus, of course, the capital investment that they represented. Though the problem was first noticed and studied by the French who were building thousands of apartments in Hausmann's Paris, it was in the northern climate of Berlin where condensation proved to be particularly vexing. It was thus natural that among the first scientists to address the problem was Adolf Wilhelm Keim (1851-1913), whose family name, by the way, means 'germ.'[3] He argued that though dampness is brought into architecture because of the capillary nature of stone and brick, that in itself is not the problem. Stones and bricks had survived relatively well even in damp climates. What happens is that the dry heat on the inside sucks the moisture deeper into the building where it no longer dries out in the summer. In the lingering encounter with lime and cement, moisture creates corrosive chemical discharges that lead to what Keim called Mauerfrass, literally a "wall-eating" disease that was, in Keim's mind's eye, similar to cancer eating at the tissue of a living body.

To protect against Mauerfrass, Keim argued that the wall needed to be ventilated from within; in other words a flow of air, the positive, would offset the flow of water, the negative. The wall, therefore, needed to be separated into two component layers, a structural wall and a type of skin or internal surface, composed of thin brick tiles separated from the structural wall by about an inch, in which space air could flow. To keep moisture in that air corridor from entering through the bricks, Keim added that it was "beneficial to give the inner surface of the tiles a coat of asphalt."[4] This would leave the surface facing the room permanently dry so that it could be coated with plaster, which can then be painted or papered. Wall paper, which had become common in bourgeois houses, and which had also become quite costly, was now safe from the damp. Needless to say, Keim's solution has been used in architecture ever since, except that by the early twentieth century, tar paper was preferred and by the mid twentieth century special types of plastic sheathing like Tyvek, known to every home-builder in the United States, became the norm.

In Keim's world, architecture, in facing the crisis of industrialization, needed to be rethought from the inside out without having to give up its unity. His metaphor was thus appropriately biological. Structure had to be separated from skin by a type of two-dimensional lung. The structure could then do the heavy lifting, the interior wall could work as backdrop for the decorative embellishments in the room, and the lungs of the newly devised body could guarantee the whole a long and healthy life. And yet, if there was a moment where we see the first true separation of interior design from architecture, and architecture from environmental engineering, it was when architecture had to guarantee a way to keep the interior surfaces dry.

The history of condensation took another step, and one that brings us even closer to meaning of the Cube, when we move from the heating to the cooling of air. If heating dried the air out, air conditioning returned moisture back into the architectural ecosystem. However, since air conditioning, with Willis Carrier's patent given out in 1906, was mainly used to cool machinery in milling and paper factories, condensation was an industrial not a civilian problem. The trend maintained itself through largely WWII when the military created sophisticated insulated and de-humidified environments for the transportation of munitions. The first de-humidifier was built for the United States military in 1947. They were more complex than humidifiers since if not maintained properly, mold and bacteria could grow inside them, thus requiring the introduction of an array of chemicals to keep them clean. After WWII, both humidifiers and de-humidifiers became significantly cheaper, which meant that mechanized air now became more properly "architectural." Soon one could find air conditioners in any American home. Condensation was now encountered by the home builders on a scale never before seen. Already in 1949 the Housing and Home Finance Agency published Condensation Control, a pivotal document in understanding the science of building moisture.

One has to remember that the shift from a biological metaphor of architectural illness (Mauerfrass as cancer that could be cured by a delamination of the skin from the architectural body) to a mechanical metaphor of respirated atmosphere parallels the design of hermetically-sealed space capsules by NASA. Architects in the mid 1960s were, of course, enamored of the promises of environmental management and soon began to design hermetically-sealed buildings. Museums were a major advocate of applied atmospheric control, with numerous studies being undertaken to show that artifacts practically of all types were vulnerable if not protected from heat and humidity. Museum chatter on the topic reached a pitch by the late 1950s, with the International Council of Museums (ICOM) dedicating its entire 1960 issue of Museum to the question of atmospheric standards and norms.[6] Machines specifically designed for museums were now available, machines that combined both humidification and dehumidification, the fundamental premise being in most museums to keep the temperature as low as possible and the humidity as constant as possible.[7] This soon became the rule governing the preservation of most art works. As one expert noted, "fluctuations in temperature and humidity caused by external factors, i.e. heating, sudden weather changes, an in-flux of visitors, etc., are a major problem for museums." This means that:

> Museums need to control the environment around exhibits 24 hours a day, seven days a week as temperature and relative humidity can fluctuate frequently and dramatically on a daily basis. This requires constant operation of the humidification system, which therefore needs to be reliable.[8]

The Condensation Cube, first made in 1963, was produced at the very time when museum curating and moisture engineering were becoming synonymous. The piece sets the natural cycles of water and condensation in relation to the invisible and tightly sealed plastic sheathing hidden from view in the museum's walls. The Cube is, however, more than an ironic counterstatement to the museological environment, for one has to remember, that it is not just the mechanization of atmosphere that is important in museums, but the need to preserve temperature and humidity at a constant level. In other words, it is the museum's constantly monitored machines – a humidifier and a de-humidifier working together with a thermohygrometer (also known as hygrothermograph) – that produce the constant rain of droplets in Haacke's Cube. The condensation in the Cube is thus a type of perpetuum mobile induced into motion by remote control. One artifice is posited against another, a Box against a Cube, a man-made constant against a natural law – the white noise of the machines against the quiet of the water.

The Cube also creates a feed-back loop with the machines that set its condensation in motion, for if the machines were to malfunction, condensation would not appear. The Condensation Cube would become just a cube and no longer a "work of art." Stated differently, by observing the Condensation Cube one is registering the efficiency of the machines, with the Cube a type of monitor in its own right. The irony is that, as the quote above indicates, visitors to the museum endanger that relationship. Humans bring heat and humidity into the room, which is why the more precious the objects, the greater the restrictions on how many people are allowed into the museum space. A museum visitor is a potential danger to the law of environmental constancy. If too many people were to stand close to the Cube, the micro-climate around it would change the Condensation Cube into just a plexi-

glass box, setting off environmental as well as curatorial alarms. The problem becomes even more complex when one takes into consideration that the environmental constant that is created to preserve art works actually endangers the building. As one researcher noted, "water vapor, thermal diffusion and interstitial condensation have become a serious problem for many museums."[9] Normally one wants condensation to form on the outside of the building, or in the specially designed air cavities, as Keim had hoped, but what happens is that in summer, internal air is cooler than outside air and that, therefore, the vapor barrier is on the wrong side of the inner air corridor; instead of blocking moisture from coming in, it blocks moister from going out. And in winter, when there is less moisture outside than inside and when the humid indoor air meets building elements that are cooled by contact with the outdoor climate, water condenses on the inner surfaces, leading, as it has been observed, "to rotting of wooden elements, mold growth on interior finishes, corrosion of metal elements, and spalling of masonry – damage which can quite rapidly reduce building elements to the point where renovation must be performed."[10] In other words, the attempt to control condensation creates situations where condensation is even more of a problem. The result is a conundrum.[11] The building's respirators keep the art alive, but spell architecture's doom. In other words, the architectural body has to be sacrificed in the name of art. The Cube, its transparent walls mimicking the vapor barrier in the museum's walls, lets us see the processes that are corroding the building from inside out.[1]

The modernist museum, one must remember, was based on the promise of the freedom that artists supposedly had within its space, thus its purported retreat from representation – the empty loft preferred over the colonnaded hallways of old. But in becoming more and more a refrigerated Box, it also became a machine-to-exhibit-in that, in turn, became increasingly regulatory and simultaneously architecturally self-defeating. It is the representation of that paradox that is at stake with The Cube. Architecture in the nineteenth century, in the service of modern comfort, had to split its surface, but once split it could not be put together again. The Condensation Cube – a condensation-producing machine in its own right – is thus the mirror into architecture's philosophical impossibility, for if, as Adorno argues, an art work is such only because it is "hermetically sealed off and blind" and yet able "to represent the outside world," then that is what architecture is in no position to accomplish, since in being "sealed" it encounters its status as something that is undone, unlike Haacke's Cube.

The difference between the Box and the Cube is the difference between modernism and postmodernism. The modernist attitude to condensation started from the premise that diseases could be dealt with by effective treatments. This was the approach of Keim, and is still the approach of the curatorialized museum. The postmodernist position accepts the failure of science – and even the complicity of science in that failure – while struggling to make sense of a more complex bio-cultural world. Architecture, however, had no real choice in the matter, yet for better or worse, it has become a bio-cultural structure where pieces start to get replaced, perhaps a hand rail here; a light fixture there, and then eventually a wall needs to be rebuilt, and then finally, it is cheaper to tear it down altogether, where its pieces wind up in a dump to mold, rot and rust at a more natural pace.

There is a redeeming element in this, in that even though machines in their effectiveness first compensated for and then actually created an ineffectual architecture (or rather an ineffectuality that we continue to call "architecture"), the museum building, unlike an art work, discovers in the process a mortality that is no longer possible for museological art. If an art work, even one that displays nothing more than condensation, is defined as that which must last, as that which must be protected from both human contact and the naturalness of climatic fluctuations, architecture is that which can never achieve such cultural status. Condensation brings to architecture a quality that is forbidden to art, namely a slow and, one could say, almost natural death. 'Mauerfrass' is nature enforcing its presence over the artificial. The Condensation Cube, despite all that it reveals in the context of the modern museum, thus traps the very mechanisms that it wishes to expose. It places them in quarantine.

On the surface, one could ascribe to art works -this one included - the potential importance of their cultural messages, and to architecture its sad and muted collapse into dampness, 'Mauerfrass,' temporality and, ultimately, irrelevance. Architecture is, without remorse, brought to light as an infirm and ultimately discardable body. But the more one sets out such a separation between art and architecture, the more, of course, it collapses. The Condensation Cube works because it explicates nature's departure from itself as something that is simultaneously absolutely natural and absolutely artificial. It respects and violates nature's legality, scanning a passage from nature to society and back again.

endnotes

1 Theodor Adorno, Aesthetic Theory, trans. Gretel Adorno and Rolf Tiedemann (London: Routledge, 1986), 257.

2 There is, however, a small hole at the bottom covered with clear tape, that allows the water to be drained when not on display.

3 Adolf Keim, Die Feuchtigkeit der Wohngebäude, der Mauerfraß und Holzschwamm: nach Ursache, Wesen und Wirkung betrachtet und die Mittel zur Verhütung, sowie zur sicheren und nachhaltigen Beseitigung dieser Übel (Vienna: Hartleben, 1881, second revised edition Vienna: Hartleben, 1901). The book was translated into English in 1902 as The Prevention of Dampness in Buildings; with Remarks on the Causes, Nature, and Effects of Saline Efflorescences and Dry-rot, For Architects, Builders, Overseers, Plasterers, Painters, and House-owners (London: Scott, Greenwood & co., 1902). Keim produced a new generation of paint that could last in the northern climes. His company, the Adolf-Wilhelm-Keim-Gesellschaft, still exists today. Other works that deal with the problem of condensation are: Vaudoyer, Belehrungen ueber die Mittel, die Feuchtigkeit in den Gebaeuden zu verhindern und zu vertilgen (1845); Eduard Mueller, Wie beseitigt und verhütet man Feuchtigkeit und Schwamm in Wohnhäusern? Für Bauhandwerker (Berlin: Mayer & Müller, 1900); Oskar Arendt, Die Feuchtigkeit in massiven Mauern, ihre Entstehung, Verhütung u. Beseitigung (Berlin: Petersilge & Korwitz, 1906), and Julius Wolfmann, Feuchtigkeit und Schwammentwickelung in Wohngebäuden (Berlin: Siemenroth, 1910).

4 Adolf Wilhelm Keim, The Prevention of Dampness in Buildings, 24.

5 Condensation Control in Modern Buildings, Housing and Home Finance Agency (HHFA), Washington, DC (August, 1949).

6 Garry Thomson, The Museum Environment (London: Butterworths, 1978). By the 1980s, the emergence of Sick Building Syndrome (first recognized in 1982) and various types of "killer mold," drove architects back to more flexible positions, but art museums for the large part have not relented.

7 The vast literature on this need not be cited. Suffice it to note that researchers have determined, for example, that humidity above 60% RH, causes wooden parts to expand and push against one another while simultaneously softening many traditional glues used to hold joinery and veneers together. When relative humidity reaches 70% in conjunction with temperatures above 60°F, mold and mildew may form and grow on wooden surfaces. See: http://www.rap-arcc.org/leaflets/wmfurn.htm [online], accessed June 2005.

8 http://www.jshumidifiers.com/art.htm [online], accessed 04 June 2005.

9 See discussion in Energy Conservation and Thermal Insulation, ed. R. Derricott and S.S. Chissick (John Wiley& Sons, 1981), 463-509.

10 http://palimpsest.stanford.edu/byauth/brownjp/humidity1997.html [online], accessed 04 June 2005. This is an excerpt from an article which was published as: JP Brown & William B Rose, "Humidity and moisture in Historic Buildings: The Origins of Building and Object Conservation," Association for Preservation Technology Bulletin, 27/3 (1996), 12-24.

11 One solution used by the Sackler Museum at Harvard was to pressurize the inside spaces so that moisture is driven outward. See: Michael Williams, "Fresh-air Climate Conditioning at the Arthur M. Sackler Museum," The International Journal of Museum Management and Curatorship, 5/4 (December 1986), 335.

12 The problem was addressed at the 1991 joint meeting of the Association for Preservation Technology and the American Institute for Conservation. One of the principles they adopted was that the museum "should recognize the need to preserve the unique character of both the historic structure and artifacts." See: http://palimpsest.stanford.edu/bytopic/ethics/neworlea.html, [online], accessed 04 June 2005.