Energy modeling of university of Massachusetts-Amherst fine art center, a modernist icon

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ABSTRACT: Energy conservation and efficiency is essential in contemporary building design. The perception that architects during the Modernist period of architecture ignored these principles is incorrect.

Modernist buildings, in particular the massive concrete constructs characterized as Brutalist, are admired for their complex sculptural form, the construction processes involved, their interplay with site and community, or the social politics of conception, program, and design. At the same time, these same buildings may be denigrated for their scale, materiality, or absence of traditional ornamentation and programmatic clues. Revered or reviled, one fact stands out: most Brutalist buildings are considered poor energy performers.

The architects of these buildings were at the height of their professional careers when called on to design these buildings. All had been educated and were practicing their discipline before the development of sophisticated mechanical systems and superior envelope materials. However, these architects were fully aware of design strategies that maximized occupant comfort, e.g. site positioning, solar shading, load mitigation with thermal mass, glare control, daylighting, and material reflectance. In this paper, we show that these strategies were optimally employed and in doing so, conserve energy.

Our case study is the Fine Art Center (1972-74) at University of Massachusetts-Amherst, a masterpiece of American collegiate Modernism executed in the Brutalist style designed by Pritzker Prize winning architect, Kevin Roche.

The process involves transferring the building's original architectural drawings and specifications into a geometrically accurate 3D digital model. The model is then inserted into energy modeling software, DesignBuilder and Ecotect, where it is programmed with all appropriate materials, mechanical systems, schedules, etc. Then the building is parametrically simulated, e.g. repositioned in orientation, material color and/or reflectance altered or changed completely, geometry of a built projection modified to determine optimization of shading and/or daylighting. We examine the design intent of the architect by quantitatively modeling these and other parameters.

Our findings suggest that the Fine Art Center, as built and situated on the site, does take advantage of many of the above strategies and does so in both expected and unexpected ways. This study advances the body of scholarship on Modernist icons by examining a uniquely under-represented feature of historical buildings-their energy performance. It also offers insight into sustainable building strategies in use before the advent of contemporary technologies and supports their use in both new construction and rehabilitation.

This insight represents a critical step toward the public's understanding of Brutalist architecture. It also helps to advance the aims and intents of contemporary green buildings that use many of the same strategies and constructs. Additionally, our findings from this targeted study are useful in promoting both the broader relevance and impacts of detailed energy studies of historically important buildings. The inventory of this building type is substantial, the embodied energy enormous, and threat of demolition frequent. Efforts at preservation are most worthwhile and may be facilitated if knowledge of energy performance strategies are available and understood.