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Beginning on page 10 is an article by Anthony C. Antoniades, AIA, AIP, Associate Professor of Architecture at the University of Texas at Arlington. Professor Antoniades taught architecture at the University of New Mexico before moving to Texas. It was during those years in our state that he developed a strong interest in and knowledge of the architectural heritage of New Mexico. Three articles by Antoniades have appeared previously in **NMA**—November/December 1971, September/October 1973 and July/August 1974.

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Space in New Mexico Architecture as a Resource for an Energy Ethic **10**
—By Anthony C. Antoniades, A.I.A., A.I.P.

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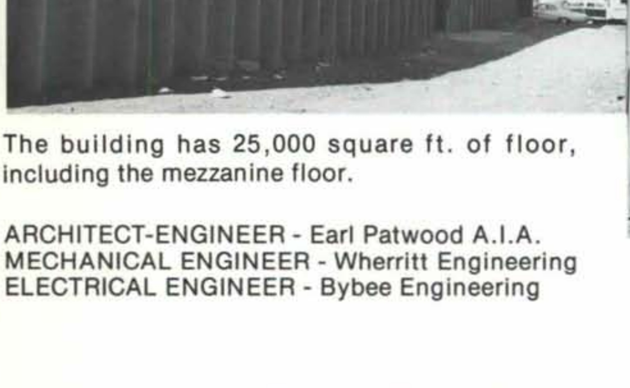

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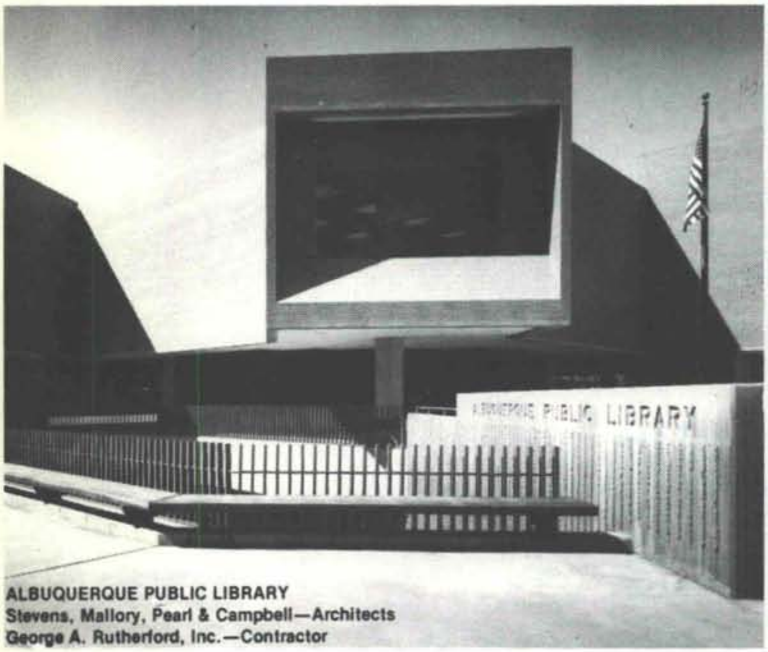

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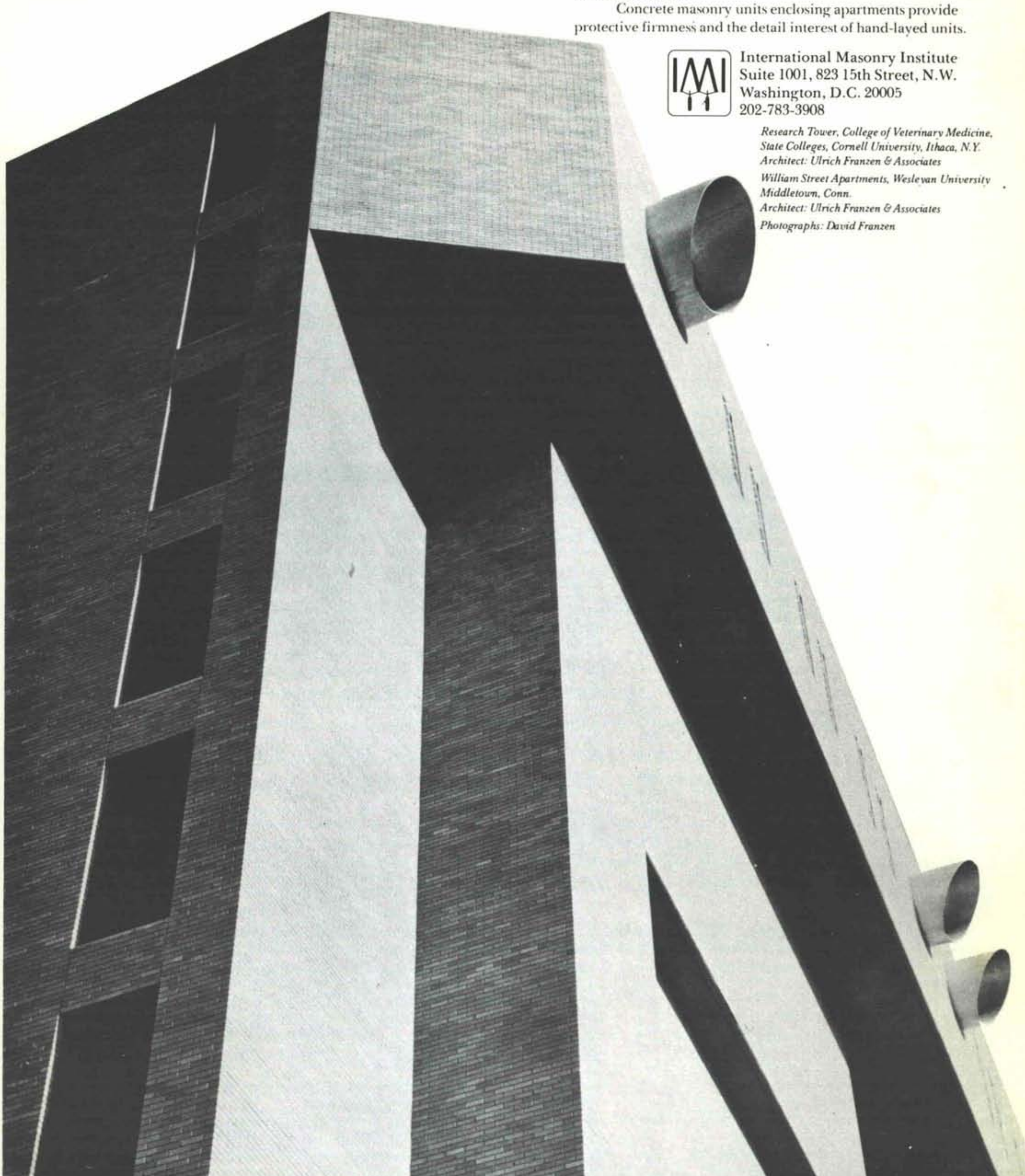


Space in New
as a resource f

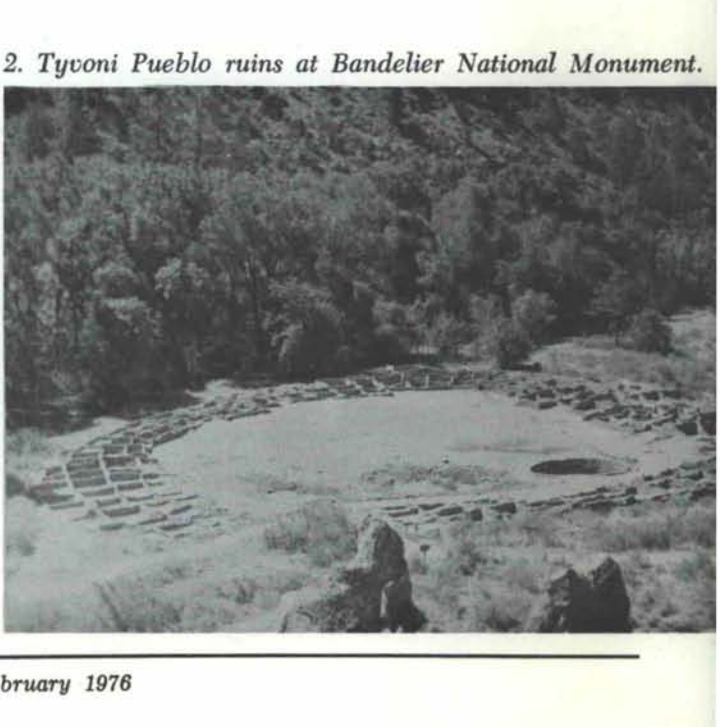
by: A

The current concern for energy conservation has generated the need for an "energy ethic" among architects. Stated in architectural terms, this "energy ethic" could be simply understood in new attitudes over "heat losses" and "heat gains," a new sophistication in the standards adopted for the environmental control of buildings, architectural form and materials used. All above may or may not enhance the conservation of energy. Of these broad factors, which are sufficiently covered in general as well as in specialized literature, the subfactors pertaining to architectural form are of generic importance, especially when one makes the assumption that "materials" and "technological sophistication" can be easily controlled by the discriminating designer. This logic brings us to the fundamental fact that it is the basic design of a work of architecture which reveals whether or not a building is an "ethical" statement regarding energy. The same logic also demands our attention to the ever present considerations for "space" creation which was and should always be the task of architects. Space should transcend the "shelter" requirements and be qualitative enough so as to stimulate efficient function, comfort, interaction and psychological appeal for the users. The component of the "space" achieving process considered abstractly are physical as well as human.[1] The physical components of space[2] are the three dimensions which finally determine the architectural mass as well as the sequence of solids and voids which control the quality of the interior through the established rhythm of lighting. The human component depends on the users of the space who through their "life styles" (and needs), cultural connotation or certain appreciation of "schemata"[3] create feedback to the three dimensional entity set by the architect and give respective meaning into it.[4] It appears, therefore, that architecture which sets conservation of energy as its task must seek to satisfy both, three dimensional as well as human requirements.

It is my premise that architects in requestioning their "energy ethic" must go way beyond their current concerns, which are mostly technological and encyclopedic in nature[5] (i.e., concern of various solar heating systems). Architects should get back into the basics of design as far as design principles go. They will have to get back to some of the preoccupations of early architectural education or early training, ask once again questions pertaining to the discipline of controlling the solids versus the voids, controlling the massing qualities of their works (dynamic vs. static massing), controlling the whole attitude towards the making of interior spaces and make them respond to energy conserving demands. Similar concerns have to be developed for large scale architecture; that is, urban design and urban planning. In the search for the new "space" and "energy ethic," I argue that the study of the "typology" and "principles" of the "spaces" and "places"[6] to be found in the vernacular architecture of New Mexico will reveal to the student and to the architect suggestions which may prove beneficial for his vocabulary of a proper archi-

1. Cliff dwellings (caves) at Bandelier National Monument.

2. Tyvoni Pueblo ruins at Bandelier National Monument.



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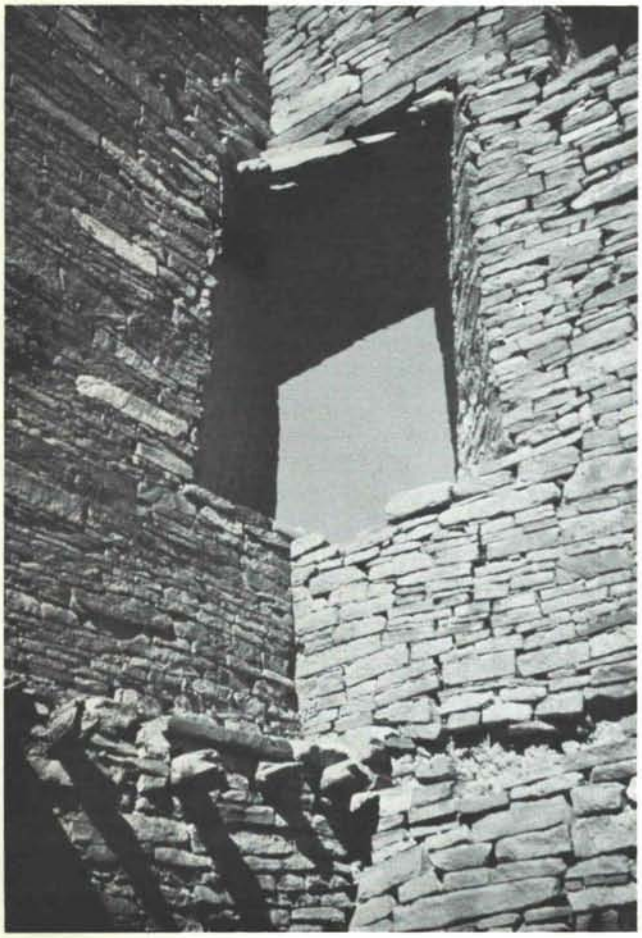
...C. Antoniades, A.I.A., A.I.P.

3. Rural pavilion on the way to Acoma.

4. Opening related to a view. Pueblo Bonito in Chaco Canyon National Monument.



tectural expression indicative of attitudes for energy conservation.

Physical Component of "Space" in New Mexico Vernacular.

Vernacular architecture of New Mexico is a good case of an architecture for the study of energy conservation principles. Fire was the natural energy used by primitive man. The only suffering ecology was the neighboring forest and the recycled manure. Yet, man had to pay the price himself. He spent energy from within himself. His survival depended on the burning of resources of his own body and his own hard work. Toil and fatigue combined with the discomfort caused by the moisture and dampness of his early Troglodytic pattern of living were the price paid to the high degree of the early (unconscious) natural energy conservation living. In this early era, New Mexico offered three types of habitation: The caves, the cave cliff dwellings, and subterannean or cliff Kivas.

The cliff dwellings were an advancement over the earliest cave dwelling in that they had their entrances protected by man-made walls or by structures that were blended into the cliff with the cliff itself and the occasional caves in it composing the back part of the building. These dwellings were achieved by means of earth extraction and by treating the added parts in "mass" articulating manner. The element of "mass" is fundamental. Its achievement was perhaps accidental from the energy conservation point of view. I suggest that structural reasons came first; the properties of masonry and earth as building materials required a "massive" approach, their use for energy conservation, energy storage, and environmental control was a secondary benefit. "Mass" therefore is the thing that must remain with the new designers if building within an energy ethic is to be achieved. The "massive" articulation of the cave or cliff dwelling permitted a tremendous ability for absorption and storage and slowed down the heat transmission that was applied to it during the day, while after sunset the radiation of that heat into the space helped to temper the chill of the evening.[8]

The Kivas were ceremonial spaces, mostly subterranean, achieved by means of extraction. Absolute control of natural lighting, ventilation through a deligent section and symmetry represented its basic physical characteristics.

In all instances the physical components that became distinctly evident are:

1. "massiveness" with a distinct articulation,
2. supremacy of solids over the voids,
3. proximity and high densities,
4. symmetry in the plans and section of ceremonial spaces due to collective attitudes of the human factor,
5. use of transitional spaces in combination with light temporary structures and light-diffusing textures for the treatment of the problem of glare.

5. Taos Pueblo. Rough log shelters provide shaded work areas. Small window openings prevent heat gain during the daytime and heat loss at night.

Massiveness: Articulation and Breaking-Down of Mass.

We may call "mass" and "massiveness" as the number one key to energy conservation in New Mexico. In later days the "mass" of the cliff edge or the mass of the man-made masonry wall was substituted by the "mass" of free-standing natural formations on which man attached his edifice. Figure[3] is a photograph of what I have called the "rural pavillion" on the way to Acoma. This small desert edifice represents perhaps a unique case of visual balance, a combination of natural and man-made, or *pas-des-deux* between the free-standing rock and architecture. Dwellings of the "rural pavillion" type were perhaps done primarily for purposes of construction economy (since the rock helped eliminate the cost of one wall), yet even if economy was the real case, it can still be argued that conservation of energy was a side effect; energy this time was the human energy that was saved by avoiding the building of the fourth wall. The early architectures of Portugal and Greece offer numerous examples of this free-standing type of rock-edifice composite.

The next type of "massiveness" is to be seen in the strictly man-made habitat of New Mexico. All the pueblos of the Indian civilizations demonstrate the qualitative advantages of the mass. Through proximity sharing of walls, use of masonry and earth, the early pueblos in Chaco Canyon, Bandelier, and Taos achieve energy economics, both natural as well as human. The natural energy resource conservation is still the same as that of the cave dwellings and of the subterranean Kiva. Additionally, the pueblos incorporate extensive use of wood burning and incorporate fireplaces and chimneys which return the heat to the interior environment after the heat source has been extinguished and during the chill of the night.

Mass articulation also helps the creation of pleasant working areas protected by the direct sun and freshened by prevailing breezes. These working areas are provided through the "human scaling"[9] of the total mass of the pueblo and articulation of the total volume.

The "volume" of the energy conserving "mass" of the New Mexico architecture is broken down to well articulated parts, thus causing a "free" or "sculptural" composition of the total. The "sculptural" quality is due to the constant change of the shading situations that are generated by the moving sun and eventually animate the building. This dynamism (movement of shadows of the surface) creates pleasing spaces between the masses and, through the variety of the mass break down (in volume and in plan), offers choice in the selection of appropriate exterior areas for productive work during the heat of the day. A side effect of the mass scaling of the pueblos is that it breaks down glare which would be unbearable if the mass were all assigned in one "static" volume. Contemporary architecture has a lot to learn in this respect as well.

Solids Versus Voids

Directly associated with the concept of "massiveness" of New Mexico architecture is the concept of supremacy of solids versus voids. New Mexico pueblos demonstrate a discipline of small openings (voids). These small openings are appropriate for materials weak in tension such as stone and adobe. Further, they are important for heat loss and heat gain purposes and their smallness protects the interior from direct sun penetration during the bright days throughout the year. The small opening in combination with the massive walls protects the comfort level during the chill of night. Characteristic examples of the supremacy of solids over voids is to be seen in the "section" of the New Mexico churches. The opening in these structures becomes uniquely placed above the altar, letting direct sunbeams hit the cross during the Mass. On other occasions, especially in residential architecture, small voids are placed appropriately framing special views or catching prevailing breezes and directing them into the interior. The supremacy of solids over the voids has been well understood as a discipline in New Mexico design. This discipline is represented in most of the vernacular works in the state as well as in many contemporary works, residential or institutional, which have really distilled the lessons of traditions and have used traditional and regional principles in intuitive contemporary ways. There are, however, certain unfortunate cases of new buildings, especially commercial and office structures which deviated from this very logical design vocabulary.

Proximity and High Densities

The third element, which is at present of maximum importance in terms of energy conservation, is the element of "proximity." The cave dwellings and the pueblos represent cases of urban habitation of very high densities. These densities in the past were achieved for purposes of protection; the whole town was a fortification operated by its inhabitants, yet the centralization achieved through this proximity reduced tremendously the linkages of communication between the inhabitants, permitted a very easy process in the division of urban labor, and offered an everlasting performance of urban theater for whoever was living in it. Nowadays, we have lost proximity. Uncontrolled growth and sprawl have increased the lines of communication among human beings. We have introduced outrageously high mileage of pipelines, electricity networks, channels of transportation, all consuming the scarce resources of energy our planet possesses. Our entertainment is costly to get; the ceremonial of the societal living has been lost; our human energy (fatigue) as well as the energy in the resource sense is wasted in the seeking of pleasures which have been widely dispersed in a dispersed environment.

Sprawl lies at the heart of the energy crisis and sprawl is the broader issue that architects and planners ought to attack foremostly and primarily. Taos, Bandelier, Chaco Canyon ought to become primary examples in teaching the principles of what energy conserving urban design ought to be. But proximity and high density are directly related to people's attitudes towards living under these conditions. The "human factor" is an extremely important consideration here and it represents the key element in making possible this type of energy conserving design. Discussion of the "human factor" and "human components" of space is now in order.

Human Component of Space—
Collective Attitudes and Symmetry.

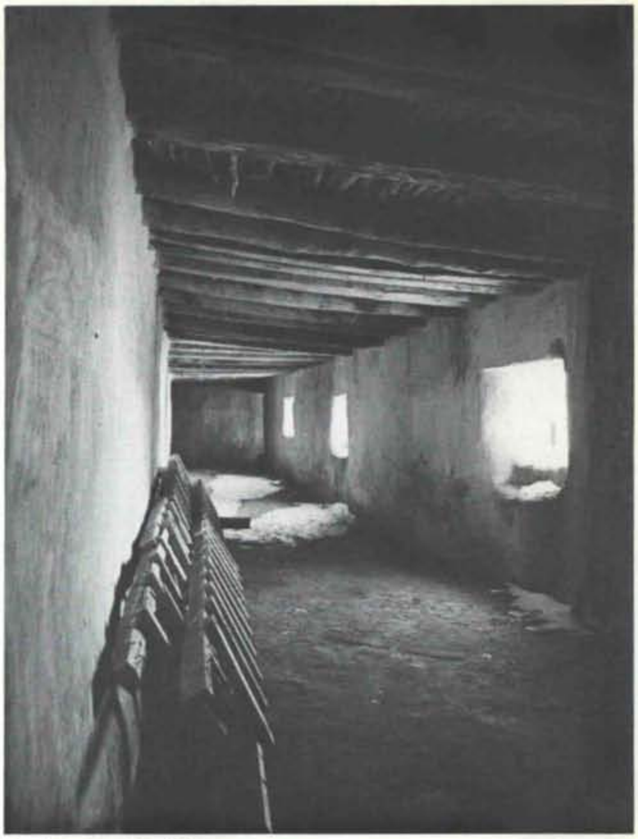
More than any other consideration affecting design and therefore affecting conservation of energy is the "human factor"[10] with its subcomponents "life style," "level of connotations"[11], "appreciation of schemata"[12]. The "human factor" responds to the spaces determined by the architects and the spaces are accepted by the humans as long as they respond to human needs in the physical, activity and psychological sense. In communities with a homogenous "human factor" one witnesses homogenuity in architecture and urban design. This is true for traditional New Mexico as well as for a good many other cultures such as the Greek, the North African, Southern Italian, and others. In communities with a "complex human factor" (diversified life styles, cultural inequities, etc.), there is diversification and non-homogenuity in architecture. In extreme cases of non-homogenuity, such as in the case of the United States, one observes environmental extremes and one faces perhaps the issue of the impossibility of a sound energy conserving architecture if this non-homogenuity is not worked out first through the channels of education, gigantic government programs, and civilization incentives. New Mexico, which teaches the principles of a sound energy conserving architecture, also demonstrates a homogenuity of its early people's attitudes towards space, towards high densities, towards environmental images (i.e., love of the inhabitants for "adobe" construction).

The early inhabitant of New Mexico had collective preferences ,collective symbols and "schemata," commonly accepted life styles. Of the human component, "life style," and perhaps even better, "the ceremonial of life"[13], had a direct effect on architecture and urban form demonstrating respect for conservation and care for energy. Life style and collective preferences expressed architecturally created the high density and proximity of the pueblos as well as the distinctive geometry of equitability for the Kivas and ceremonial places. The form of certain individual functional areas (Kivas, rooms, hogans) were symmetrical (circles, semicircles, octagons, squares[14]), while the form of the total urban unit was also following the rules of compact symmetry as much as it was permitted by the topography and the general environmental constraints. Symmetry and geometry of absolute shapes can be well justified in subterranean functions because the general environmental constraints (sun,

wind, view, rain, topography, etc.) are left outside, bearing no effect in shaping the building. Absolute symmetry would be undesirable for above the ground purposes which are exposed to environmental constraint. Different functions have different environmental requirements thus affecting differently the various parts of the building. Symmetry of subterranean functions, apart from the equipotentiality it offers for user participation, also offers equity in enjoying heating or ventilation and it is economic beyond description. "Symmetry" (circles, squares), therefore, should stay with us and, if nothing else, should at least represent one of our concerns in checking out our energy saving schemes. It is very possible that there is a very good chance for strong symmetrical spaces in a good number of the multifunctional buildings we design today, such as large hotels, shopping centers, community and university buildings, etc. If nothing else, a good, strong, well balanced geometric space will help us distribute the heat sources and the cooling devices appropriately and economically will offer absolute equity of comfort to the users of the interior. The interior, by the way, can develop ground arrangements and circulation patterns that are "free" of symmetry if diverse functional activities occur in it.

Glare.

Sun, brightness, and extremities between day and night temperatures represent the key environmental problems to be faced by the architecture in this state. Brightness causes the discomfort of "glare" which to a good extent is taken care of by mass articulation that has been discussed already; sun absorbing textures (beige color of stucco) and glare controlling transitional areas in the plan represent the other two major ways of glare control. Glare is not directly related to natural resource wastes. It is, however, related to human energy control and human comfort. The problem of glare is treated by considering the location of transitional areas in the plan. These areas, such as porticos (covered walkways around patios or entrance ways) permit a sequential and harmonic variation of light transition eliminating abruptness which is an essential for glare. Glare is also caused by direct contact of the sun with the grounds surrounding a building. Especially when the surrounding landscaping is "hard," glare may become a real handicap. Untreated building surroundings may produce environments non-conducive to outdoor living and outdoor working. Treating the problem of glare in the outdoors is the most energy conserving act man ever performs in the shaping of his environment. The New Mexico Indians of the Taos Pueblo use temporary shelters which they construct out of rough logs thus creating shaded areas on the ground which are cooler than the surroundings and can stimulate outdoor living and working during the summer time. The energy to create comfort has been absolutely taken care of by inexpensively created shadow in combination with the prevailing breeze, thus eliminating the need for massing air-conditioning for the enclosed work areas.



6. Acoma Pueblo.

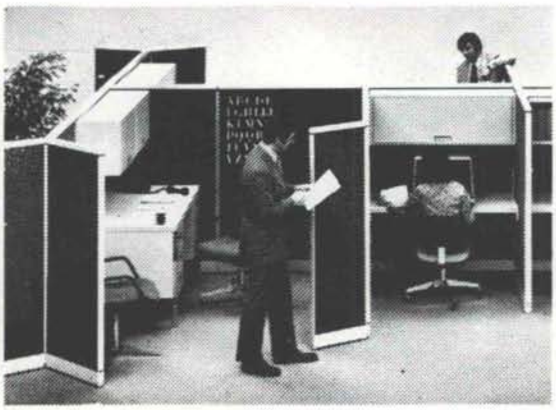
Conclusions.

It is perhaps not accidental that energy awareness is highly developed in New Mexico. A lot of personal experimentation and research has been taking place in the state for some time.[15] In fact, some of the earliest works of modern architecture, sensitive to energy, were built in New Mexico.[16] Yet, to my mind, it is absolutely doubtful that individual schemes of solar energy self-sufficiency (houses, domes, etc.) are the answers to the energy issue at large. Energy is in the heart of sprawl and the individual cases of private solar heated dwellings are absolutely insensitive to sprawl. I believe that the total environment will benefit only if the scientific, empirical and experimental ingenuity give hands to a responsible and "space" oriented architecture. I do not advocate that we return to the troglodytic habitation of the cave, but I do suggest that we look at technologically less sophisticated civilizations and use their principles as the basis for our designs. This article is not intended to suggest that the observations and points made, and perhaps the lessons to be drawn through further and elaborate study of architecture, are going to be the universal answers to the energy problem everywhere. What the article claims is that the apparent consistent universality throughout the regional architecture of New Mexico produced in the past what has been understood here as energy efficient architecture and urban organization. In this sense it is argued that a certain formal and spatial universality will have to evolve in other regions with similar sets of environ-

mental constraints if energy is going to become an issue and really hit the heart of architecture. This universality will not exclude individual expression or the use of new materials; it will rather adhere to certain universal principles of design sensitive to the question of energy and will be sometimes as simple as "glass versus no glass" attitude. Such attitudes, scientifically justified through the sound scientific advice of the appropriate consultants, will produce the "ethical"[17] or energy conserving work which will be not only responsible to the needs of the current users but it will also be responsible to future generations. And, as for New Mexico, it is rather clear that the formal vocabulary of "ethical" energy conserving architecture is that of massiveness, mass break down, superiority of solids over the voids, proximity and high density, abundant use of shading and heavy sun diffusing texturing. —*A. A.*

Notes—Bibliography.

1. See C. Norberg-Schulz. Space is understood as "a two way process, a real interaction. 'Architectural space' is a concrete physical aspect of this process." Existence, Space and Architecture, Praeger/1971. p. 37.
2. For well covered theory of the physical component of space and related design concepts, such as scale, rhythm, proportions, etc., refer to articles "Interior Volume" and "Exterior Volume." Progressive Architecture, June, 1965. pp. 155 and 166. Also basic reference on the subject. S. Rasmussen, "Experiencing Architecture."
3. Landmark reference for the study of above concepts also suggesting attitudes towards dealing with space: Paul Baker, "Integration of abilities: Exercises for creative growth." Trinity University Press/1972.
4. See C. Norbert-Schulz. "Meaning in Architecture," ed. C. Jenks and G. Baird/1969.
5. This refers to concern for information on specific energy saving devices, such as solar heating equipment, currently popularized even through popular magazines yet not genuine concern for fundamental design principles which might affect energy conservation. i.e. Popular Science, March/1975.
6. Distinction is made here between "space" and "place." Space connoting "enclosure," "focal point," "end in itself." "Place" connoting "an end and a beginning," "a terminal and a distribution point." "Place" is referring to urban design cases. See K. Lynch, "The Image of the City"/1960. p. 72. Also C. Norberg-Schulz, "Existance Space and Architecture," op. cit. p. 39.
7. Kittridge A. Wing, "Bandelier" National Park Service, Historical Handbook Series, No. 23, Washington, D.C. 1955, reprint 1961, p. 4.
8. R. Banham, "The Architecture of the Well-Tempered Environment," Architectural Press/1969, p. 23.
9. For discussion on the "scale" issue of the pueblos, see A. C. Antoniades, "Traditional vs. Contemporary Element in Architecture," in New Mexico Architecture/Nov., Dec., 1971.
10. For detailed general information on the "people" of New Mexico (Indian, Spanish, and Anglo) refer to A. Paul Theil, "New Mexico, Dancing-ground of Sun," Historical Society of New Mexico and School of American Research, Santa Fe, 1954, p. 10.
11. "Level of Connotations," terminology originated by the "semiologists," refer to L. Straus, Piaget, etc.
12. "Shemata," Greek term meaning "shape of things," introduced to Anglosaxon architectural literature by C. Norbert-Schulz.
13. Characteristic activities of this ceremonial are witnessed in the Indian dances and in the Mexican festivities (i.e., annual fiesta in Santa Fe, religious ceremonies, etc.).
14. "Squares" is referred to the almost absolute square pattern of the individual rooms of pueblo of Kuaua at Coronado National Monument. See A. Paul Theil, "New Mexico Dancing-ground of Sun," Historical Society of New Mexico and School of American Research, Santa Fe, 1954, p. 31.
15. A good part of the developments in this direction was reported by Jeffrey Cook, "The Varied and Early Solar Energy Applications of Northern New Mexico, A.I.A. Journal, August/1974, p. 37.
16. ibid. "Solar Building" by Stanley and Wright in Albuquerque, p. 38.
17. In my knowledge, the term "ethical" referring to energy responsible architecture was first mentioned by Texas Architect Frank Moreland in lecture pertaining to global issues of energy, U.T.A./Spring, 1975.



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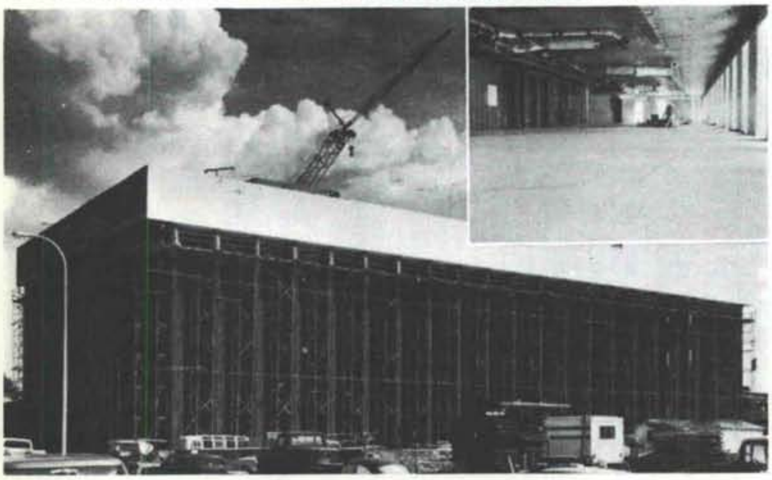

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