DOCUMENT RESUME

ED 079 819 EA 005 182

TITLE	Physical Recreation Facilities. A Report.
INSTITUTION	Educational Facilities Labs., Inc., New York, N.Y.
PUB DATE	Apr 73
NOTE	57p.
AVAILABLE FROM	Educational Facilities Laboratories, 477 Madison Avenue, New York, New York 10022 ($3.00)
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Air Structures; Athletic Fields; Building Conversion; *Building Innovation; Cooperative Planning; Cost Effectiveness; Extramural Athletic Programs; Facility Improvement; Field Houses; Flexible Facilities; Intramural Athletic Programs; *Physical Education Facilities; *Recreational Facilities; Roofing; *Swimming Pools
IDENTIFIERS	*Artificial Turf; Shared Facilities

ABSTRACT

New goals in physical education are leading instructors to seek new kinds of athletic facilities. School administrators are in the process of rethinking the classical facilities, i.e., the box-shaped gymnasium -- facilities designed without sensitivity to the students' desire to participate in the games they can continue to play after graduation. This new thinking also includes the design of facilities oriented to the female need to have a place for body exercise. This report seeks to display the various current forms and shapes of facilities designed for physical education, interscholastic and intercollegiate sports, and recreation. Although it does not advocate any general solution for everyone, the report displays the more imaginative and economically prudent solutions that have been built or proposed for specific settings. (Photographs may reproduce poorly.) (Author/MLF)

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EFL

Educational Facilities Laboratories, Inc , is a nonprofit corporation established by The Ford Foundation to help schools and colleges with their physical problems by the encouragement of research and experimentation and the dissemination of knowledge regarding educational facilities

Physical Recreation Facilities

A report from Educational Facilities Laboratories

EFL

Copies of this publication are available for $3.00 from
EFL, 477 Madison Avenue, New York, N.Y. 10022.

Library of Congress Catalog No. 73-76704
First Printing April 1973

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Foreword

Facilities for physical education, sports and recreation frequently loom large in the capital budgets of schools and colleges. They are, therefore, a proper concern for an agency like EFL whose mission, in part, is to help educational institutions get the most value from whatever they choose to build.

EFL has observed that many innovations in education, especially audiovisual aids, first entered our institutions through the vestibule of physical education and athletics. This surprising phenomenon confounds many a scholar. Yet, to give but two examples, education's first introduction to the overhead projector and to the videotape recorder was in the locker rooms of academe, not in its academic classrooms. This occurred because coaches (whose success in teaching is publicly evaluated on the scoreboard) are especially alert people who will embrace innovations that can speed the learning of their charges.

Now new goals in physical education are leading instructors to seek new kinds of athletic facilities, thus school administrators are rethinking the classical facilities—the box-shaped gymnasium for basketball, the stadium for six afternoons in the autumn, and facilities designed without sensitivity to the students' desire to participate in the games they can continue to play after graduation.

There's also another reason for an interest in new kinds of athletic facilities. It has always been an unwritten mandate of the American educational system that Johnny has always had as much right to pitch, punt or shoot as to read, and sometimes in better facilities than his classroom. But more recently, Mary Jane has demanded a place to exercise her body as well as her mind; she has found, not surprisingly, that the facilities were oriented toward a man's world.

This report seeks to display the various current forms and shapes of facilities designed for physical education, interscholastic and intercollegiate sports and recreation. It is not meant to advocate any general solution for everybody; rather it displays the more imaginative and economically prudent solutions that have been built or proposed for specific settings.

EFL has relied on the judgment of P. Richard Theibert, Director of Athletics and Special Assistant to the President at Hofstra University, to assemble the projects illustrated herein. For nearly a decade, while he was at Brown University, at Chapman College, and now at Hofstra, Dick Theibert has been retained by EFL to advise schools and colleges about facilities for physical education, competitive athletics and recreation. These are his choices from what various institutions are doing, or are planning to do, to provide better places for people—young and old—who seek to develop a sound body for a sound mind. From this assemblage, the reader may discover a sensible solution for the physical accommodation of the unique requirements of his or her institution.

EDUCATIONAL FACILITIES LABORATORIES

Introduction

An increasing number of students are no longer content to enjoy sports vicariously through elite groups of football or basketball players representing their college or school. Instead, students seem to want to participate in physical activities that they can continue throughout their lives. Many are more interested in swimming, jogging, climbing, skiing, playing tennis or golf, etc., than in watching big team games.

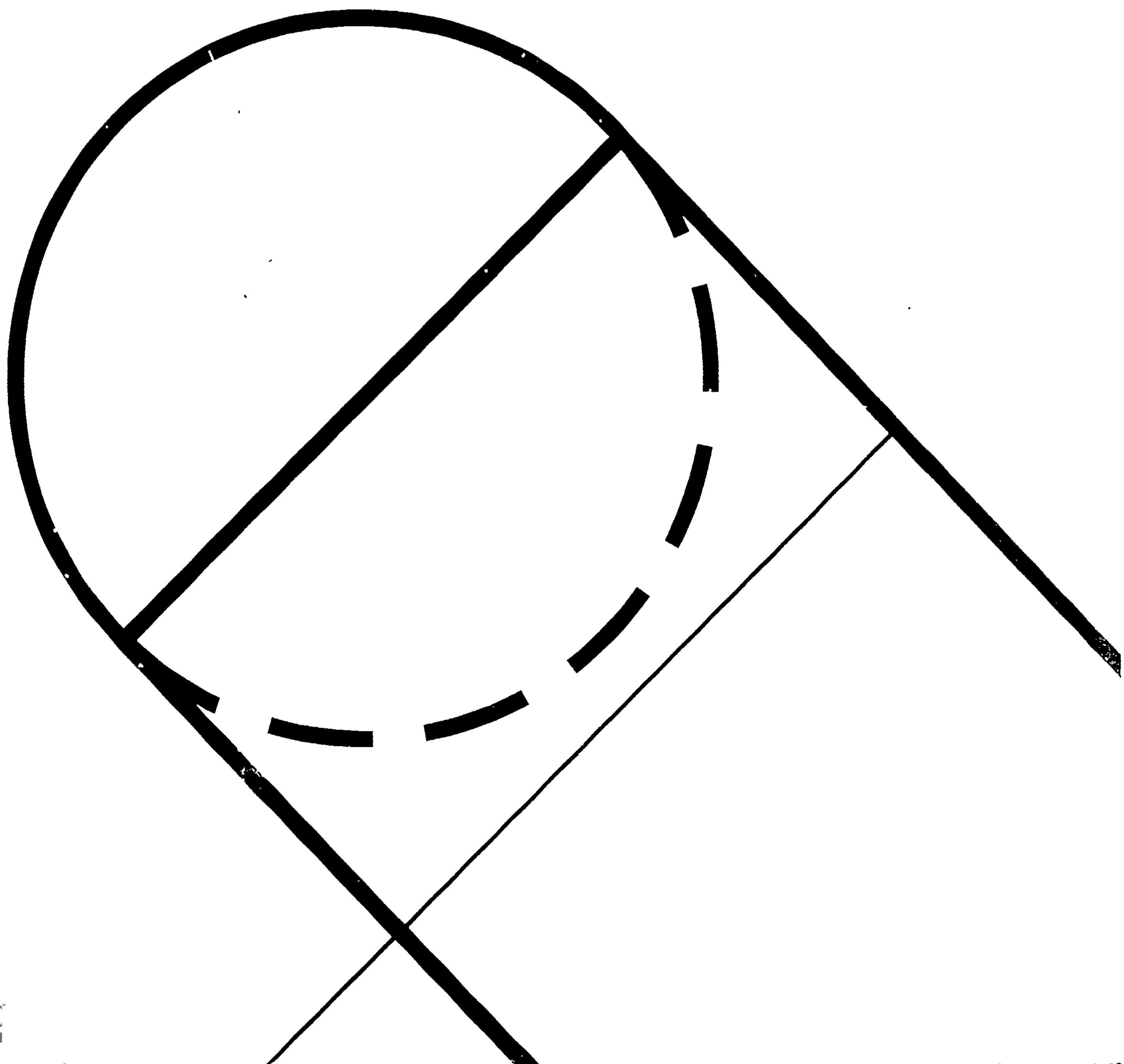
This change in sports styles affects the types of physical education facilities, most notably in the obsolescence of football stadiums and traditional gyms. In its heyday, college football could draw enough paying spectators during a short season to offset the costs of running an athletic program and a stadium. Now that crowds are dwindling, administrators are letting stadiums fall into disuse and dropping sports in order to cut their losses. They believe there isn't much else they can do.

However, there are two major alternatives open to an administration seeking to put a stadium to better use, or, for that matter, an administration that contemplates building a new stadium. First, seasonal limitations can be removed by roofing the arena for year-round use. Second, the football field can be deconsecrated and used for several kinds of games. These changes provide new flexibility because intercollegiate programs can still be incorporated in the sports program.

Enclosed stadiums are costly, but professional clubs in Houston, Detroit and New Orleans seem to find the investment rewarding. A new kind of enclosure in which a roof membrane is held up by air pressure may eventually remove the cost prohibition from enclosed stadiums. When large areas of playing space are covered with economical roofs, two alternatives present themselves. Seating can be installed so that the stadium can probably support itself financially with a variety of sports and entertainment events, or, without seating, the structure can be used as a giant fieldhouse for students' physical recreation.

Whatever use is made of it, the sports facility should never become one of the traditional "temples of sweat" operated at enormous cost for the benefit of a few talented people for a short season of the year. This book offers alternatives to this antediluvian principle.

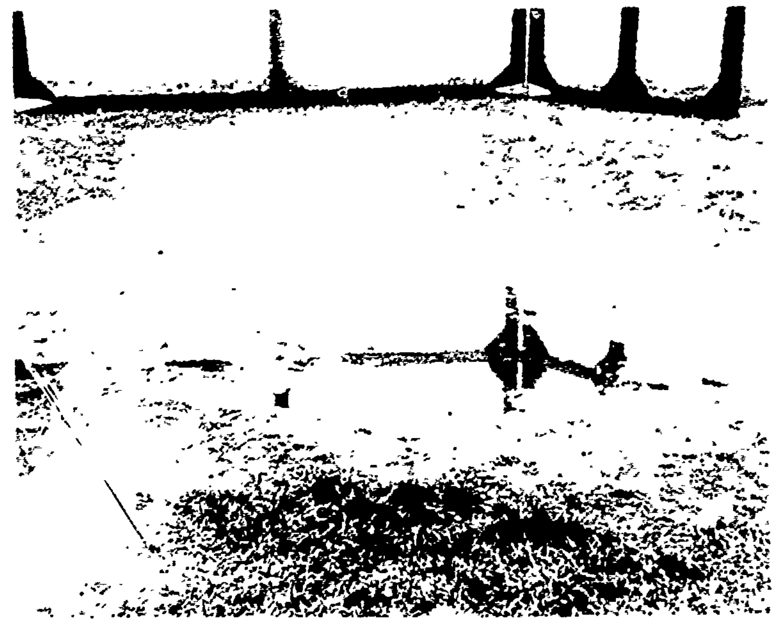
Updating Old Places

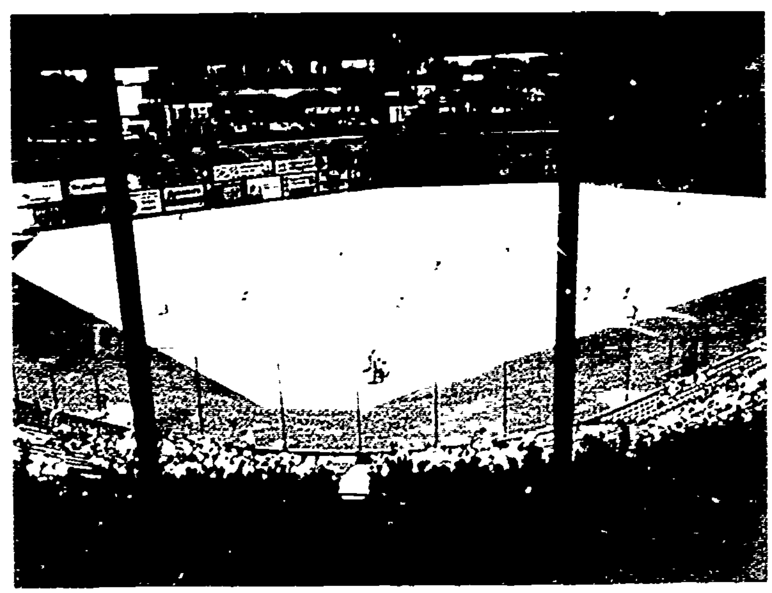


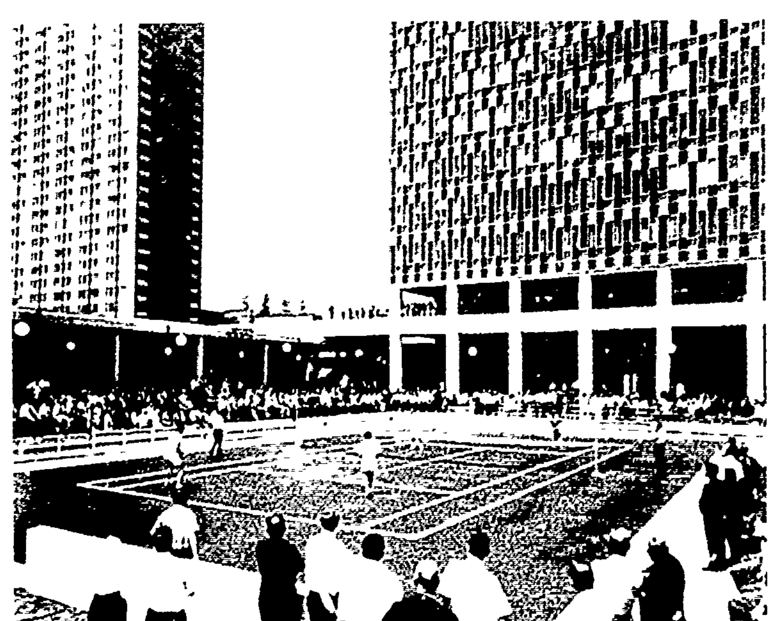
Sports activities demand a playing surface that gives maximum benefit to the players at an economical cost. An asphalt roof can be played on, but it's not responsive to the rapid footwork of games, it is abrasive to anyone falling on it, and if left unprotected it will eventually allow rain water to penetrate. Hence, some sort of playing surface should be laid over an asphalt roof.

Similarly, a concrete or asphalt playground needs rubber mats to protect children playing on swings or other equipment, and it should have artificial turf or an equivalent surface for ball games and general running about.

Artificial surfaces have also replaced grass fields that quickly became worn or stayed waterlogged long after rain stopped falling. The ubiquitous baseball diamond no longer needs to have bald dirt paths between the bases because artificial turf will keep the whole playing area green. And, of course, there's a maintenance bonanza since artificial turf never needs cutting. When necessary, it can be made portable for temporary use such as an exhibition tennis game in a city plaza.

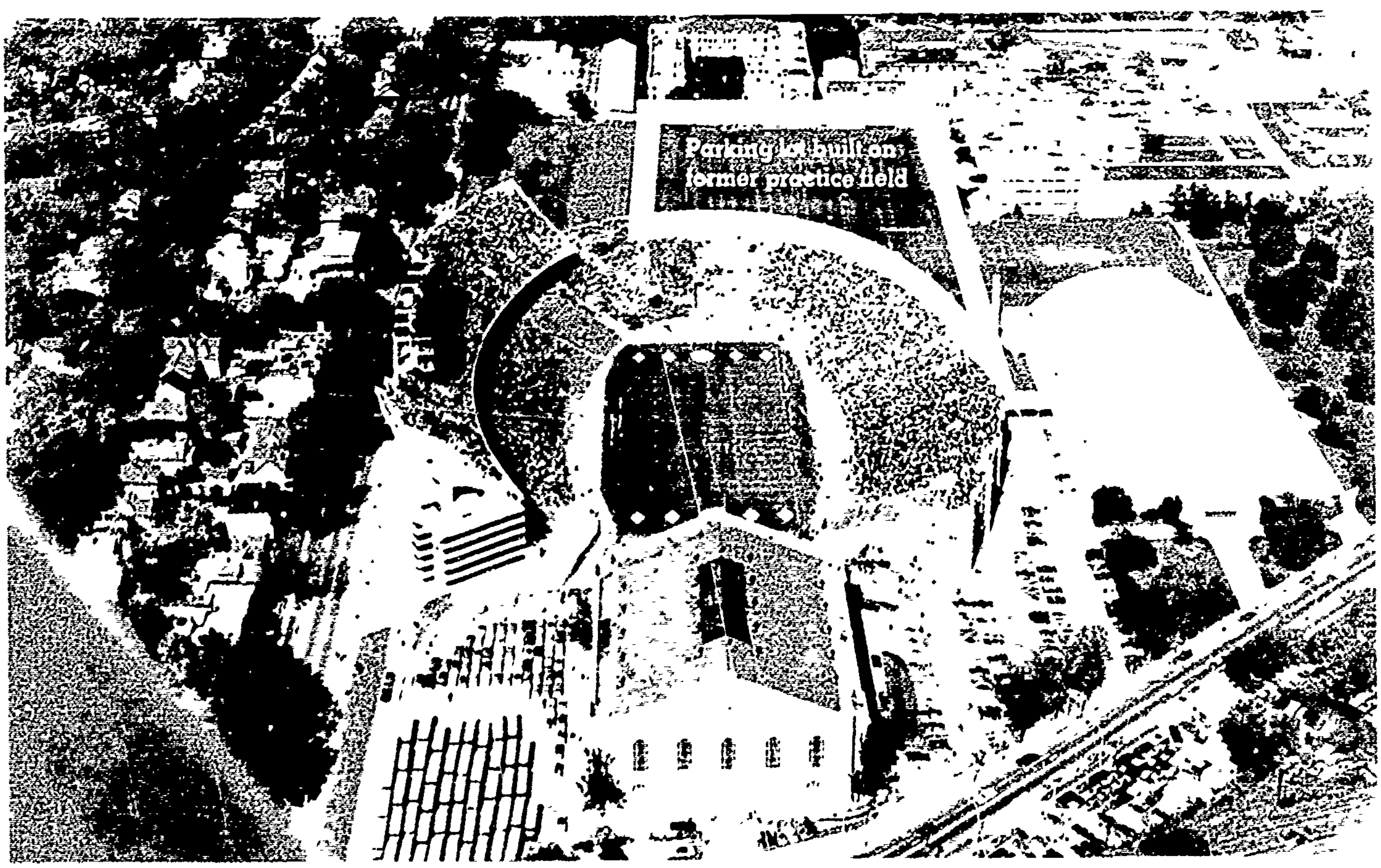




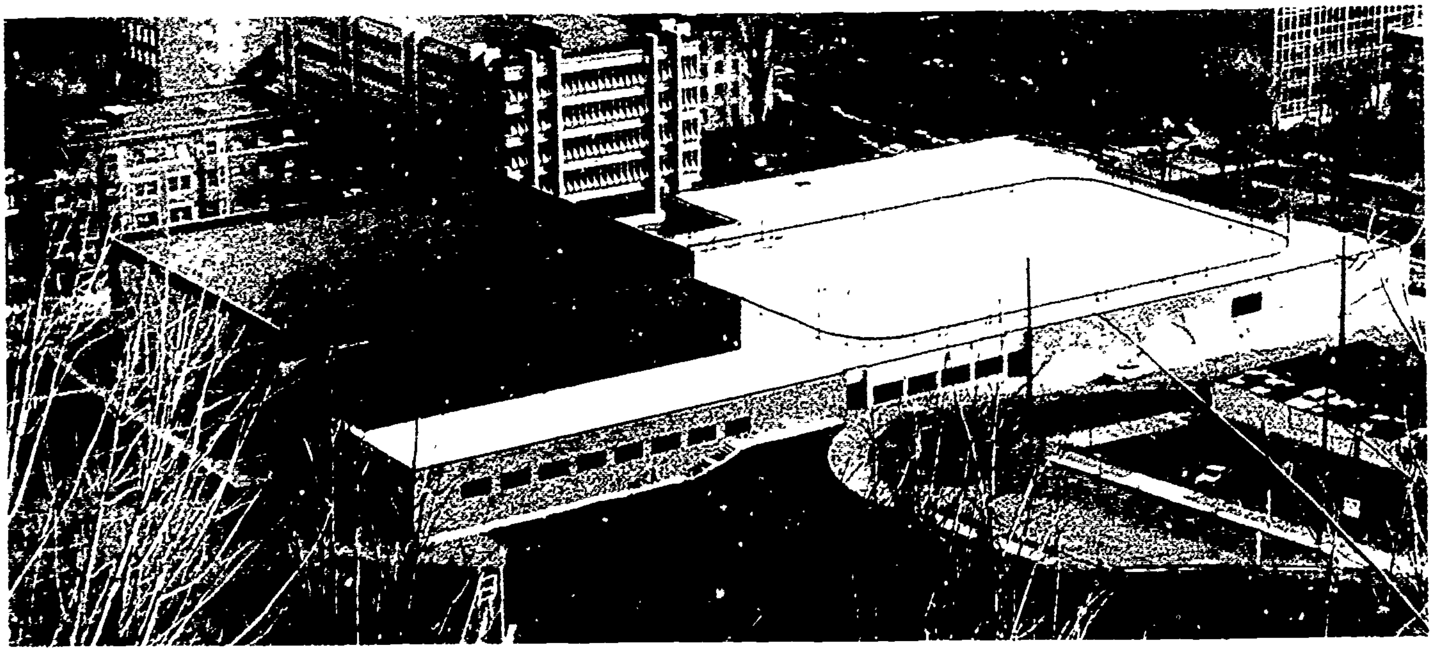


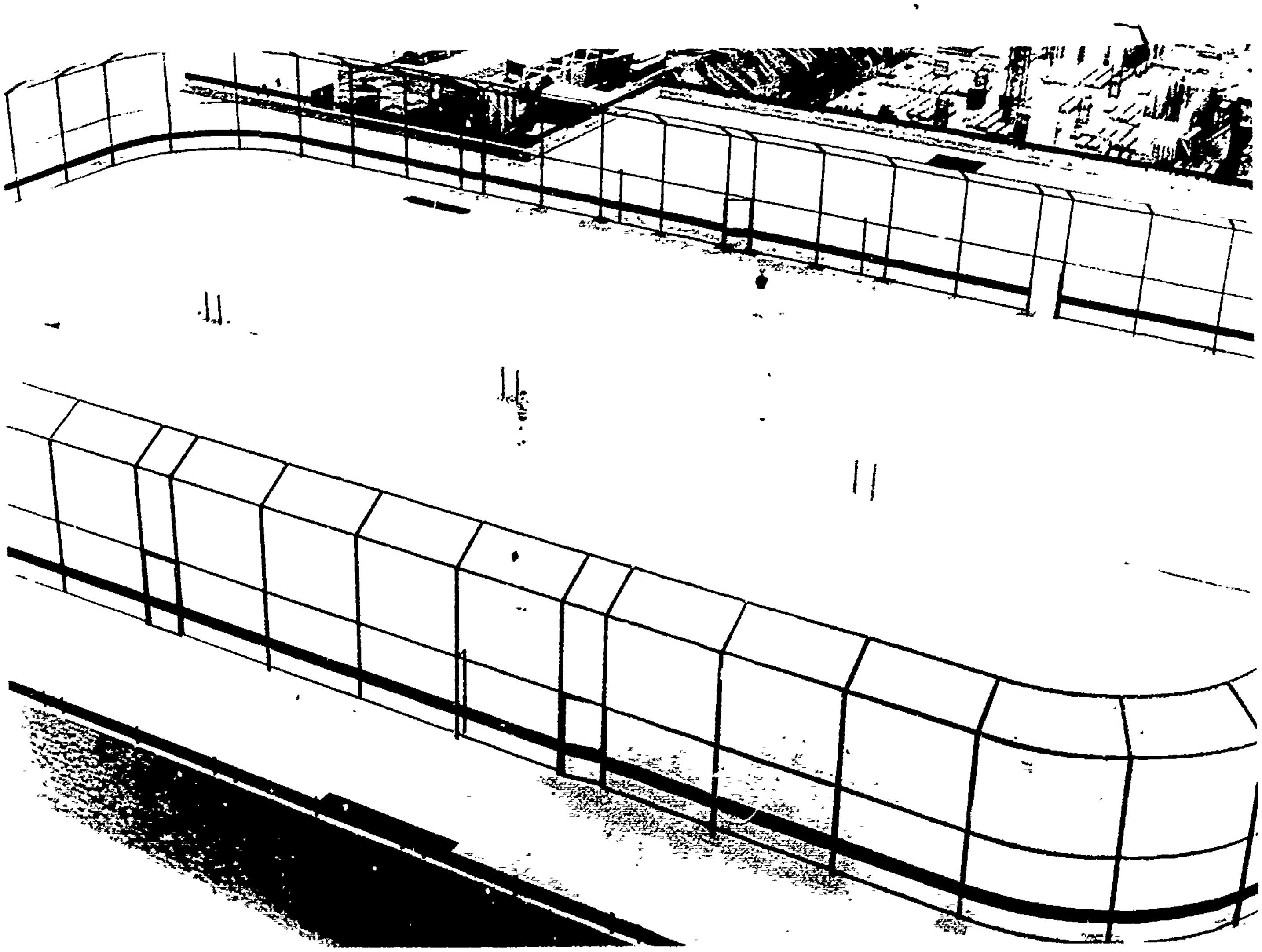
One way to extend the usefulness of a stadium is to replace the grass with an artificial surface that can withstand the rough and tumble of daily use instead of being preserved for the weekly football game. At the University of Wisconsin, artificial turf allowed the stadium to be used for daily team practices without harming the playing surface for the Saturday games. In this instance, one of the former practice fields outside the stadium was converted into parking lots for the university, but if parking spaces had not been needed, the site could have been used for a university building.

Many sports people believe that athletes perform better on artificial turf than on grass. The drawback is that since the players are traveling faster on the new surfaces they are also colliding at higher speeds which leads to harder falls and, possibly, worse injuries. Statistics on the injury rating of grass versus artificial turf are dubious in value since they can be bent to suit the beholder.



A urethane surface doubles as a playing surface for tennis courts and as a waterproof roofing material on a building at Portland State University.





With versatile playing surfaces to extend the life of a sports facility, the next logical move is to extend its usable life by enclosing the space to keep out the weather. One of the more satisfactory techniques is to shelter the area with an air structure.

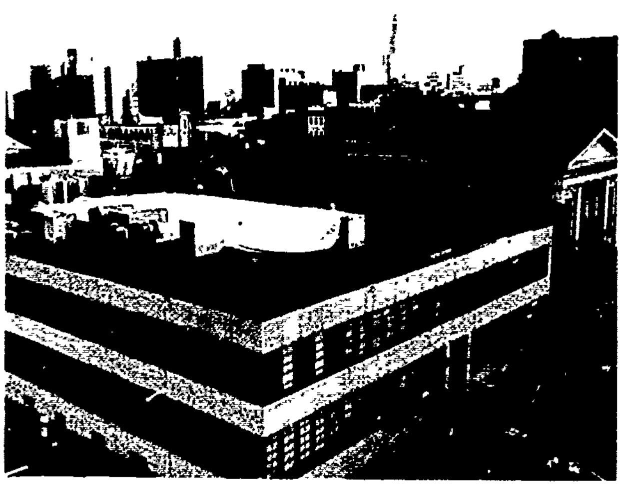
The principle of air structures—whether small or vast—is delightfully simple: Air is blown under a membrane so that it floats above the space to be enclosed. If the area is large enough, the membrane has to be prevented from moving away by cables anchored to the ground. Of course the membrane should be fire resistant and must be protected from vandals, and provision should be made to prevent the occupants from smothering if the air supply fails. Technology has made these potential hazards almost nonexistent, and it has also made the interior climate comparable in quality to that in other large structures. However, further research and development is required to regulate heat loads so that airconditioning is economical in hot climates.

Small air structures, usually sized in multiples of a tennis court, can be bought "off the shelf" at costs competitive with rigid structures. They can be erected much faster than regular construction, and if a building is only needed for a limited time, an air structure can be deflated and used at another site.

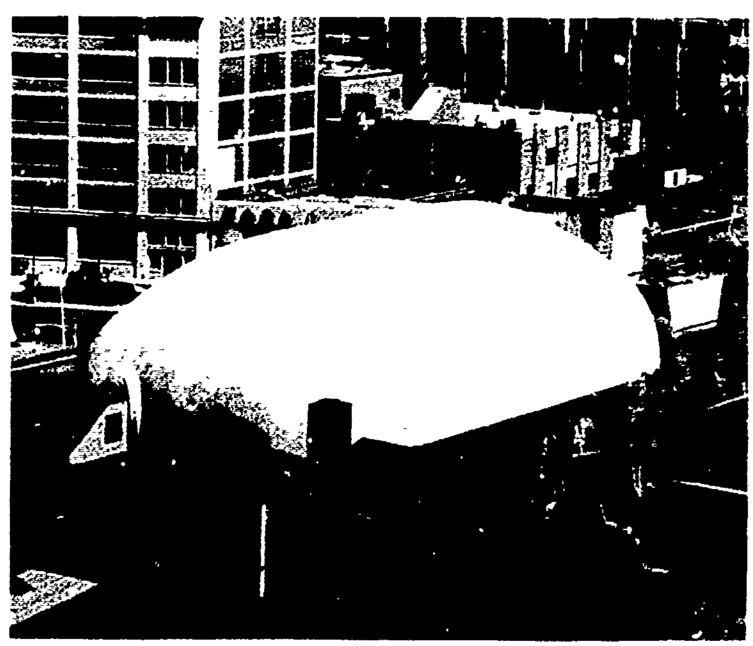
Large air structures have to be custom designed and fabricated, but their economy increases with increases in area. The costs of air structures are influenced by the materials used in the membranes, and this in turn affects the length of the guarantee. A small structure made of fabric is guaranteed for about three years, and a membrane of teflon-coated fiberglass is guaranteed for 20 years.

In cities, rooftops are often the only available space for a small air structure. Some roof equipment, such as stairs and water towers, may not be movable, but airconditioning equipment can often be relocated to make space for a gym or tennis courts.

One of the prime advantages of air structures for rooftop shelters is that their light weight doesn't exceed the carrying capacity of the building. A heavier type of shelter may necessitate strengthening the building to support it.

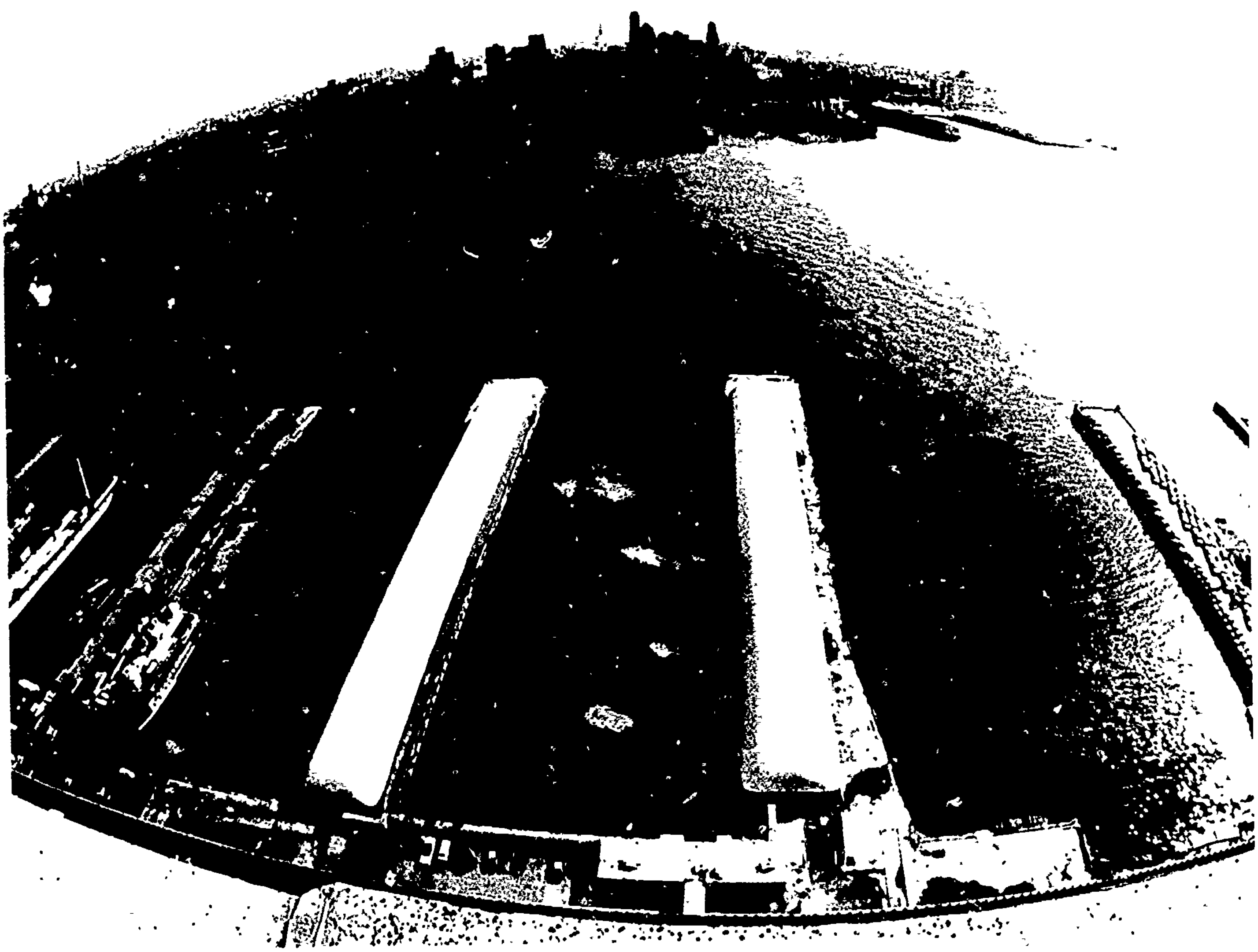


Brooklyn Polytechnic Institute



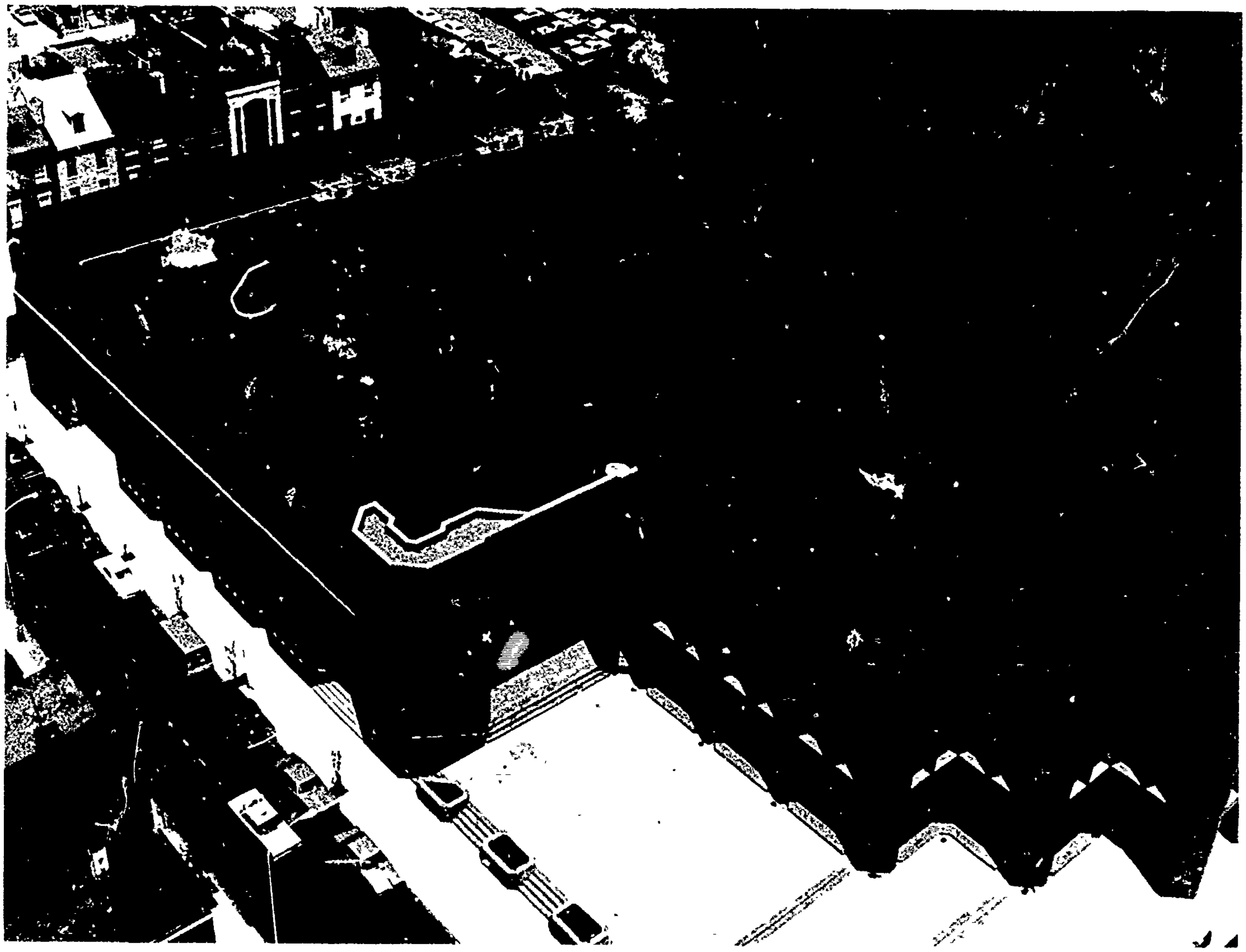
Unused piers accommodate these two air structures belonging to a commercial operator of tennis courts in the financial district of New York City. Customers can play at any time of the year on courts that would have been prohibitively costly to build on a regular site with conventional materials.

Wall Street Racquet Club



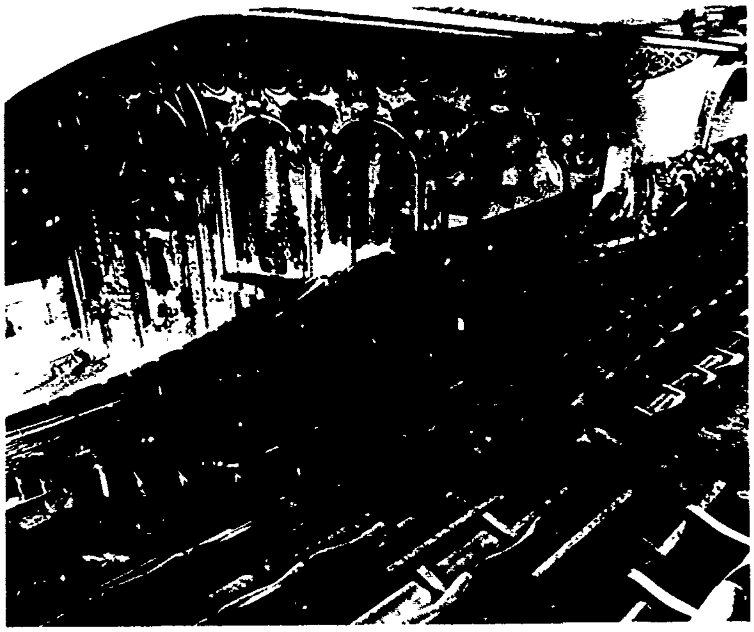
A more radical approach to providing playing areas at economical cost was demonstrated by Friends Select School which occupied a downtown Philadelphia site that included a playing field. The school needed larger and updated facilities that would normally have been economical only if they had relocated outside the city. Instead, the school leased some of its land and netted sufficient [illegible] to pay the cost of a new school on the existing site.

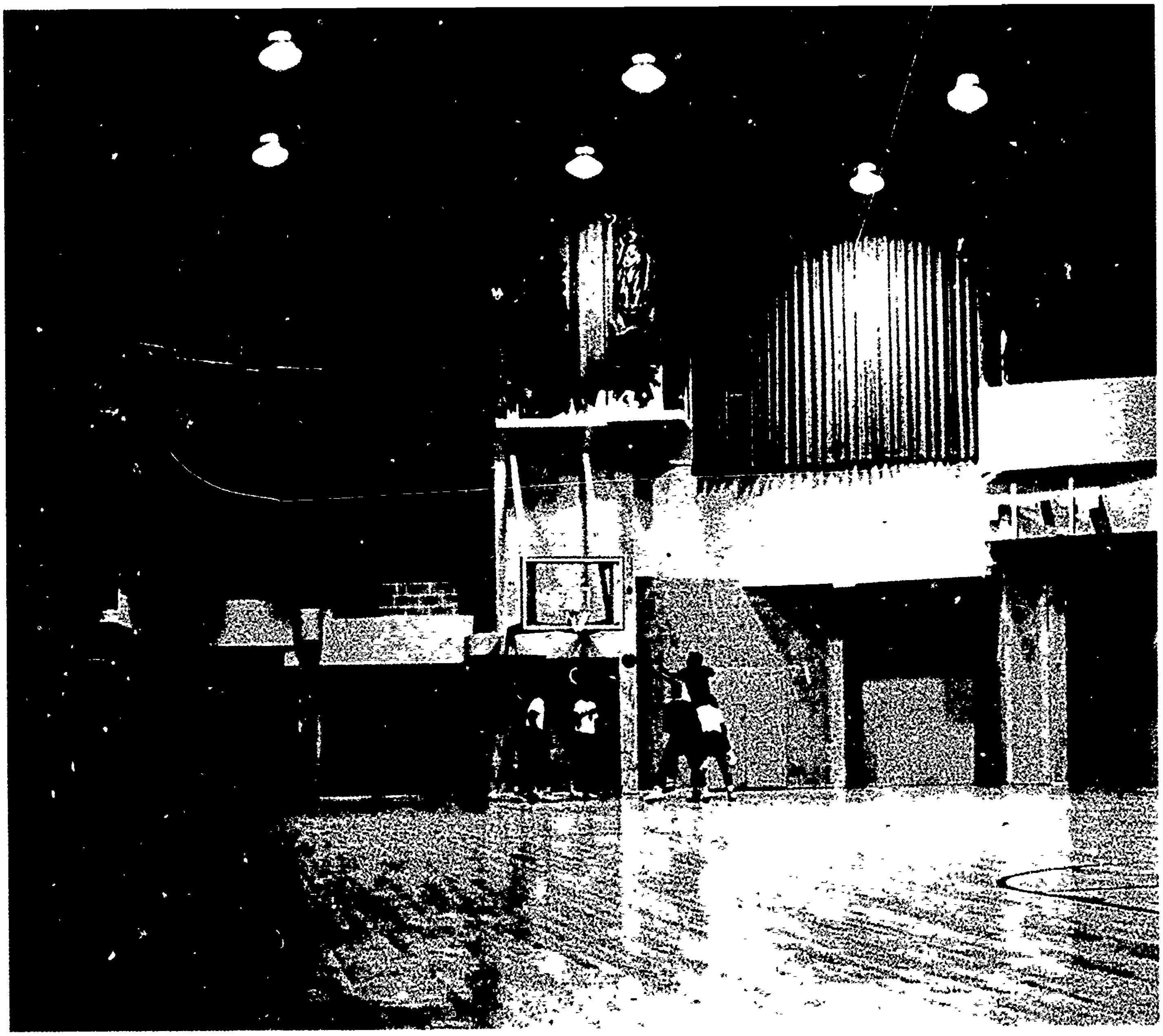
Friends leased one-third of its site to a company that built an office tower. The school was able to build new premises on the other two-thirds and double its former space. To compensate for losing the playing field, the school covered the roof with artificial turf and fenced it in to stop balls sailing into the streets.



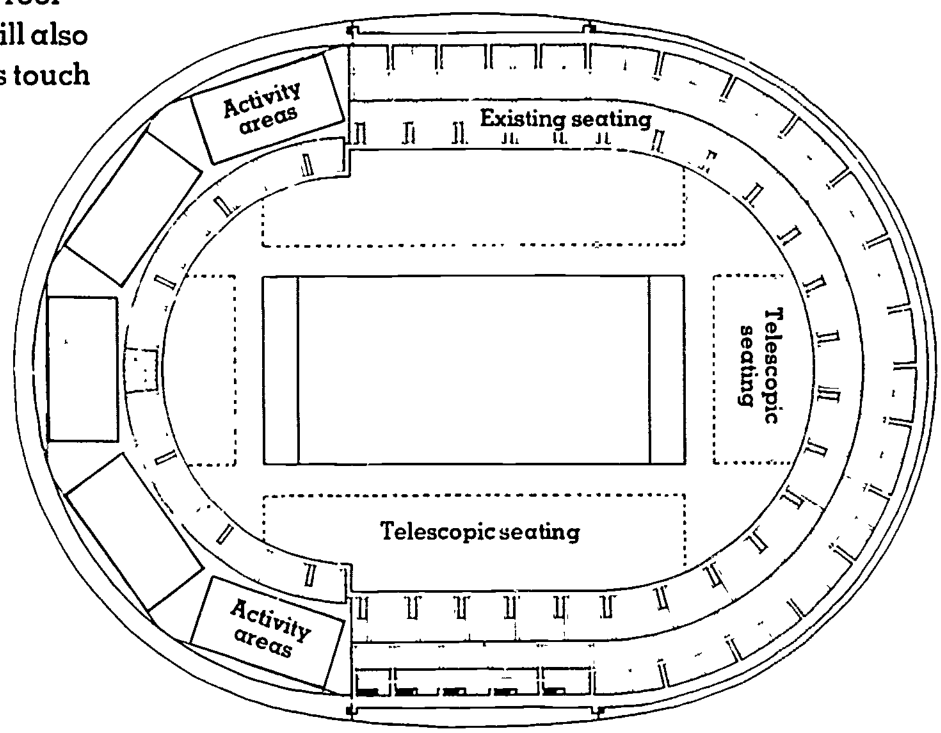
Schools and colleges frequently convert other buildings for academic use, so it's not surprising to find unlikely buildings being made over into gyms.

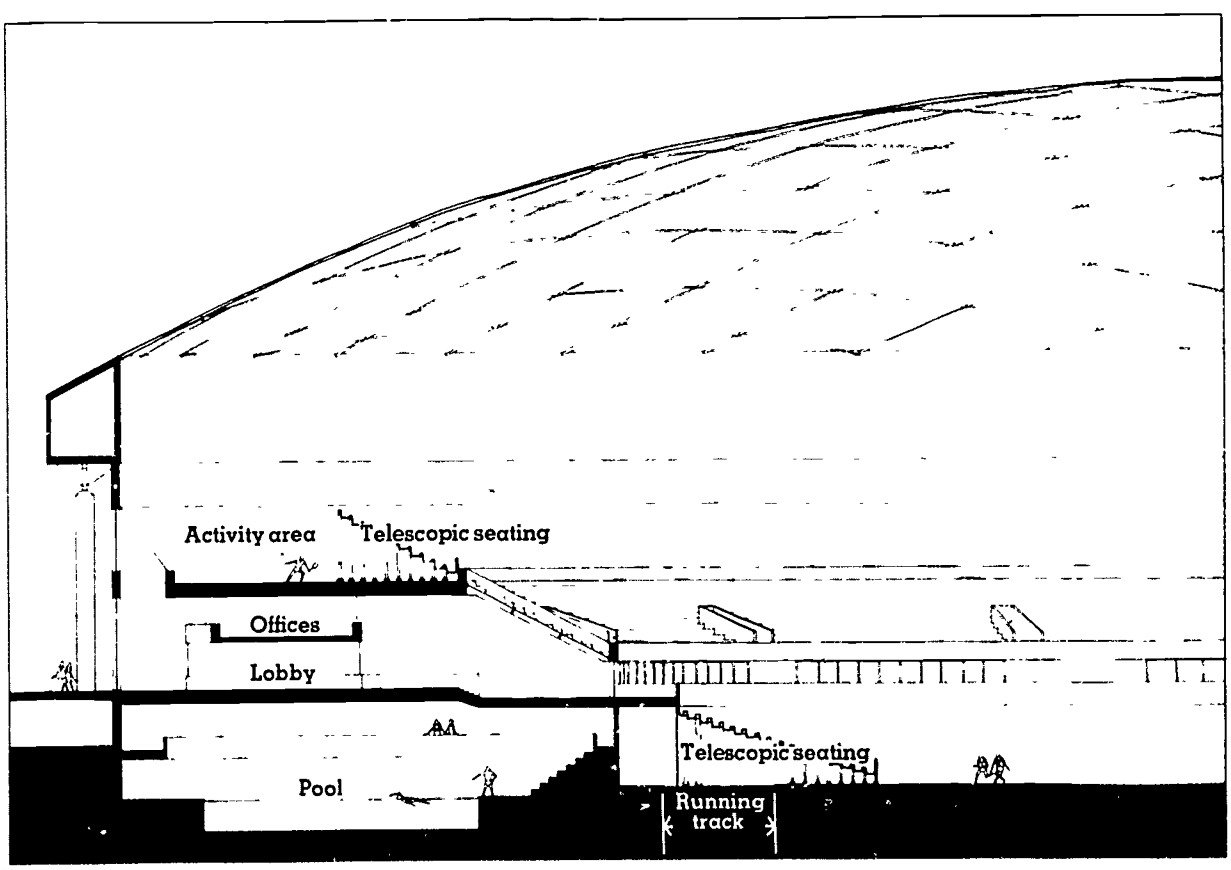
Long Island University bought a baroque movie theater close to its Brooklyn campus and converted it to a gym. It was a major construction job, but in cities the cost of new buildings invariably outweighs the cost of conversion.

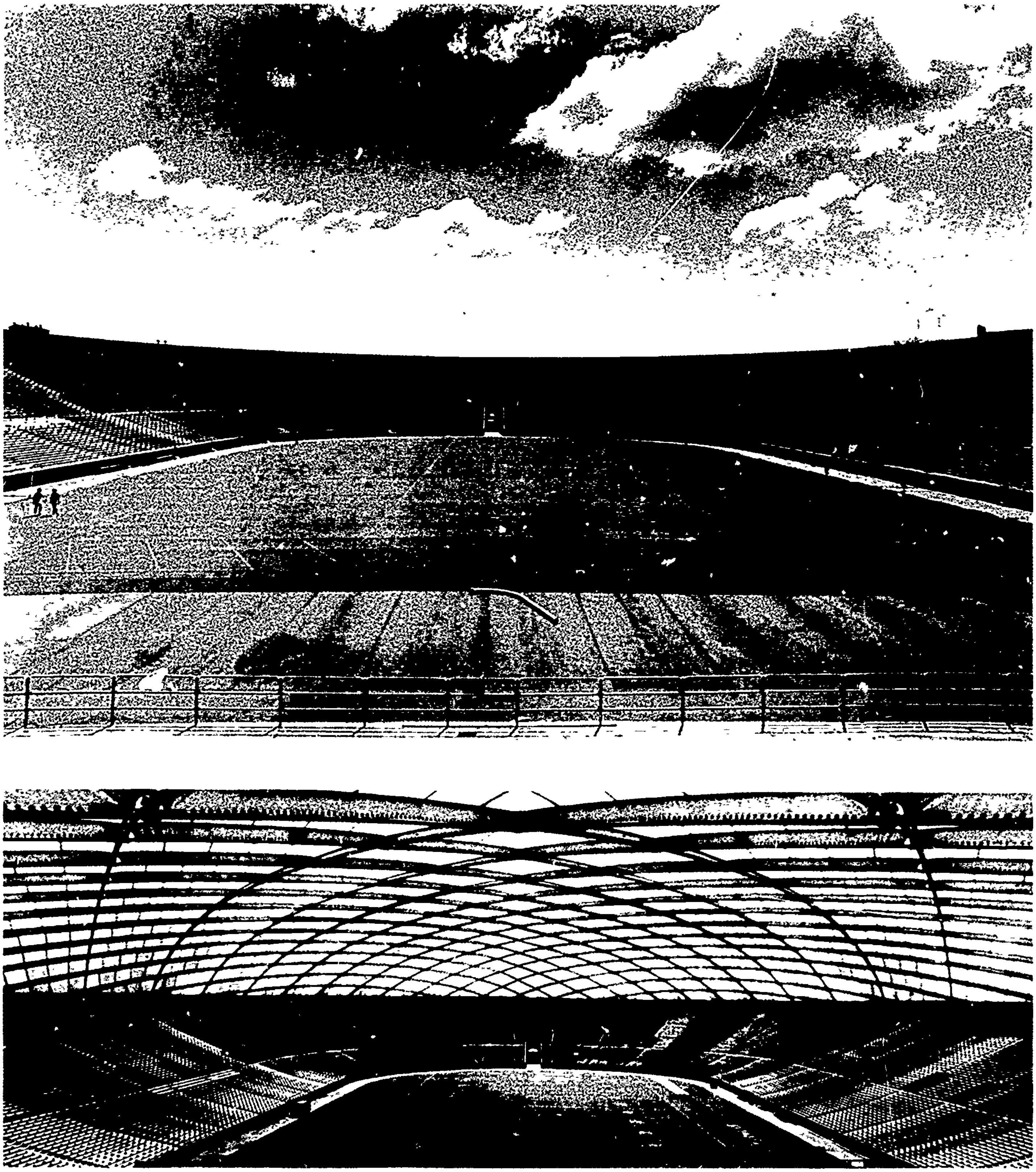




The college football season is not long enough for the take from home games to cover the operating costs of a large stadium. But if roofed over, the arena can be used regardless of weather or climate. And, of course, it can be used for other kinds of sports and games. If the University of Minnesota erects the air-supported roof proposed for its stadium, the field will also be available for three simultaneous touch football or softball games.





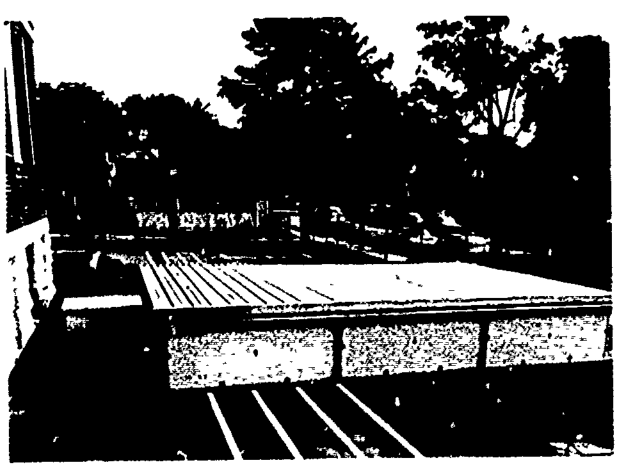


Composite picture of the existing stadium and the air-supported roof of the U S Pavilion at the World's Fair in Osaka

Techniques For New Places

Swimming pools may never go out of style, but there are variations on the traditional pool that ought to be considered. For instance, hydraulically operated pool bottoms can vary the depth of water so that the pool can be used for different activities, such as wading and swimming.

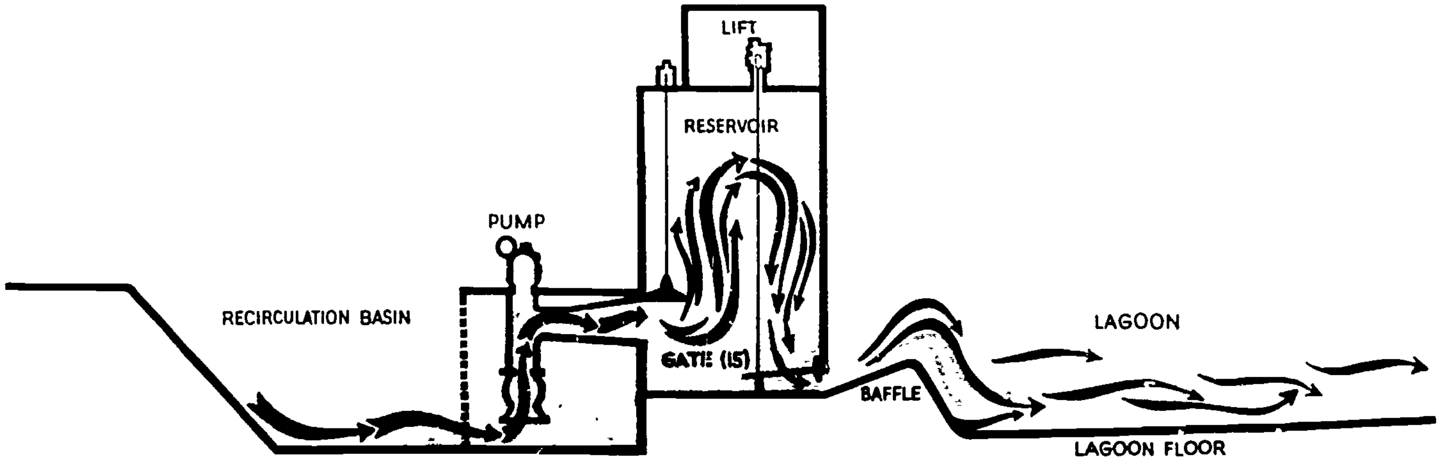
Portable pools that are erected on top of the ground or on a floor can give youngsters who live a long way from traditional pools an opportunity to swim. Portable pools are also ideal for teaching children to survive in water. "Drownproofing" is the name of a technique for staying alive in water by floating for long periods of time. It is not the same as swimming and requires much simpler facilities: a small tank not more than 3 ft deep, and a normal room-height ceiling if it is indoors.



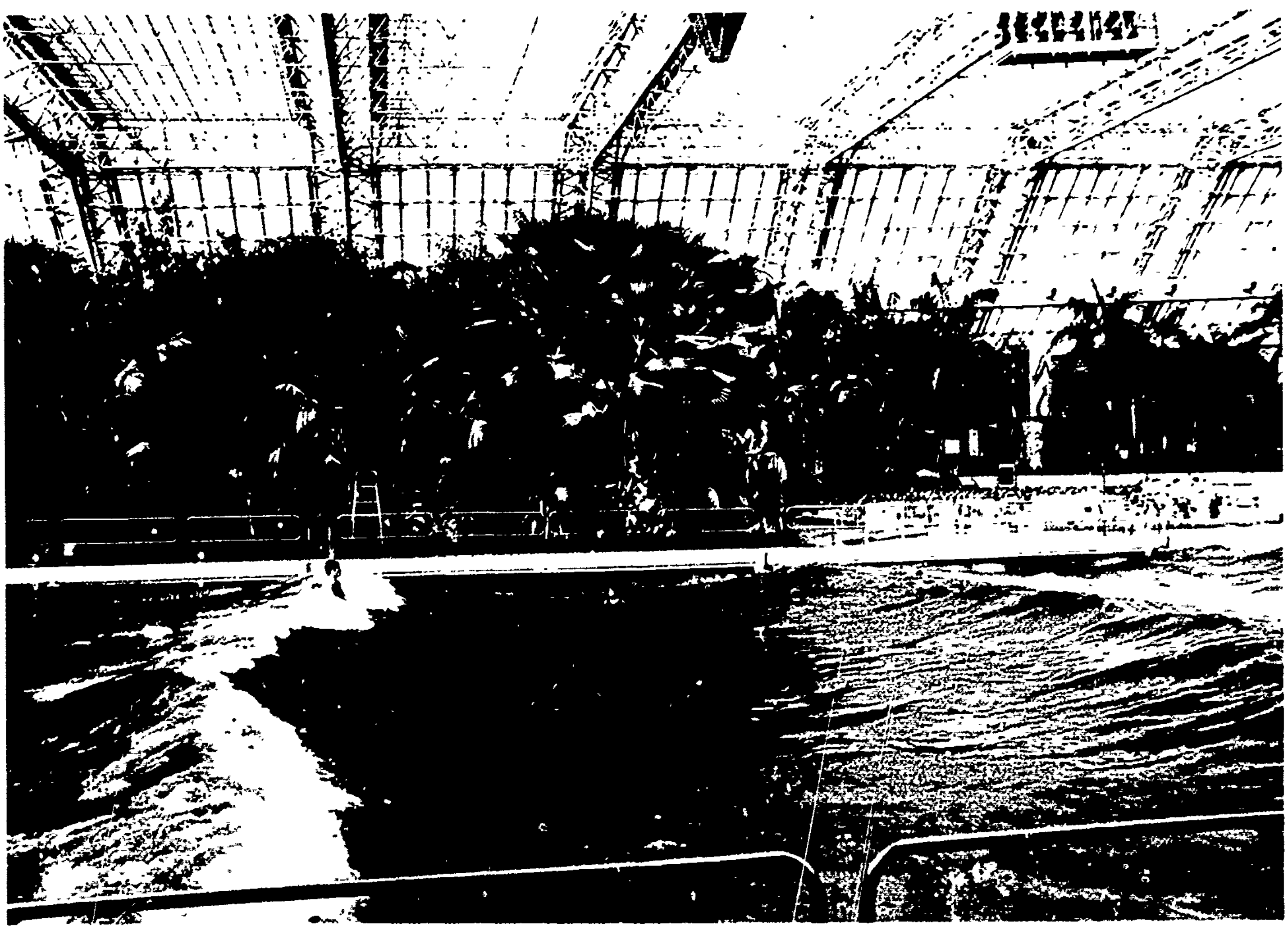
Carroll County School District, Carrollton, Miss

Surfing is a popular water sport with people lucky enough to live near ocean beaches with the right kind of conditions to produce surfing waves. Now it could also become popular with people living hundreds of miles from an ocean because the surfing conditions can be reproduced in a pool.

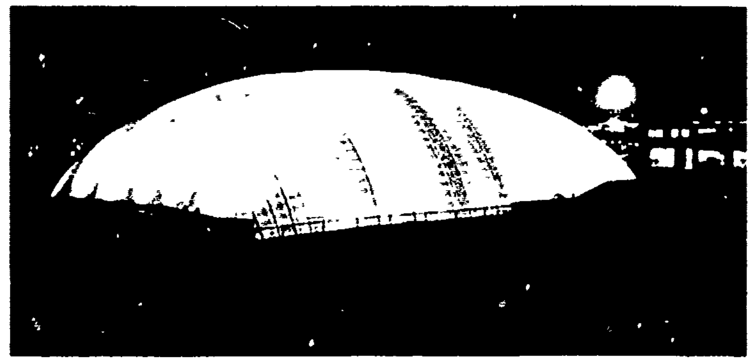
The first surfing pool in the U.S. was built at Tempe and is used by Arizona State University. Water surging from the base of the reservoir wall creates waves at 50 second intervals.

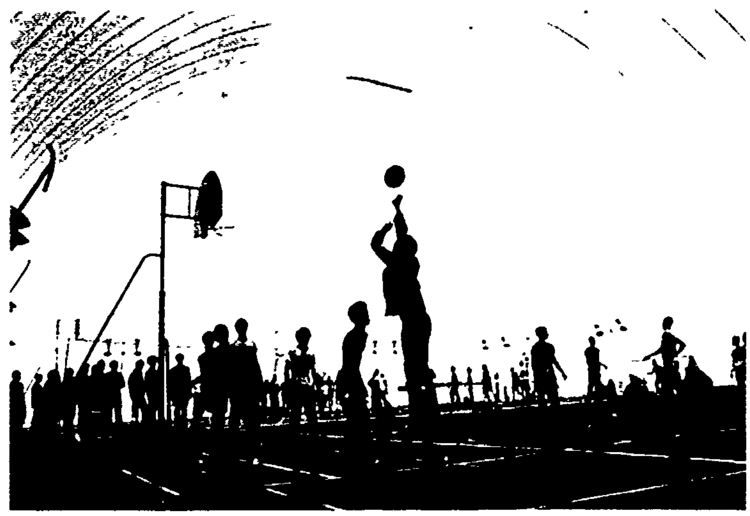


When the wave generating machinery is shut off at the Summerland pool in Hachioji, Japan, the surfing pool becomes a swimming pool. The large pool is shelved at one end for the waves to run out or to allow small children to get into the water the same way they would at a beach. The other end is wide enough for swimming races. The building has a landscaped interior that dispels the sterile atmosphere usually associated with indoor pools.

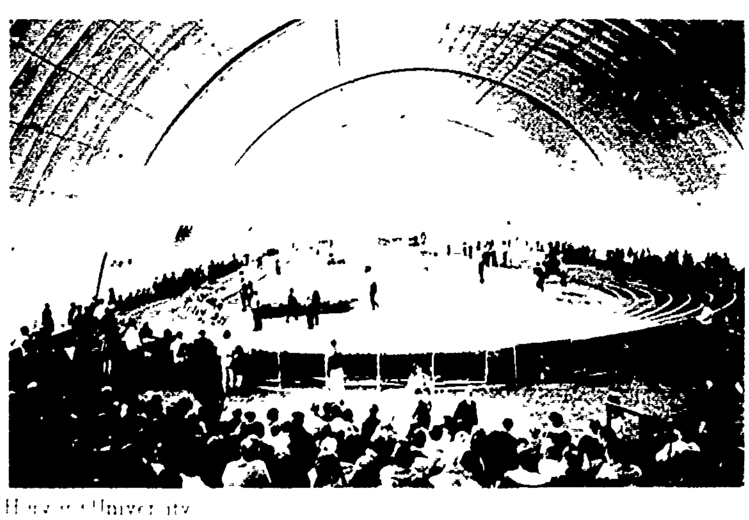


There are no restrictions on the activities inside an air structure. Ice, water, artificial turf or boards can be used. One main attraction is that there aren't any columns in the way. The main disadvantage for some owners is that it isn't easy to accommodate spectators, but for lifetime sports this objection isn't important.

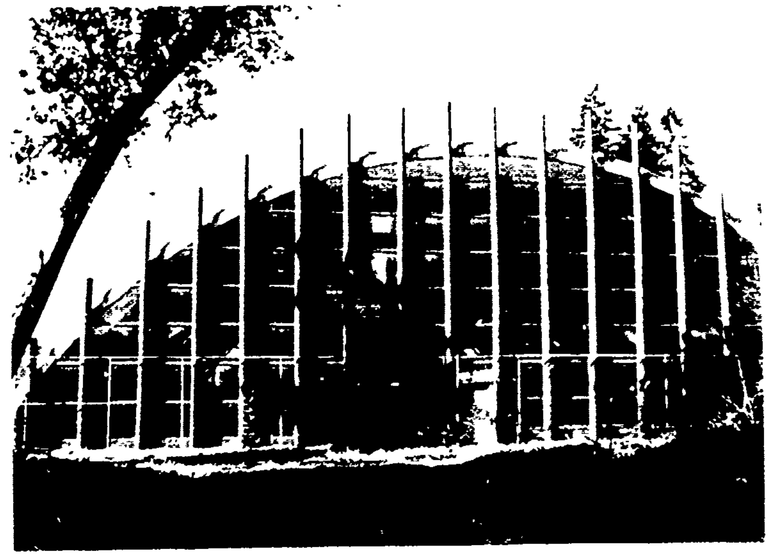


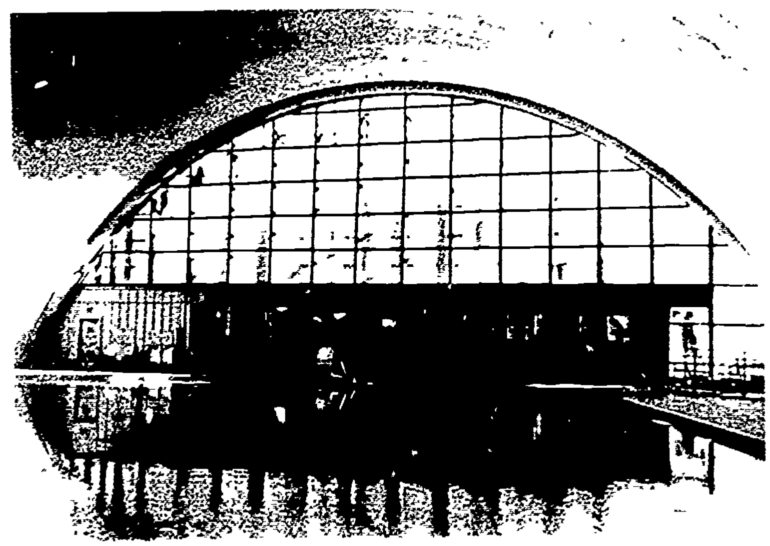


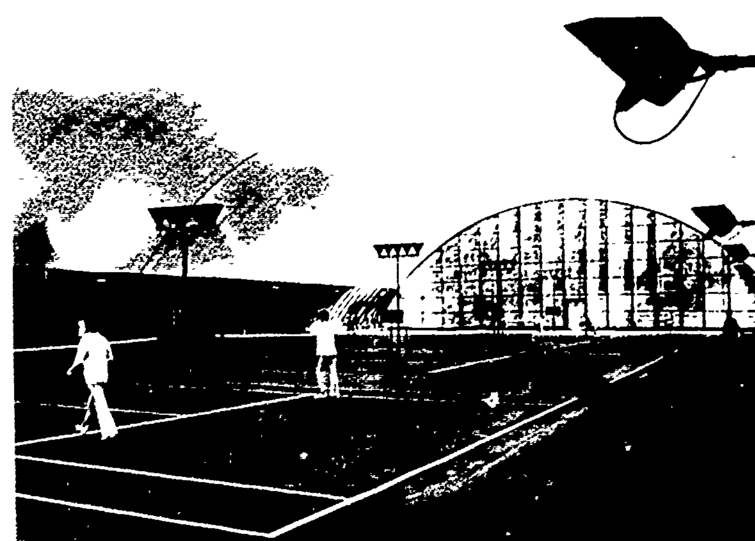
[illegible] School, Litchfield, Conn.



Harvard University







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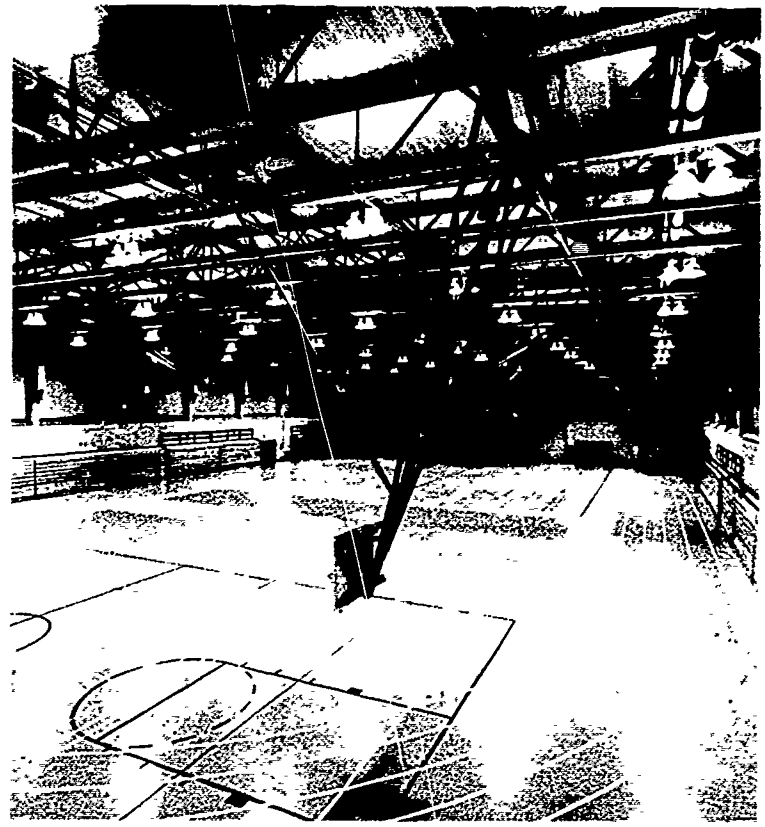
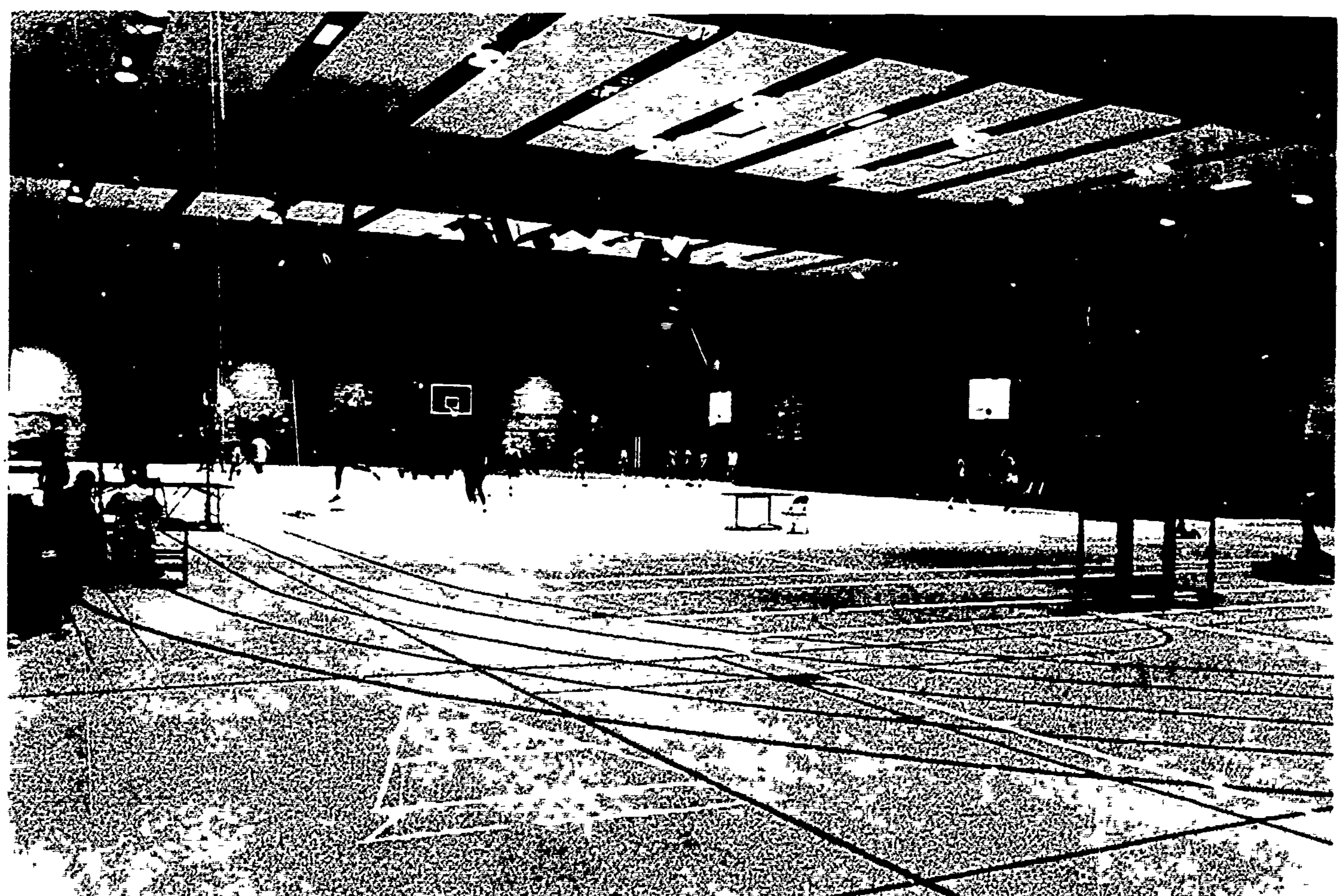
Physical recreation facilities for secondary schools are best provided in fieldhouses built adjacent to a schoolhouse. Because of the large sports area required, there's no sense in wrapping an expensive school structure around a physical recreation facility. Instead, the fieldhouse should be enclosed either with an air-supported membrane or with low-cost conventional construction.

Interior finishes can be much less sophisticated than for a cafeteria or auditorium. The underside of the roof structure can be left exposed and the heating ducts and plumbing pipes needn't be hidden. The fieldhouse should be at least large enough for a standard-size running track to encircle the basketball courts.



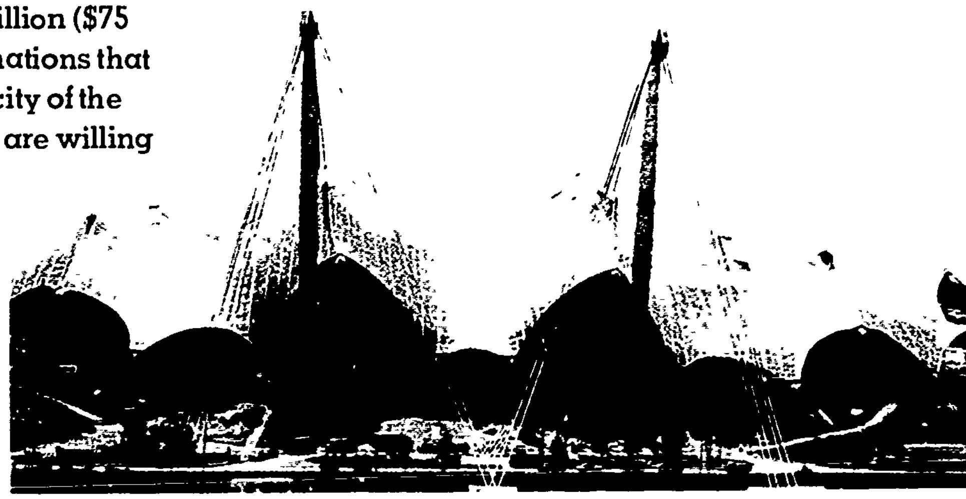
Wilton Senior High School, Wilton, Conn

Juanita High School, Kirkland Wash

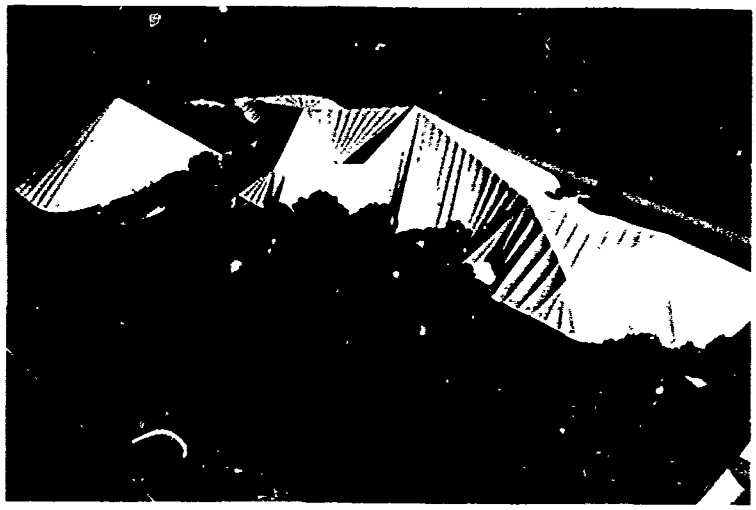


Three of the arenas for the Munich Olympic Games are fully or partly enclosed with cable-net structures. The Olympic stadium accommodates 84,000 spectators (50,000 in seats), but the playing area is not covered. The Sports Arena and Swimming Arena are fully covered.

The three roofs alone cost $60 million ($75 per sq ft, for 800,000 sq ft). Only nations that set high store by the good publicity of the Olympics and the World's Fairs are willing to bear the enormous costs of hosting them. Few colleges could pay for such publicity. However these structures should be considered prototypes for economical versions.

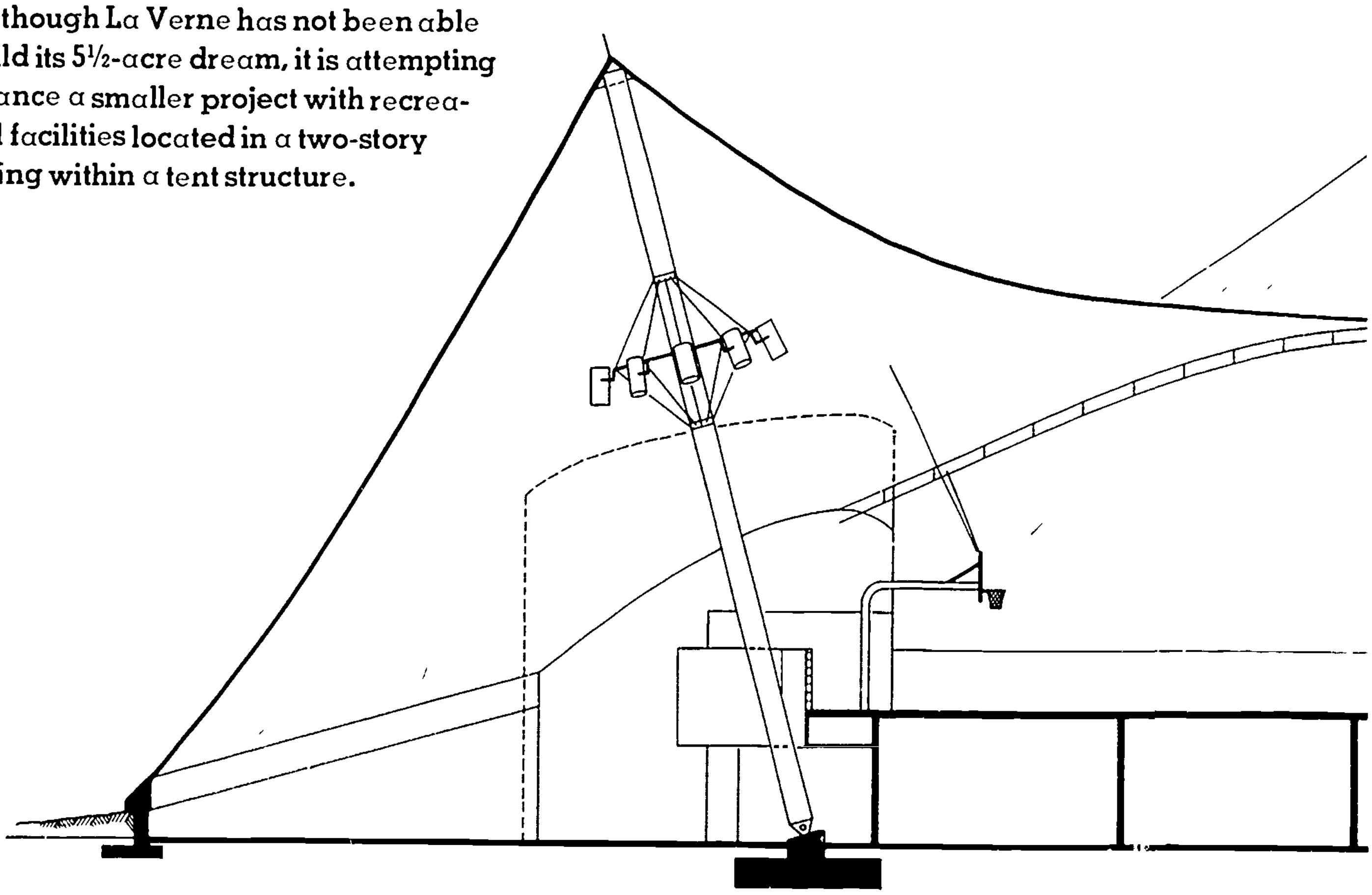


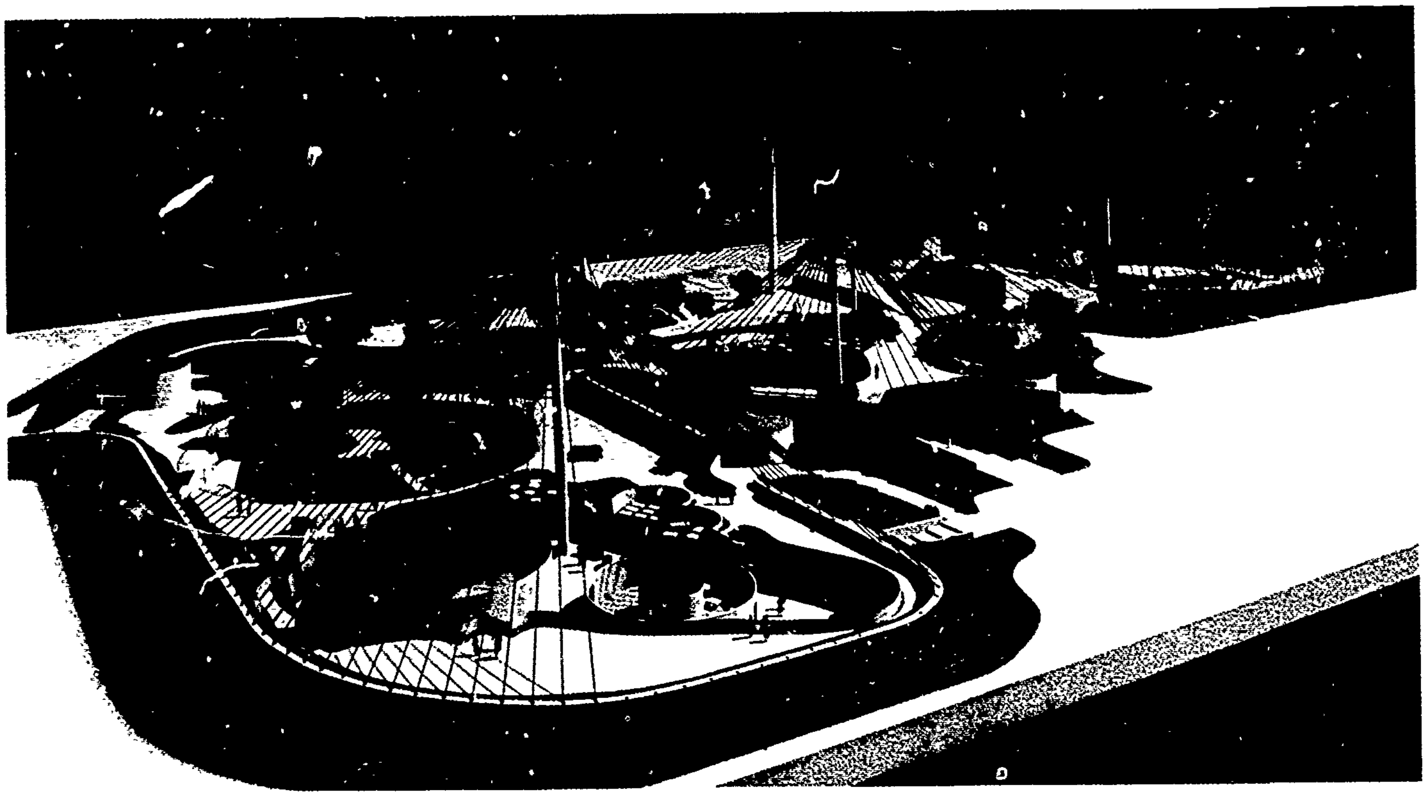
The architectural importance of structures often overshadows the facilities that are enclosed. At La Verne College in California planners developed a concept for accommodating recreation to the rest of student and community life; but to do this successfully requires a large structure enclosing 5½ acres. Although high costs are making the project difficult to realize, the concept is exciting.



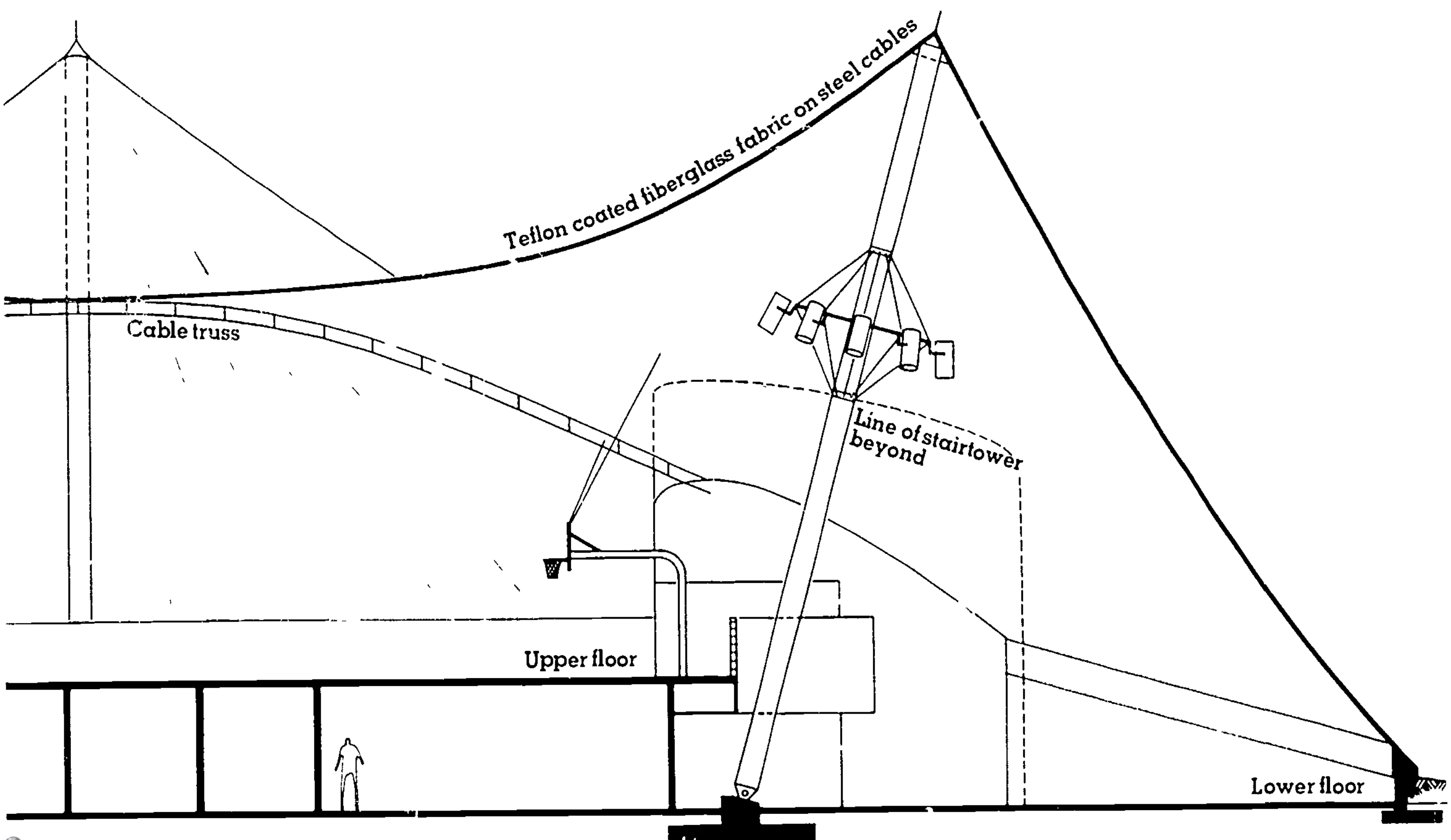
La Verne intended to build five areas under the big tent-like structure: Swimming and skating, basketball and tennis, fine and performing arts, a student union and a leisure time area. These activities would serve the students and the community since they are not confined to young people nor do they require the organization of, say, a football game. Areas under the structure would have been divided by landscaped mounds and trees as if all the activities were out of doors. The great advantage, of course, being that seasons and weather could not affect the activities under a roof.

Even though La Verne has not been able to build its 5½-acre dream, it is attempting to finance a smaller project with recreational facilities located in a two-story building within a tent structure.

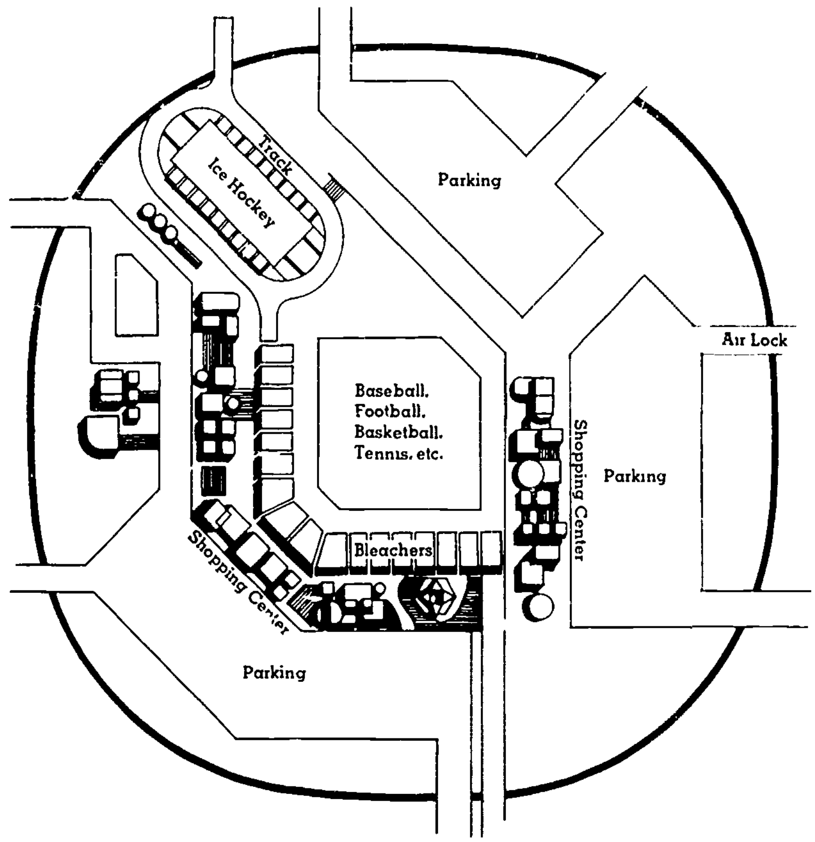


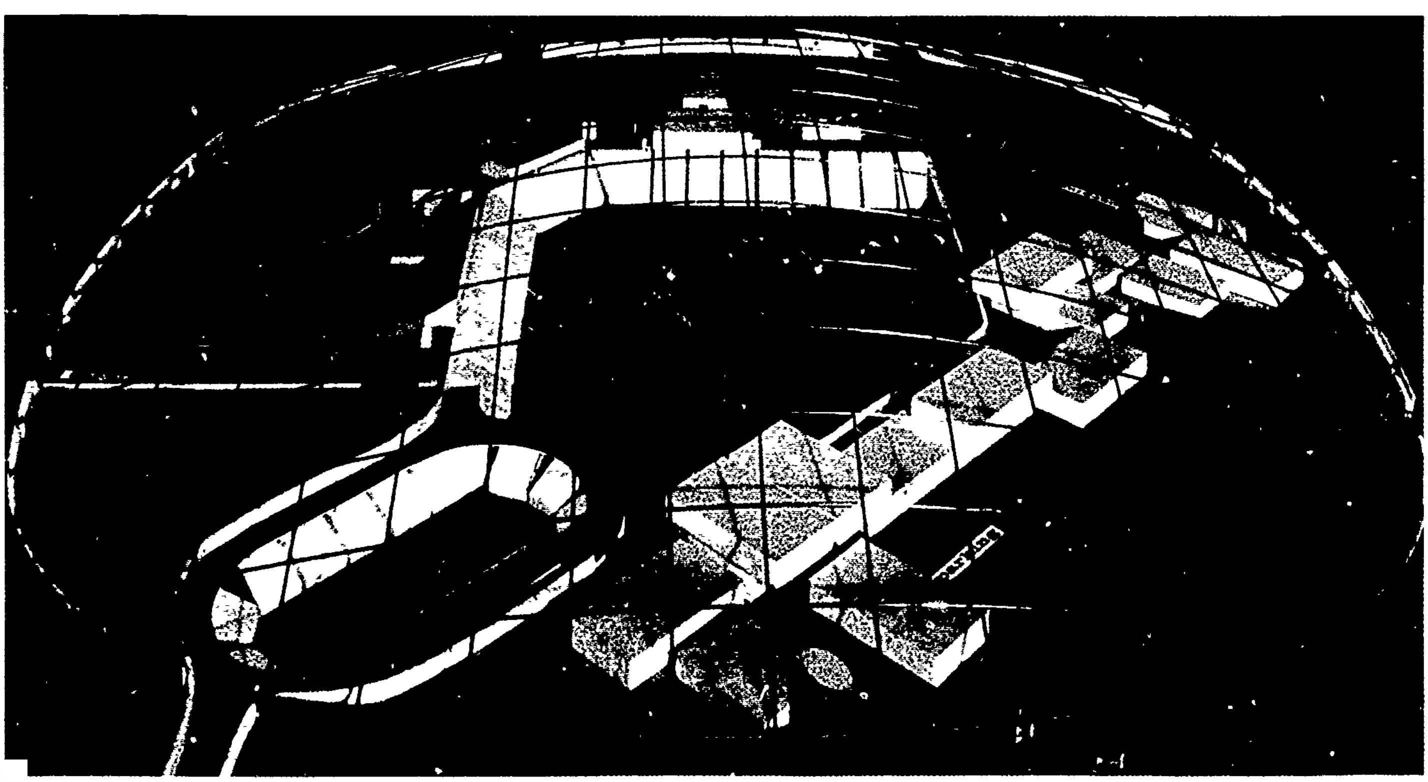


Original scheme (above) had to be dropped in favor of smaller structure shown below

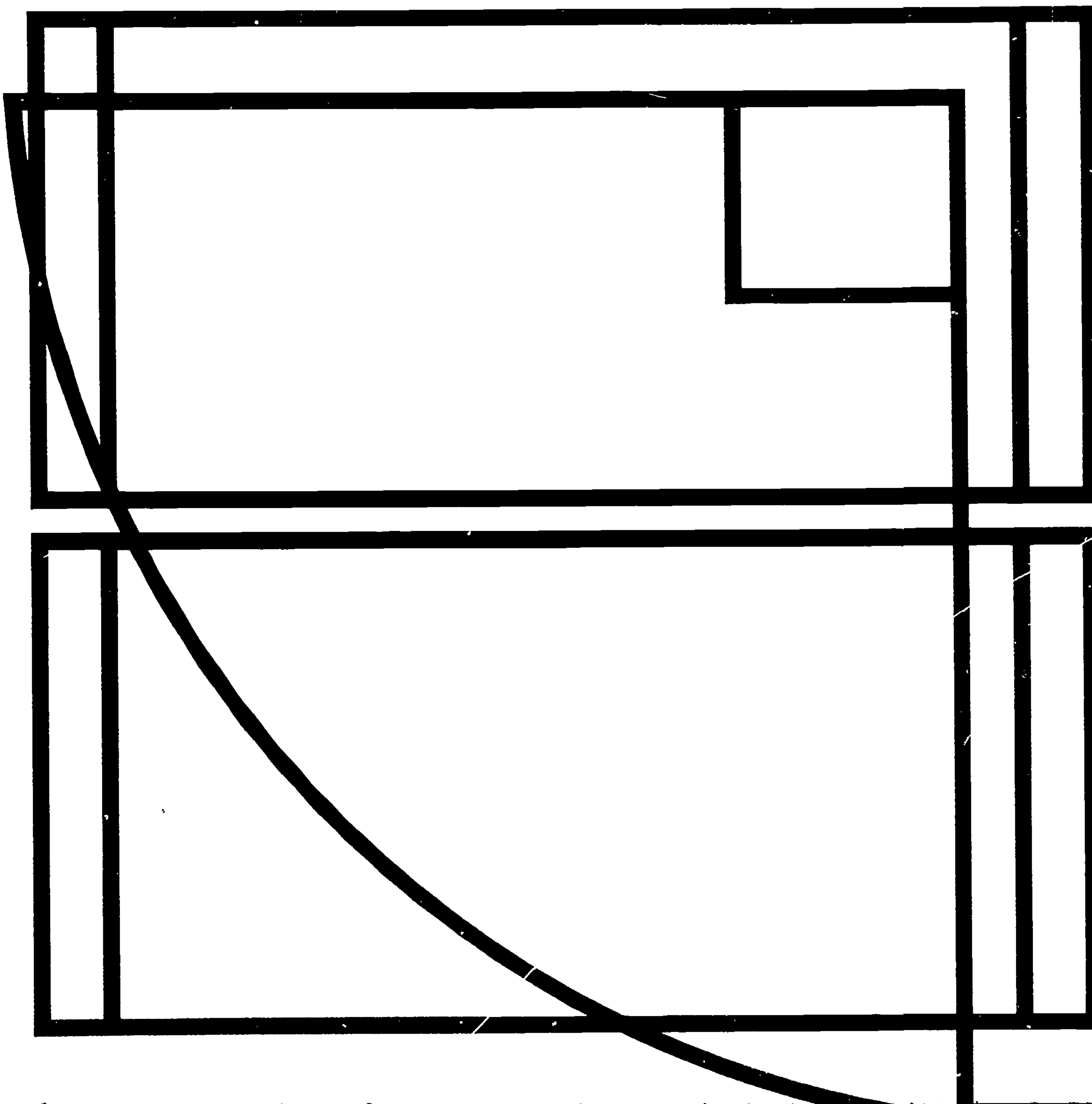


Covered structures for sports facilities are more necessary in hostile climates than in benign regions. Not surprisingly, one of the first real proposals for a breakthrough in the size of air structures is for 40 acres of encapsulated space in Alaska. This would enclose sports facilities, a shopping center and parking spaces for visitors. The sports areas would be open to schools, colleges, professional teams, recreational leagues and for free play. The shopping center and commercial spaces would help defray the public costs of the project. The buildings under the air roof would not be unhampered by winds, cold and snow so that they could be less durable and less costly than conventional buildings.





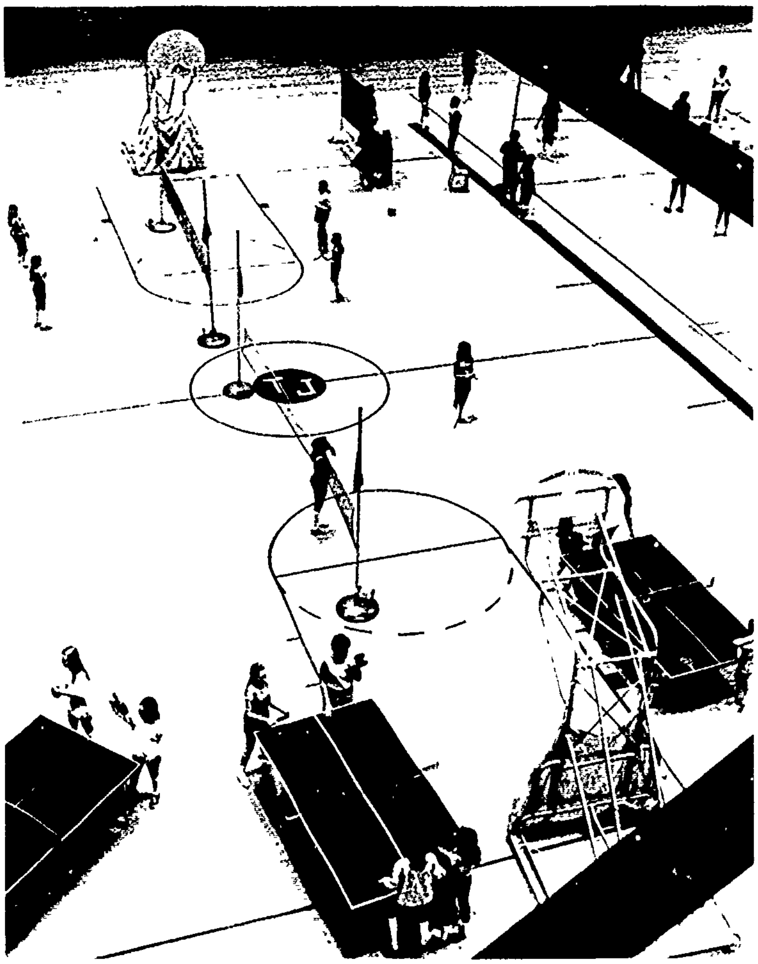
Shared Facilities

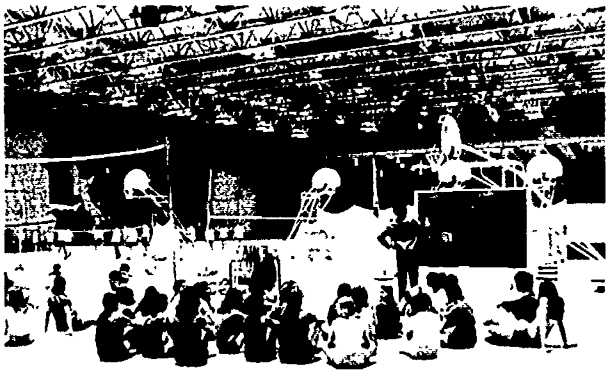


Various forms of facility sharing have been advocated by EFL for several years. Gradually, the concept is taking hold in communities which realize that schools are not separate entities divorced from the other services provided by civic governments. Sharing educational and recreational services is the simplest and most common example. For instance, instead of the parks department building a playing field for evening and weekend use and the school board building one for schools to use during the day, the two agencies can pool their resources and build one field to serve two purposes. The initial cost will be lower, and since the maintenance costs will be shared, the taxpayers don't have to pay twice over for the services.

Apart from the financial benefits, the quality of life in a community will be improved if people can use the schools' educational and recreational facilities. It gives adults a chance to exercise, to keep their bodies fit and to continue playing games such as badminton, handball and tennis.

The foremost example of shared facilities at present is the Thomas Jefferson Junior High School and Community Center in Arlington, Virginia, where areas for performing arts, recreation and physical education are jointly built and operated by the county's department of recreation and the school board. All these facilities are available from 6 a.m. to midnight seven days a week.

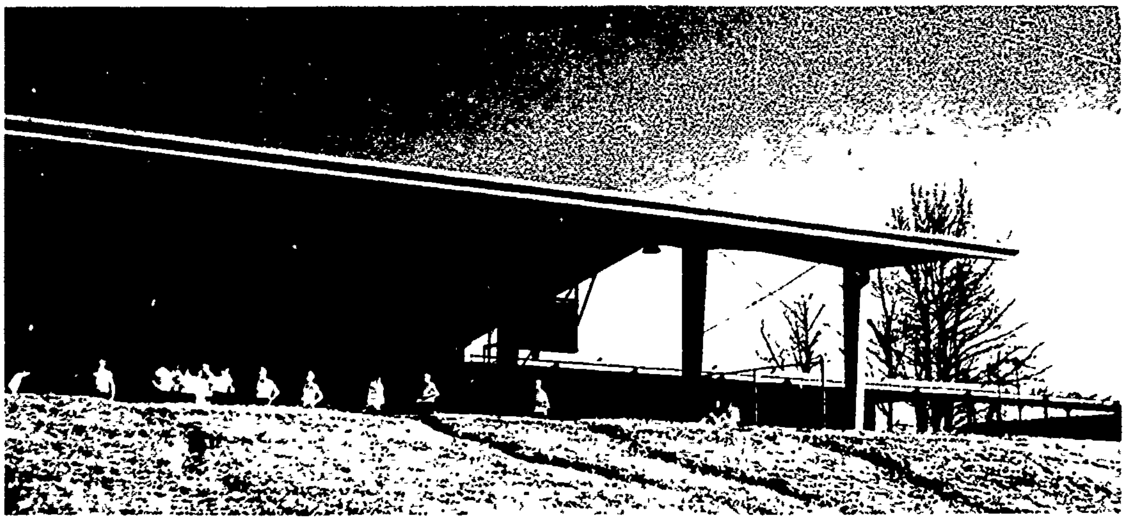




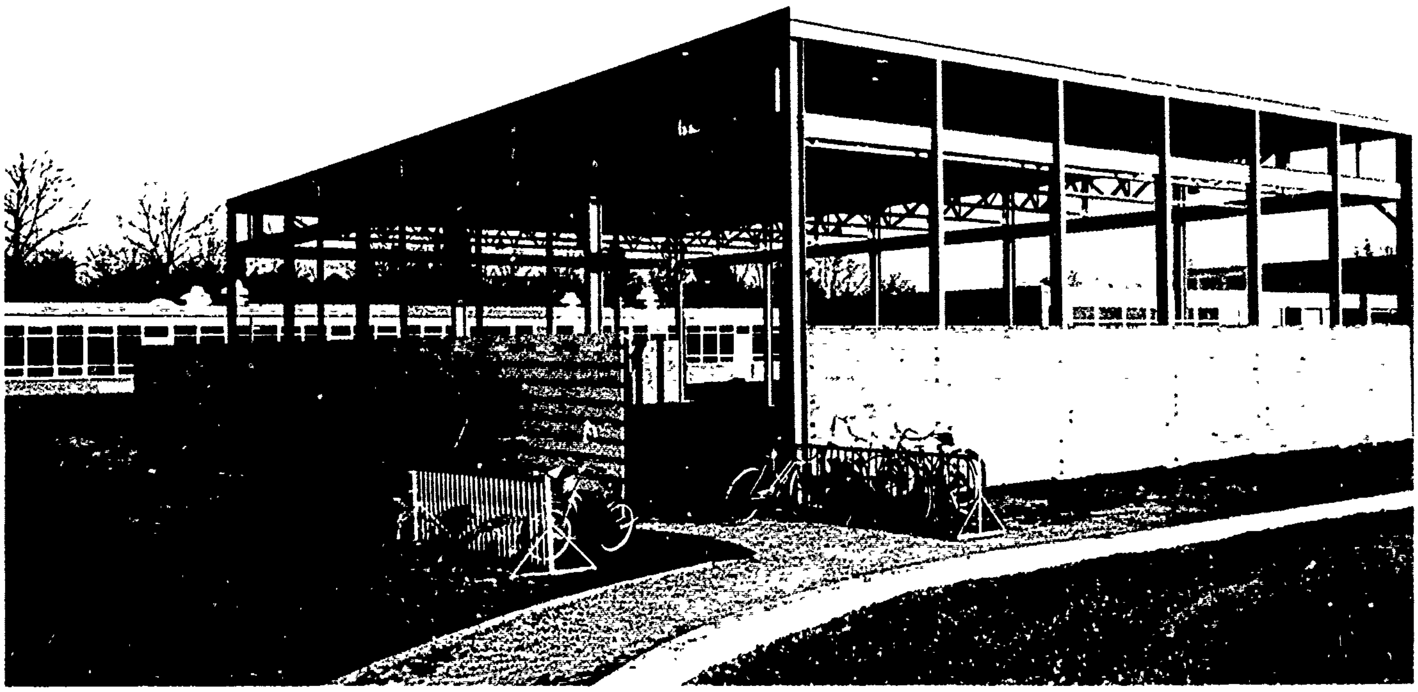
One of the burdens of keeping physical recreation facilities open at night and on weekends is that salaries have to be paid to staff supervising the premises. However, if the buildings consist only of a roof and some basketball hoops there is little opportunity for vandalism and the building can be left unsupervised.

These shelters are best located adjacent to a school gym so that during the day equipment can be moved in and the area used as additional gym space. Lights should be installed so that the public can use the shelter at night.

Boulter Junior High School, Tyler, Tex

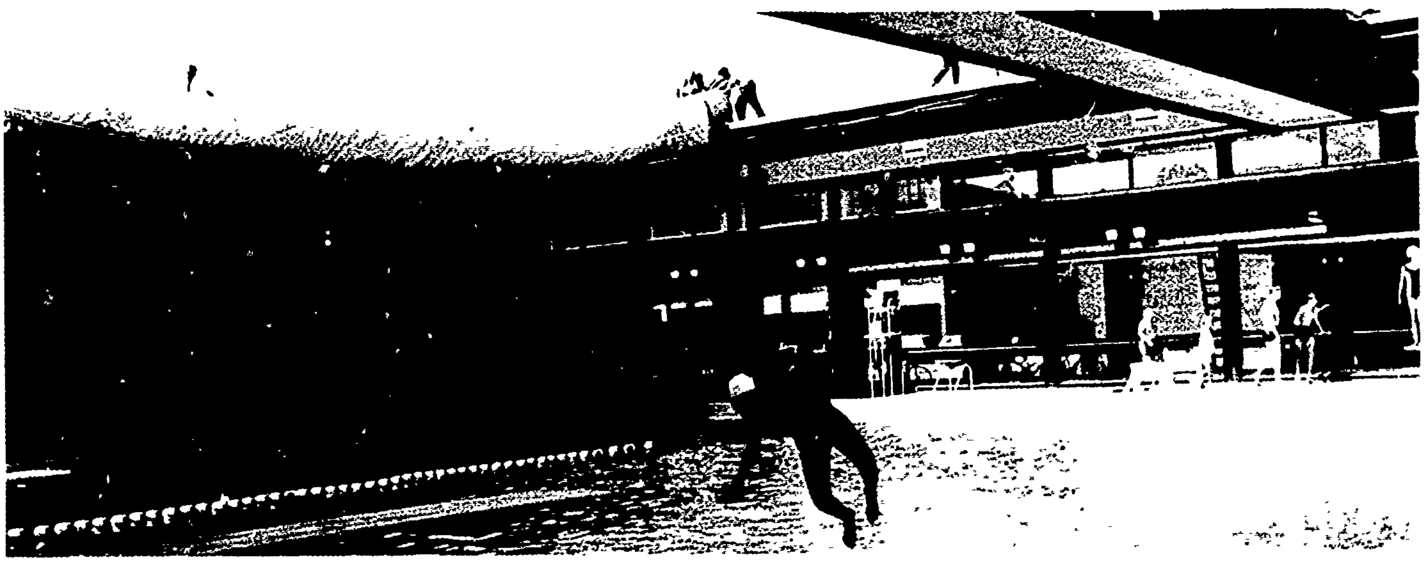


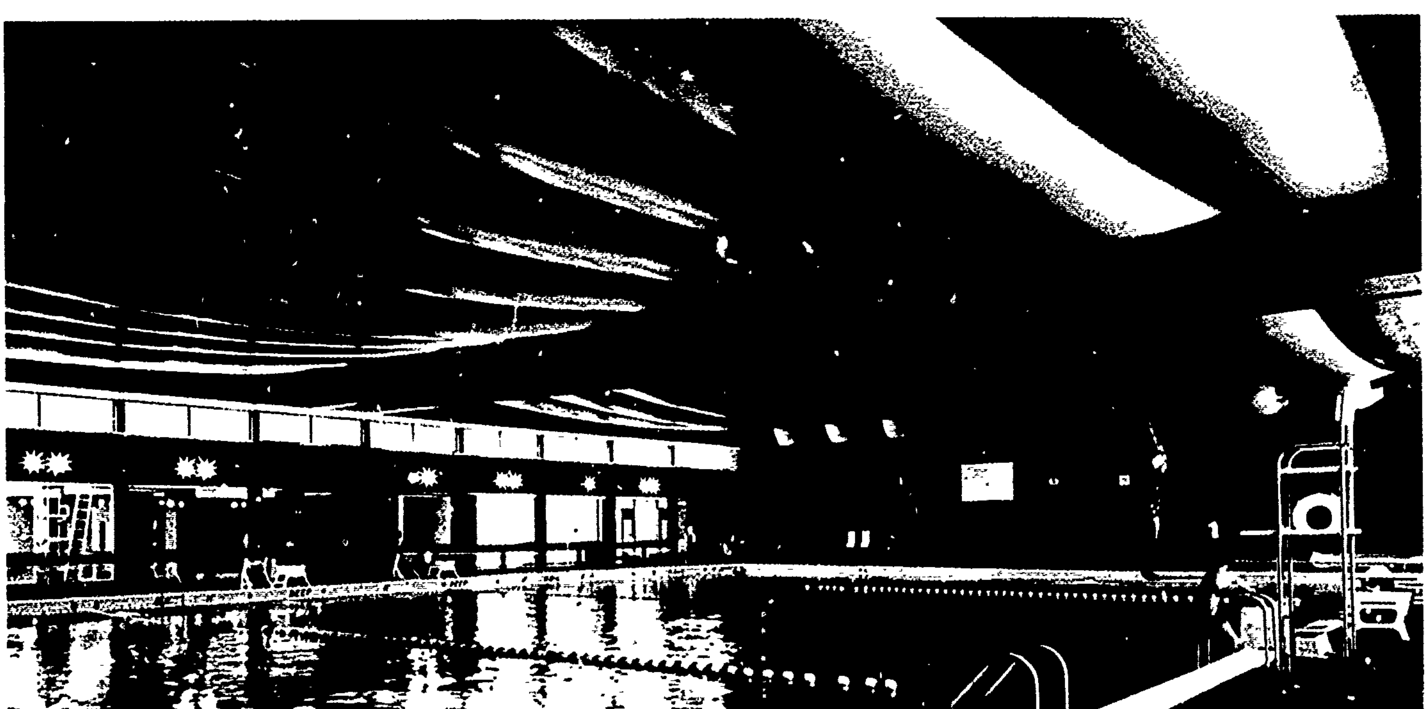
Riverside Elementary School, Princeton Township, N J



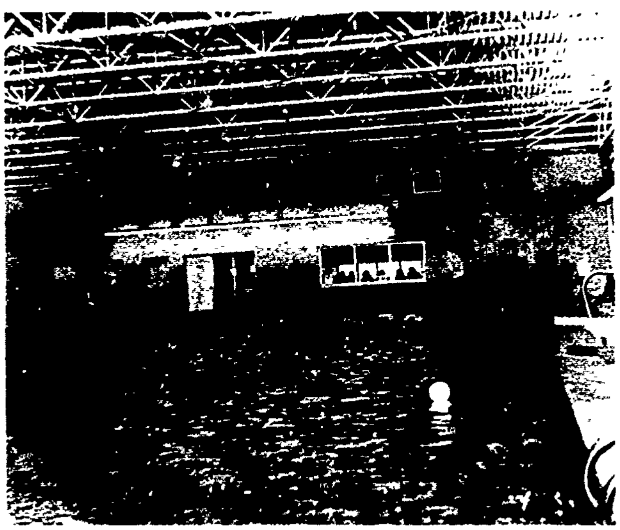
The high cost of swimming pools easily justifies joint ownership by schools and recreation agencies. One of the better ways to get full value from the joint ownership is to extend the usefulness of the pool by making it convertible from indoor to outdoor swimming. Three of the techniques for removing the roof in summer are shown.

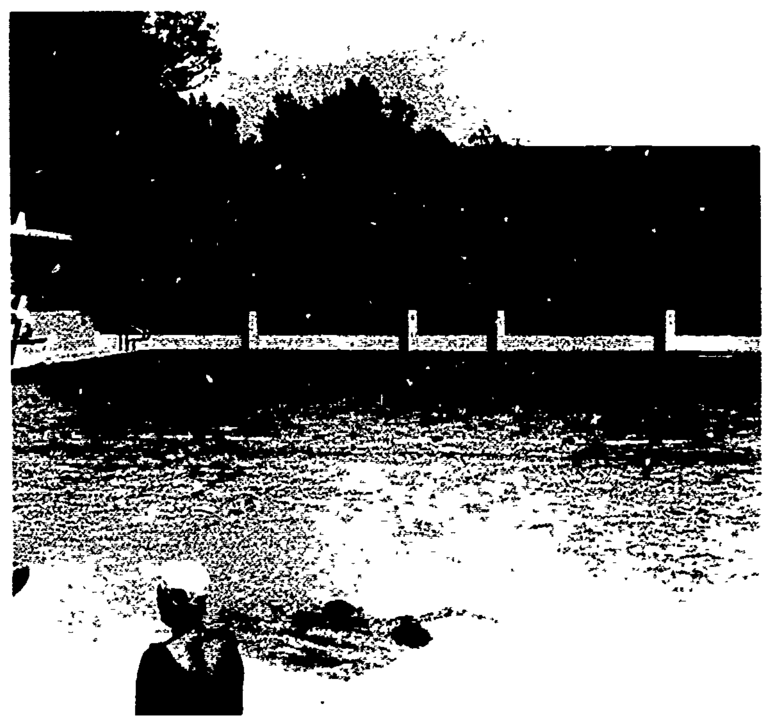
The city of Mamaroneck, New York, built tennis courts and a pool on city-owned land with school board funds. The board shares maintenance costs with the city. The pool is roofed with an inflated air pillow that is deflated and rolled back over supporting cables.

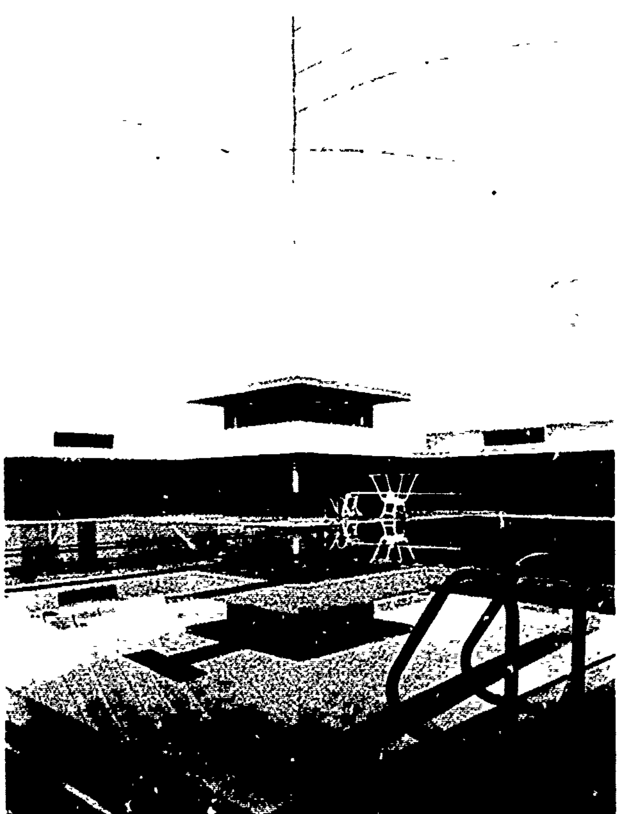


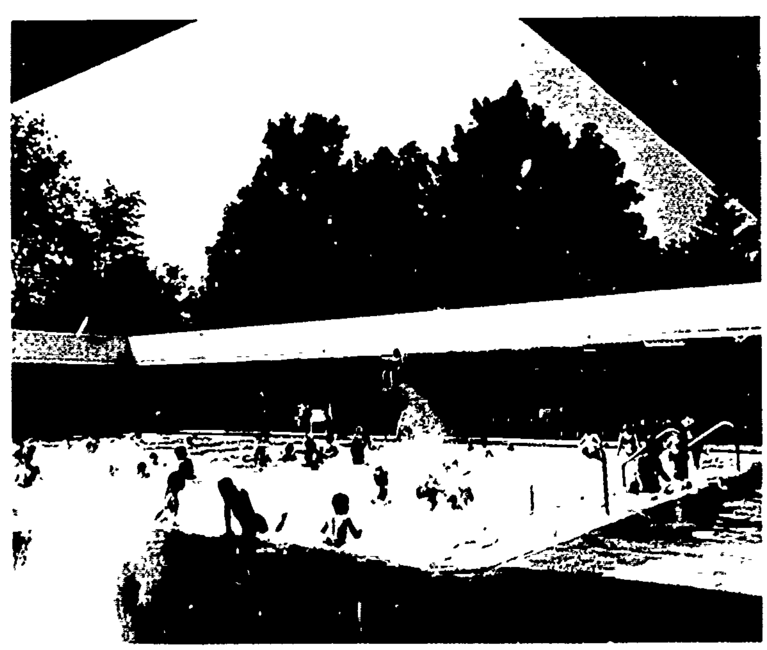


A swimming pool and other recreational facilities in Flint, Michigan, are shared by the schools and the park service. The pool roof slides in one piece along tracks that carry it over an area that serves as a shaded playground in the summer. An air-supported roof encloses the swimming pool at Cuyahoga Falls, Ohio. When inflated, the roof floats over the facilities and almost gives the effect of an outdoor pool. The roof is removed and stored during the summer months.







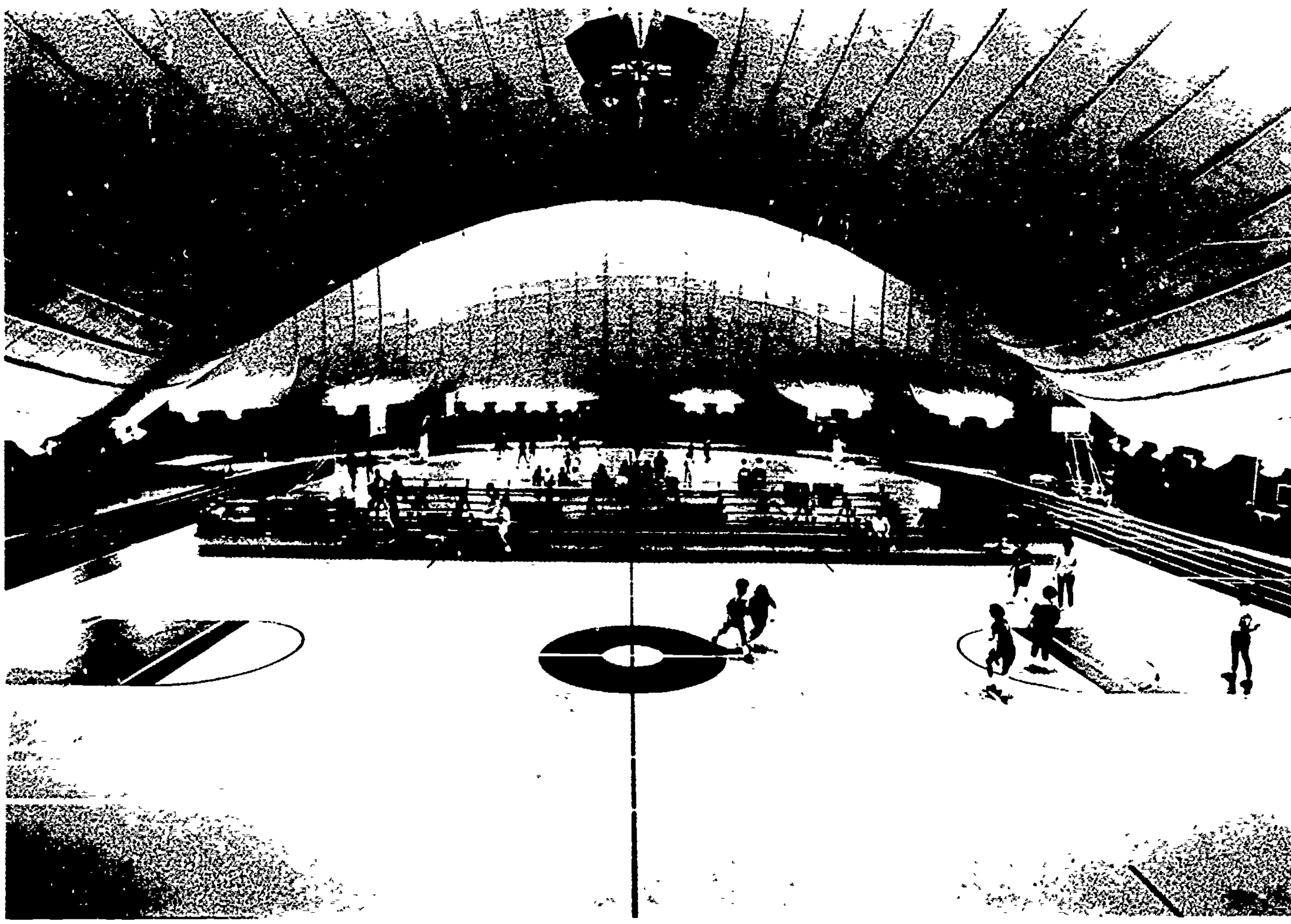


Ice provides some of the most widely enjoyed recreation for people of all ages. It is used by small children and their grandparents quietly figure skating, by teenagers racing and by boys and men booming their way through hockey games. But best of all, whole families can skate together instead of being segregated by age or skills as in most other sports.

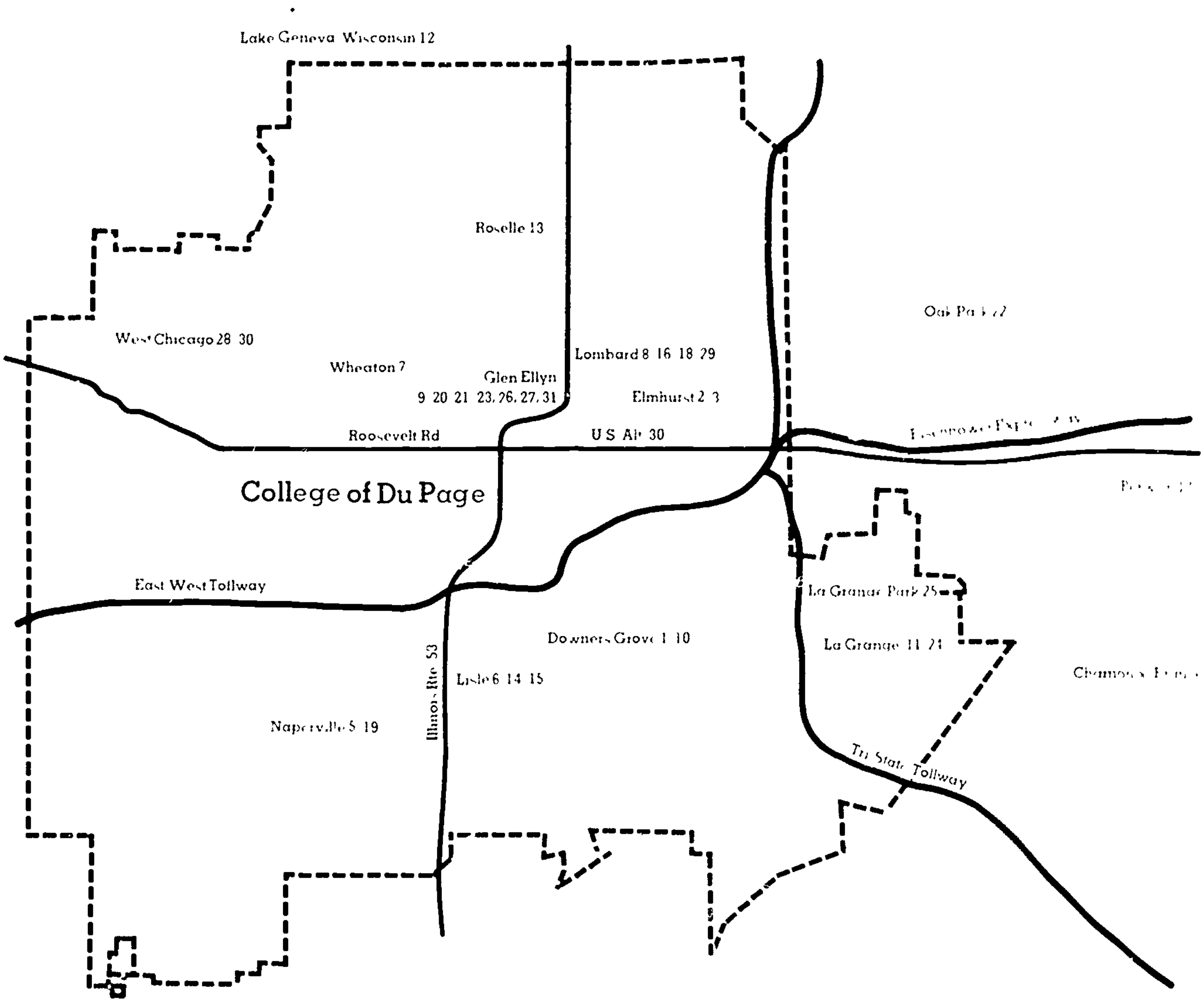
An outdoor rink is effective if the weather is favorable, but since rain, snow or heat destroy the ice surface, a covered rink is desirable. In cold climates, nature provides the refrigeration for several months a year, but many communities have to depend on artificial ice. Unfortunately, artificial ice is expensive because the refrigeration equipment is costly.

However, some developments are underway to reduce costs. Plastic pipes have been substituted for metal ones and they can be laid on top of a concrete base instead of being embedded in it. This makes maintenance simpler since the pipes are more accessible, but it means that the rink cannot be boarded over for other activities. Another approach dispenses with pipes altogether. Two sheets of plastic are heat sealed to form a pattern similar to a pipe layout so that a refrigerant can be circulated between them. Water is sprayed on top of the sheets and frozen by the circulating refrigerant.

Lifetime sports for both students and the community have plenty of room in the fieldhouse at Graceland College, Lamoni, Iowa. The 300-ft by 175-ft structure is also large enough to accommodate intercollegiate games.



There are occasions when it is better to rent than to buy—even in the physical education facilities field. The College of Du Page, a community college near Chicago, lists 31 sites for its physical education recreation and intercollegiate programs and they are all off the campus. Students travel to ice rinks, YMCA's, high school gyms and tracks, golf courses, tennis clubs, riding stables, pools, shooting ranges and ski resorts.

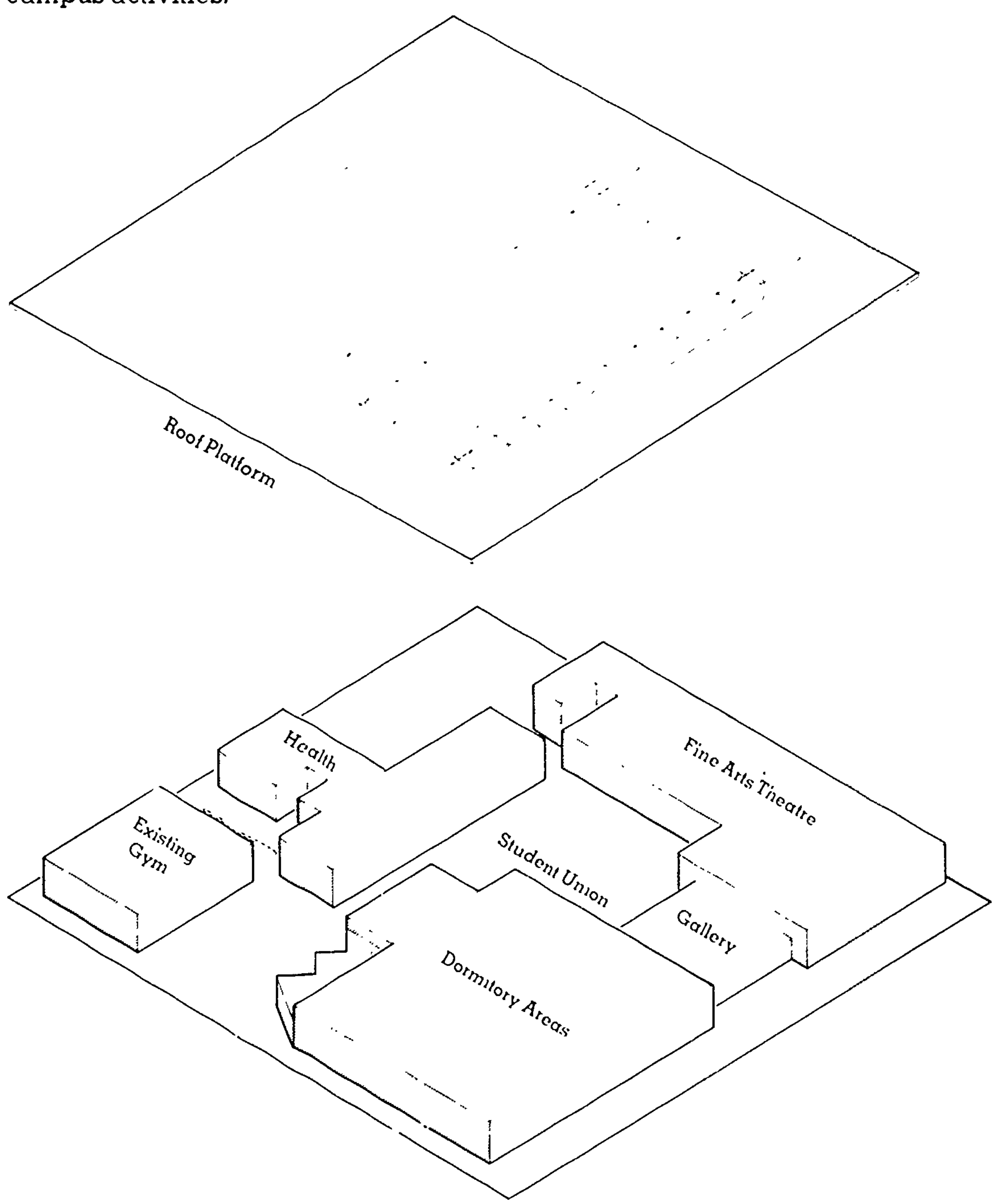


ACTIVITY

1. Varsity Tennis Practice
2. Intramural Hockey, Varsity Ice Hockey
3. Roller Skating Classes
4. Skiing
5. Horsemanship Classes
6. Intramural Skiing, Skiing Classes
7. Indoor Tennis Classes
8. Tennis Classes
9. Intramural Bowling
10. Intramural Hockey, Varsity Hockey
11. Night Riflery Classes
12. Scuba Diving Classes
13. Night Physical Education Classes
14. Bowling Classes
15. Night Slimnastics Classes, Outdoor Track Practice & Meets
16. Cross Country Meets
17. Indoor Track
18. Training Room Facilities for Football
19. Varsity Swim Practice, Night Scuba Classes, Indoor Track, Varsity Football Practice & Games
20. Figure Skating Classes
21. Day Riflery Classes
22. Hockey Practice
23. Aquatic Classes, Handball Classes
24. Varsity Baseball Games
25. Intercollegiate Tennis Matches
26. Soccer Classes, Soccer Practice and Games
27. Intramural Golf, Intercollegiate Practice and Matches
28. Night Volleyball
29. Intramural Golf, Golf Classes
30. Judo and Karate Classes
31. Skin and Scuba Classes

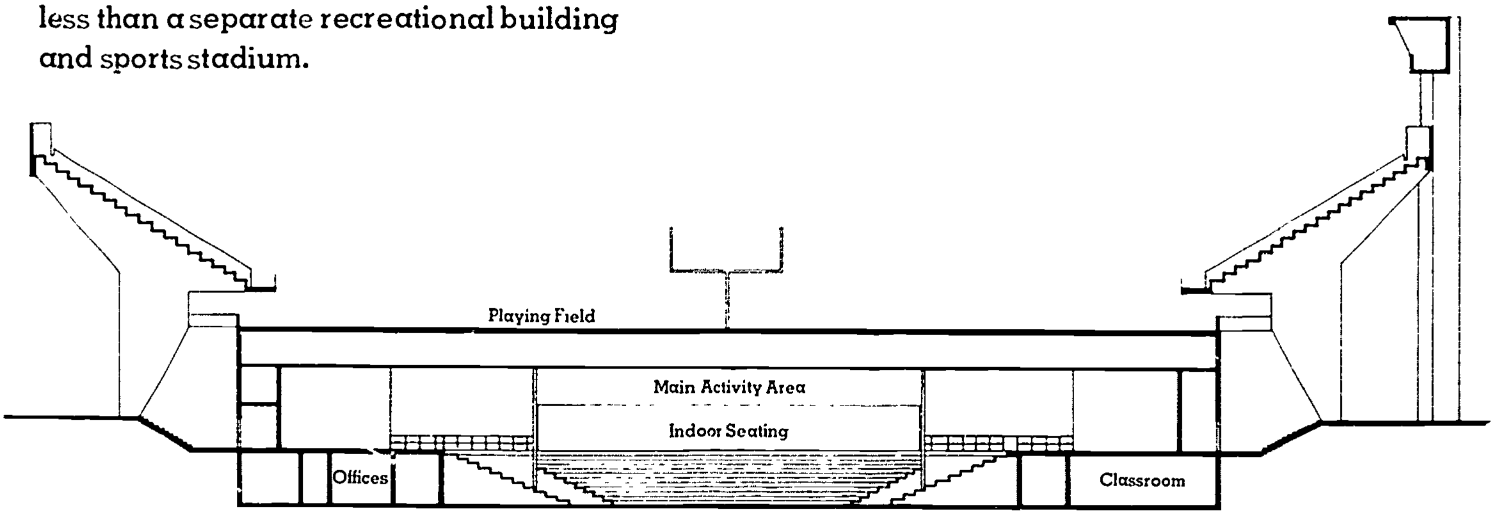
Another concept of sharing facilities is to share with oneself. At Chapman College in Orange, California, a major shared-facilities plan called the Educational Activities Center has been proposed. It will house art studios, classrooms, dormitories, a health department, and a student union. All these facilities will be topped by a platform carrying a sports field.

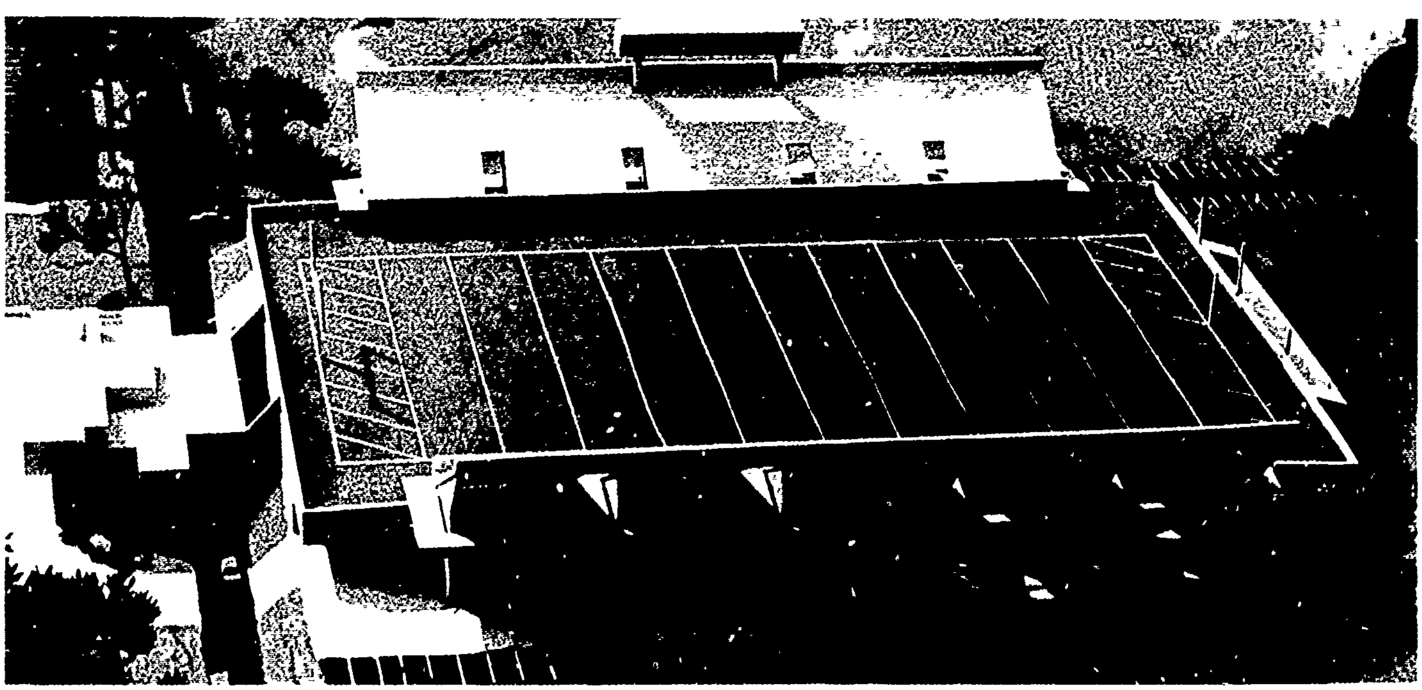
Several benefits will accrue from this proposal: The college doesn't have to buy any more land and so it will save an estimated $3 million, the reduced land usage means that the facilities can be located close to the center of campus activities, construction costs are expected to be lower than those for separate facilities, and two federal agencies, HUD and HEW, believe they can offer 85% of the total cost in grants and loans.



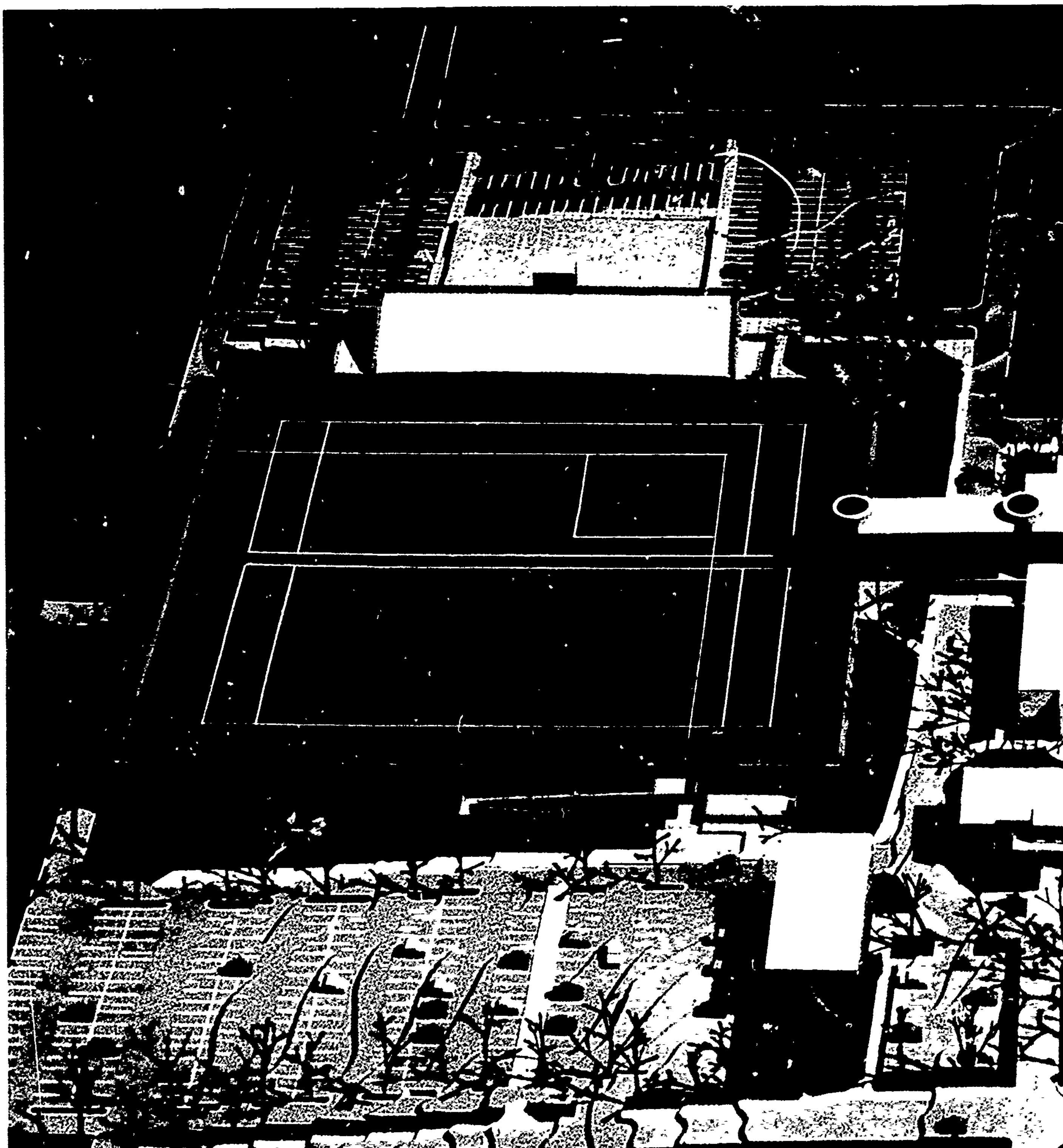
Although rooftops are excellent sites for tennis courts, it requires an act of faith for football coaches to lead their teams onto a rooftop football stadium. But there's no reason it can't be done, and Knoxville College in Tennessee may be the first to prove it. Space in the center of the campus is tight and since a city ordinance prevented the college from using its parking lot, the proposed field is to be atop a building that will house other sports facilities. This close location will allow changing rooms and all the back-up facilities to serve indoor and outdoor sports.

The cost of an elevated field is high, but as it serves as a roof for the building underneath the combined cost is considerably less than a separate recreational building and sports stadium.



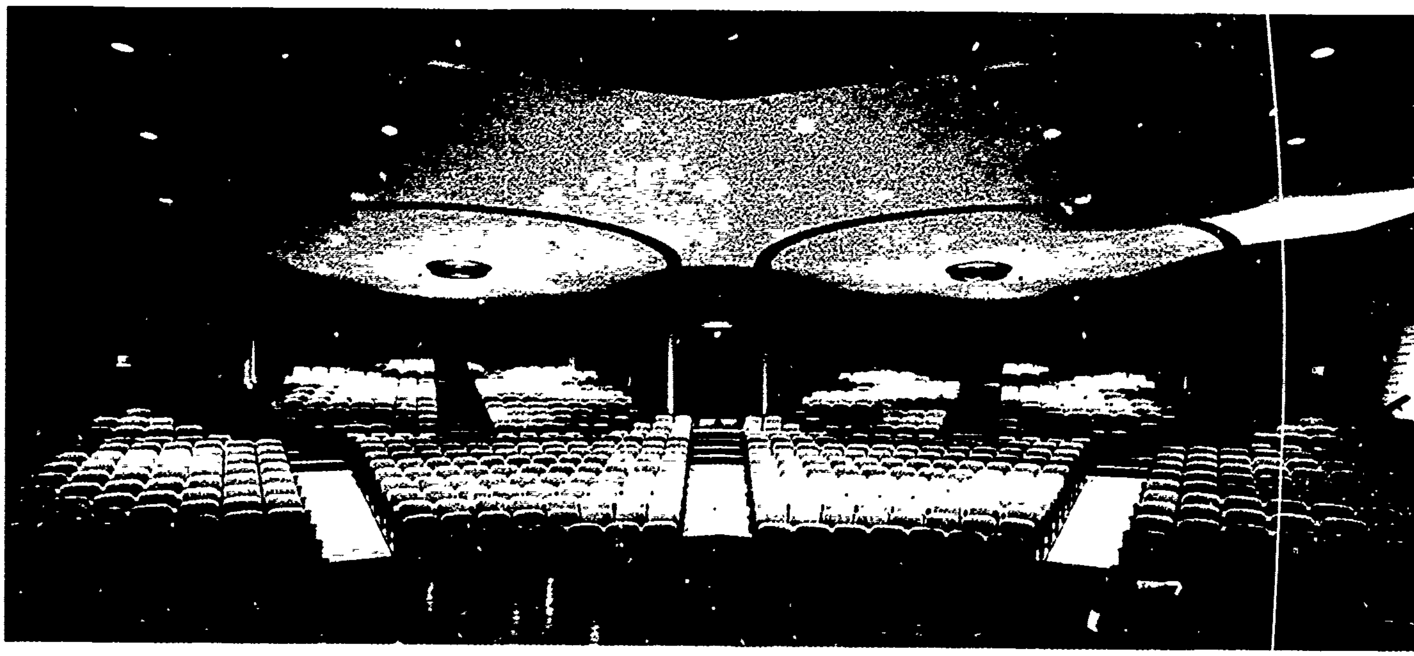


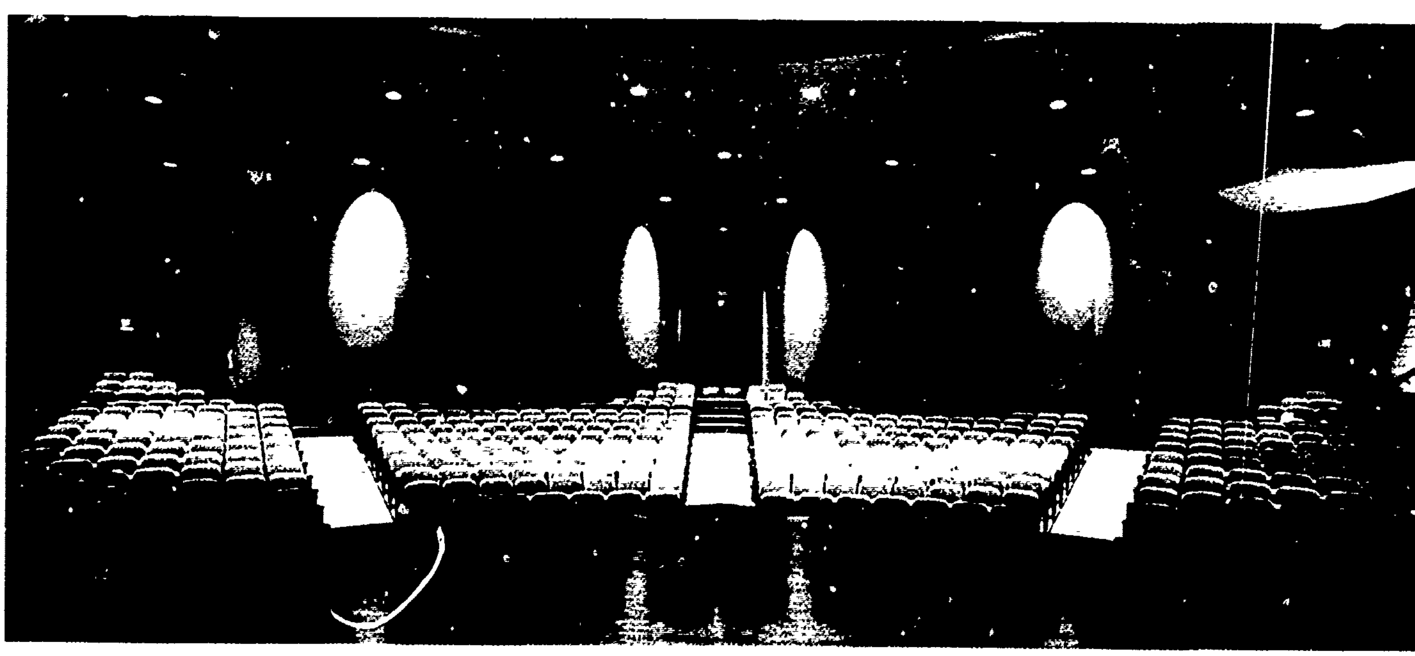
Miles College in Alabama also proposes to put a sports field atop a physical education building but it is planning for a square field to accommodate baseball and football with space left for a running track. One of Miles' objectives is to locate these facilities in the center of the campus so they are easily available to the students and the community.

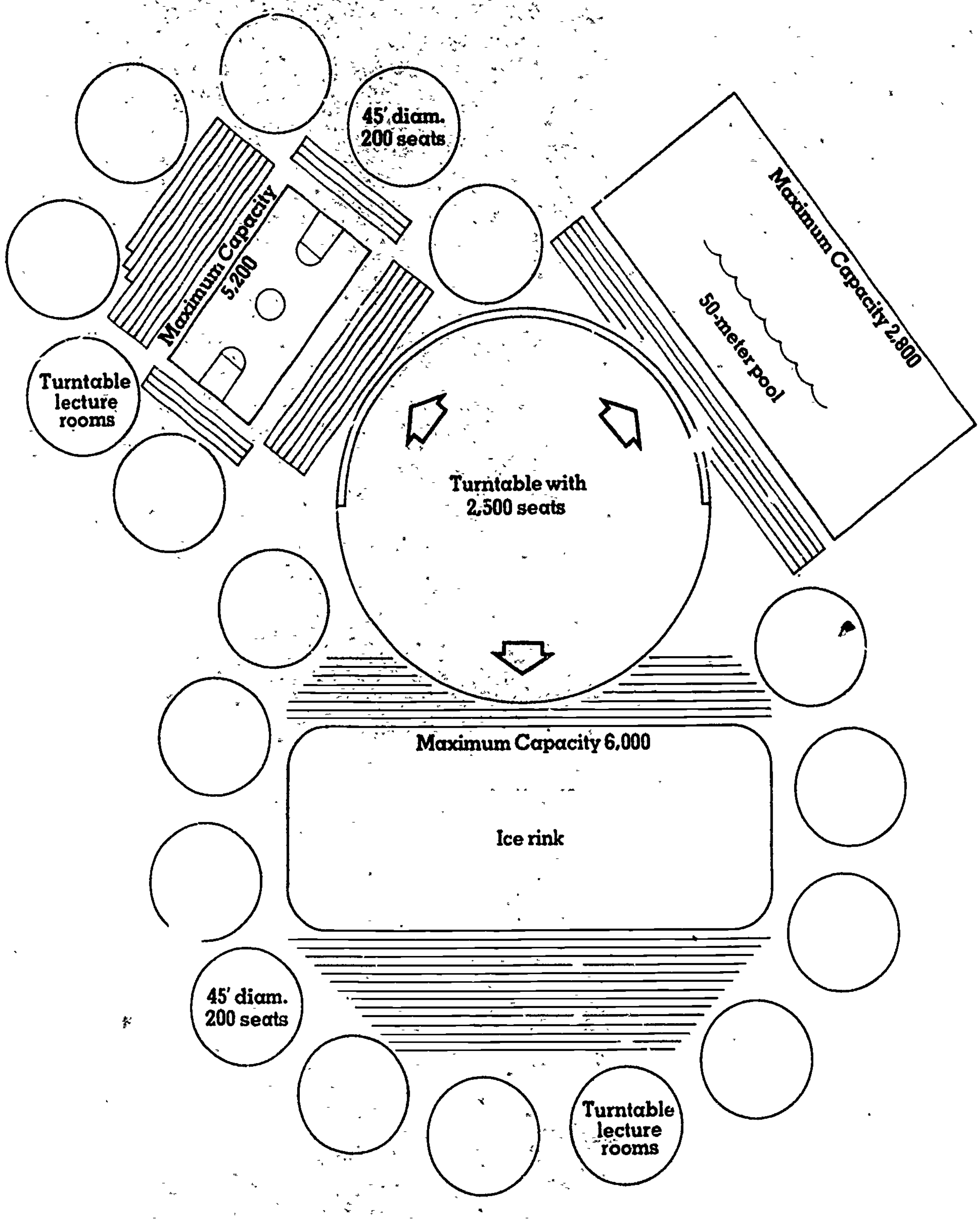


A recent development in auditorium design enables a school to divide the large space into small spaces by installing some of the seating on turntables. A wall is installed at the rear of the turntables containing rows of auditorium seats. When the turntables face front the seats are part of the auditorium; when they are reversed the walls separate the seats into self-contained classrooms. Designers have now proposed adapting the same principle to physical recreation facilities so that the turntables provide classrooms or grandstands.

Agua Fria High School, Avondale, Ariz





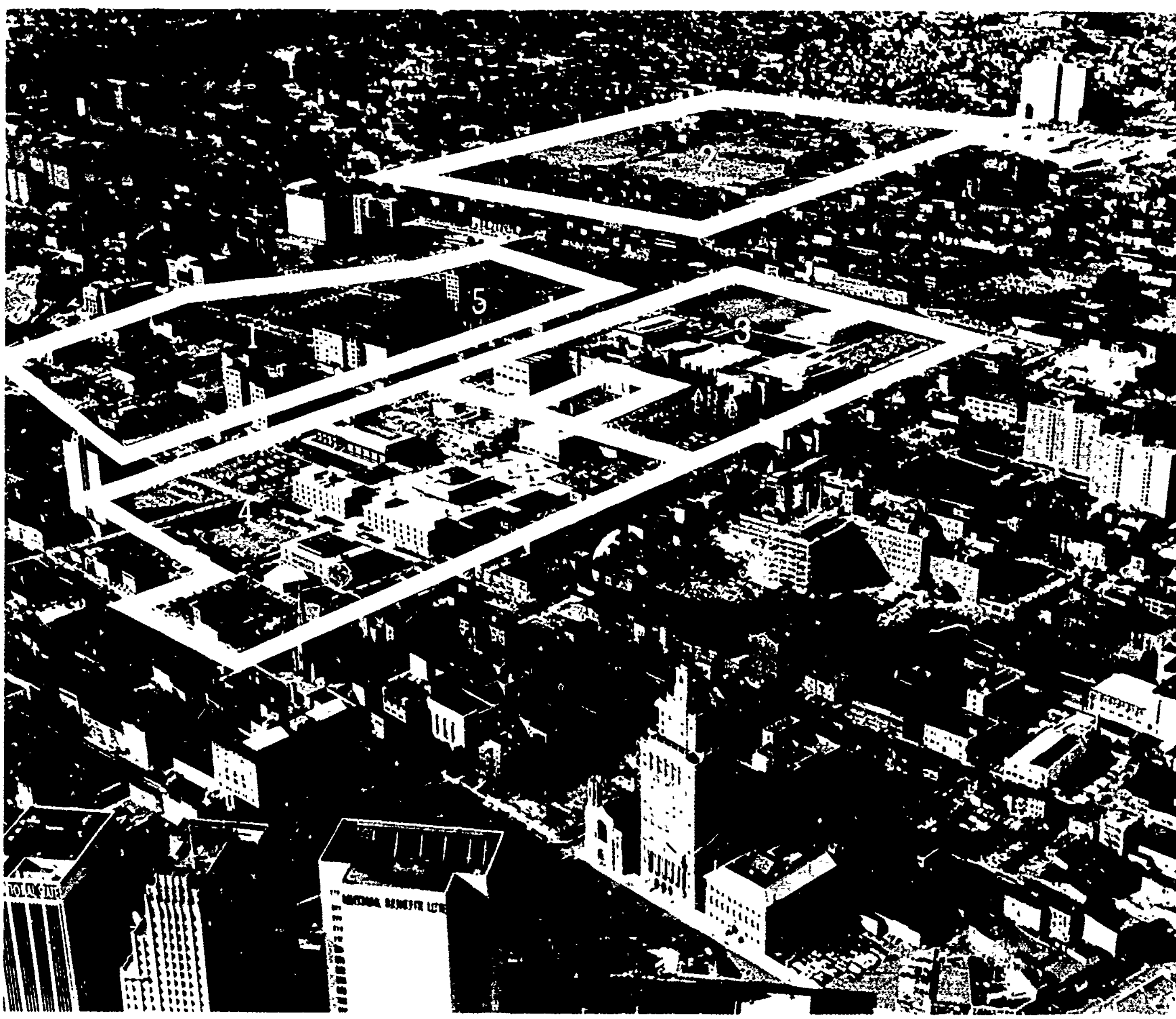


45' diam.
200 seats
Maximum Capacity
5,200
Maximum Capacity 2,800
50-meter pool
Turntable
lecture
rooms
Turntable with
2,500 seats
Maximum Capacity 6,000
Ice rink
45' diam.
200 seats
Turntable
lecture
rooms

Four colleges in Newark, New Jersey, want to build a super sports center that they will all share instead of building four separate, and no doubt less adequate, facilities. The cooperative venture promises to be better than a single college could hope to build, and it should considerably reduce each college's operating costs for the physical recreation program.

The close proximity of these four colleges greatly enhances the plan for sharin a central facility, but two or more schools or colleges within reasonable distance of each other could also make a joint venture work to their advantage.

1. Essex County College
2. New Jersey College of Medicine and Dentistry
3. Newark College of Engineering
4. Newark Campus of Rutgers University
5. Proposed gymna um



Low Cost-Per-Use Places

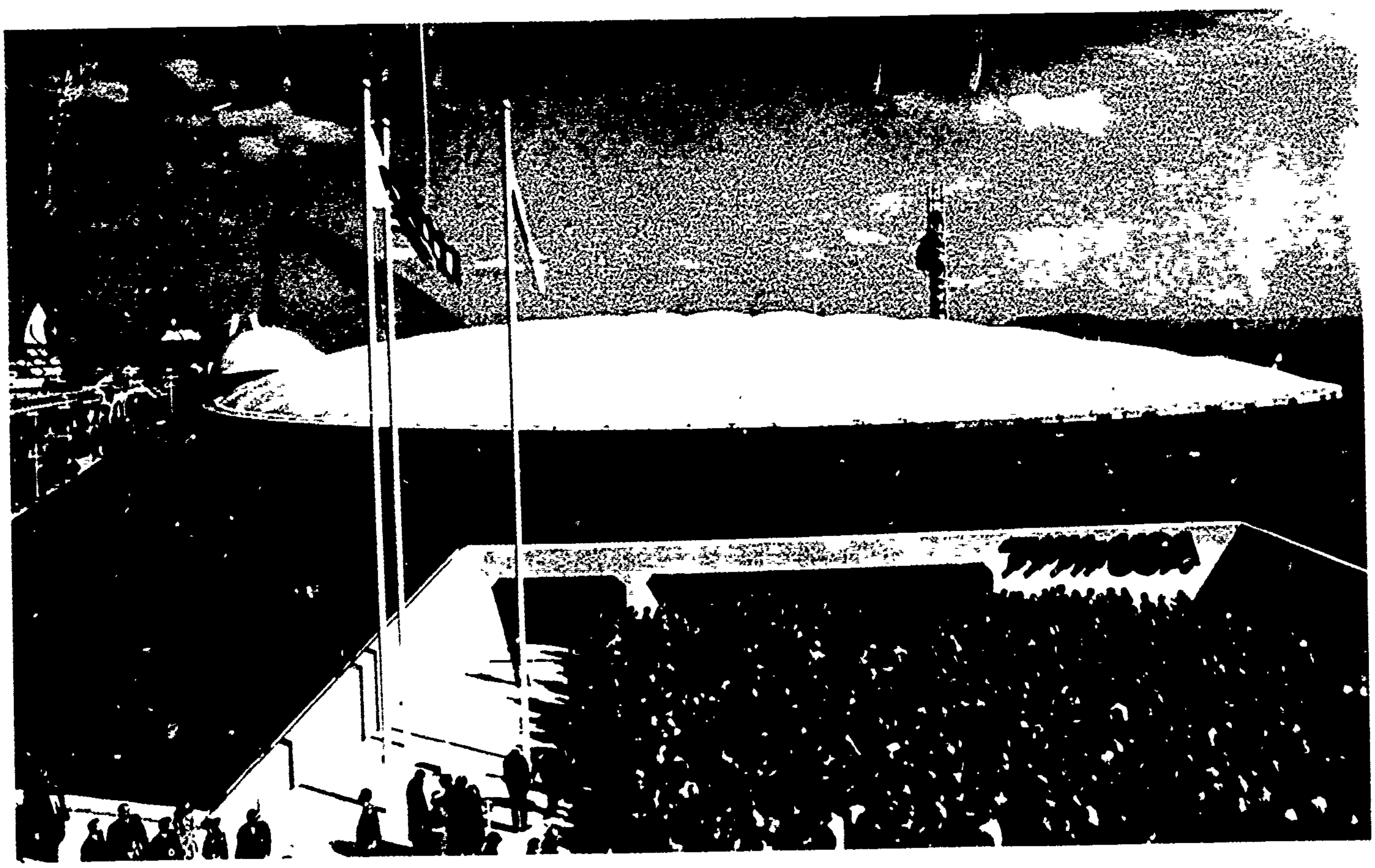
The invariable shortage of capital restrains the exuberance of designers and administrators when sports recreation facilities are being planned. The omnipresent "What will it cost?" often eliminates equipment and/or space that would have enhanced a building's design and usefulness. But the real test of economy is not the construction cost per sq ft but the cost-per-use of the facilities.

Low construction costs can still produce an uneconomical building if the facilities are underused. Hence the cost-per-use yardstick becomes important in ascertaining the value of a sports recreation center. This cost is based on the number of people using the facilities in a day and the daily cost of operating and maintaining the premises plus the prorated construction cost.

A whole sports complex should be analyzed this way by determining the number of people using each section and assigning a cost-per-use factor to each activity. If the daily count gives an atypical sampling, it should be prolonged over a week or even a month.

Certain self-evident costs will result. Tennis courts may not be used frequently during the day, but their cost-per-use can be brought into line by renting the courts at night. Other areas may be popular during the day but unwanted at night. One of the discoveries made by sports administrators who have appraised their facilities carefully is that large open areas that can be used for a multitude of activities have a lower cost-per-use in the long run than a cluster of specialized areas.

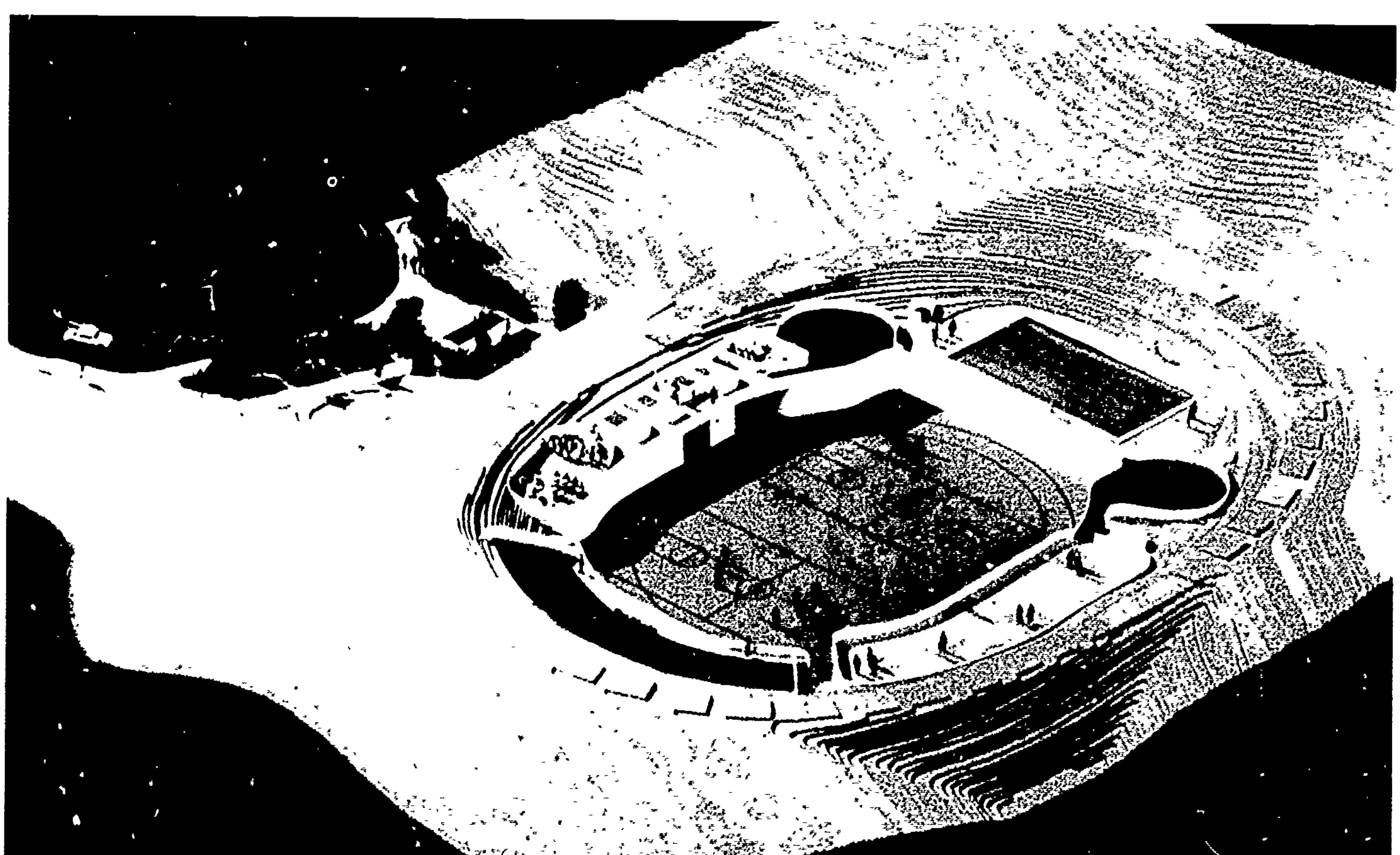
The U.S. Pavilion at the 1970 World's Fair in Osaka, Japan, solved many of the problems that had inhibited the development of large air structures. Manufacturers developed a fire-resistant membrane, restraining cables that didn't abrade the roof membrane, a structure that could resist typhoon forces, air locks that would admit 8,000 people an hour, airconditioning, and best of all, an interior that became a delightful exhibition hall with an ambiance that everyone enjoyed. For the record, the pavilion was 465 ft long and 265 ft wide. The structure cost $4.50 a sq ft including the foundations, the earthworks forming the exterior wall and the ring beam.



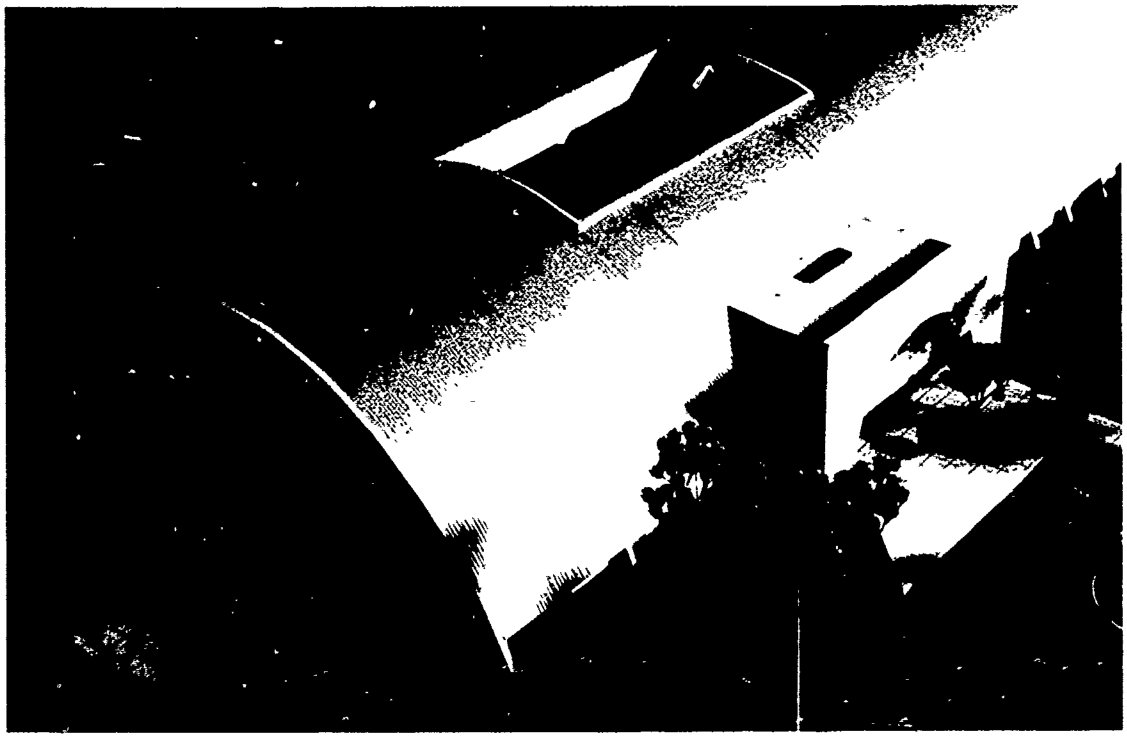
During 1972, Milligan College in Johnson City, Tennessee, began building the largest permanent air structure in the U.S. The 212-ft-diameter roof encloses 45,000 sq ft (on two levels) of a column-free fieldhouse with a pool and two basketball courts. The contract came in at $1.5 million.

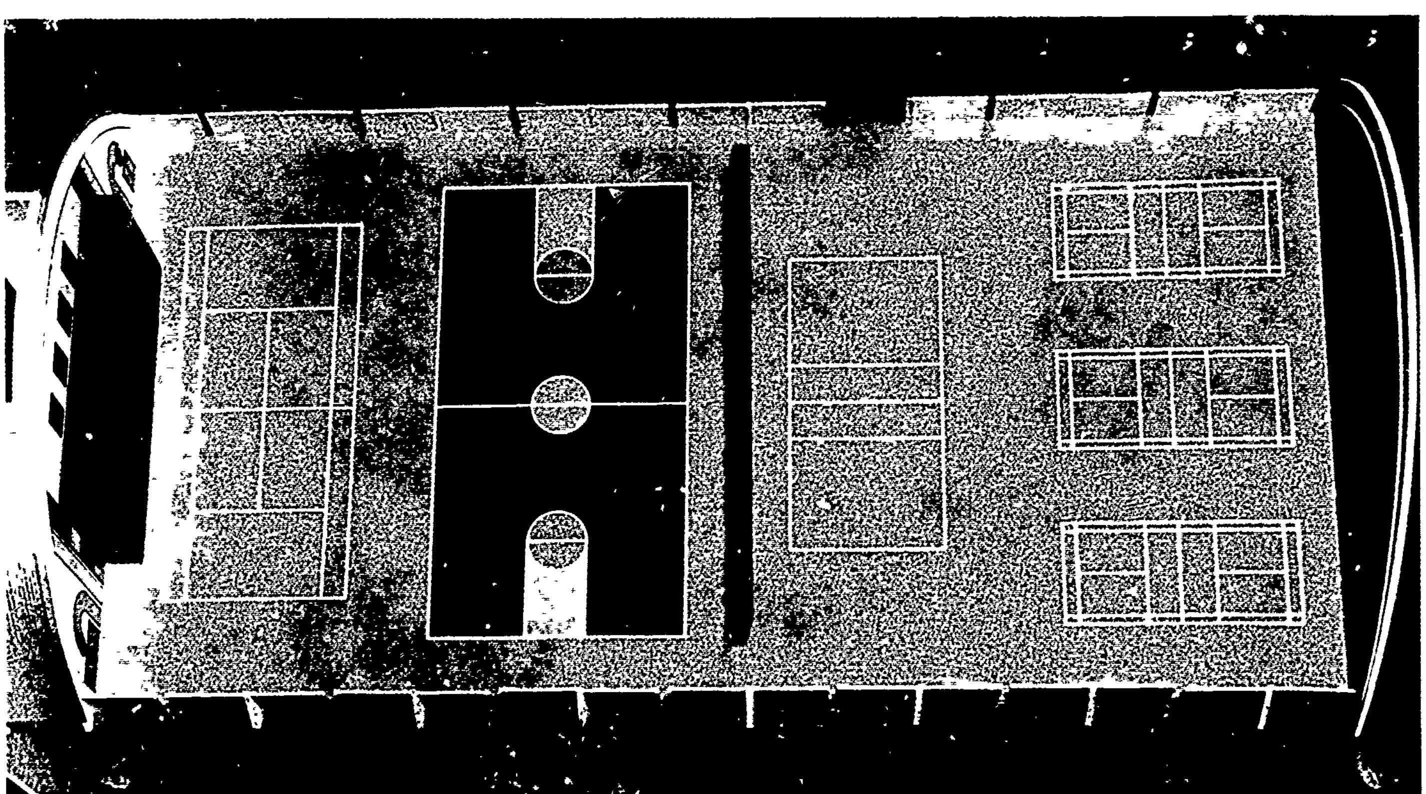
Milligan's fieldhouse is located in a small valley so that it required a minimum of earth-moving to form an earth berm for the exterior wall. The berm also serves as anchorage for cables extending across the top of the membrane to stabilize it during high winds. A thin membrane, only 1/32 in. thick, is sealed to the top of the earth berm. Air blowers maintain pressure within the building slightly above the outside pressure, although the difference is imperceptible to athletes and spectators.

The surrounding earth wall is a safety measure as it raises the roof membrane high enough to prevent it from falling on occupants of the fieldhouse if the air pressure should drop, and it keeps the membrane out of reach of vandals. Changing rooms and refreshment stands can be built economically under the roof because they do not have to be made weatherproof.

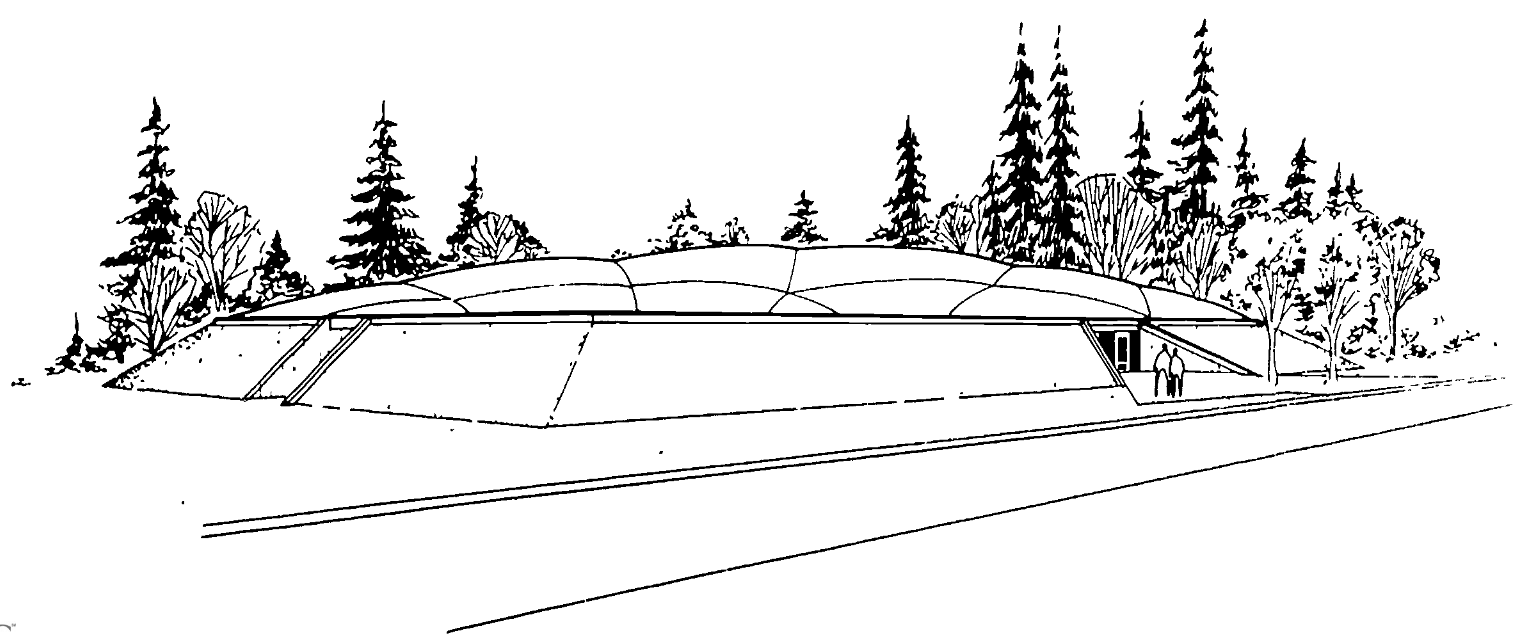


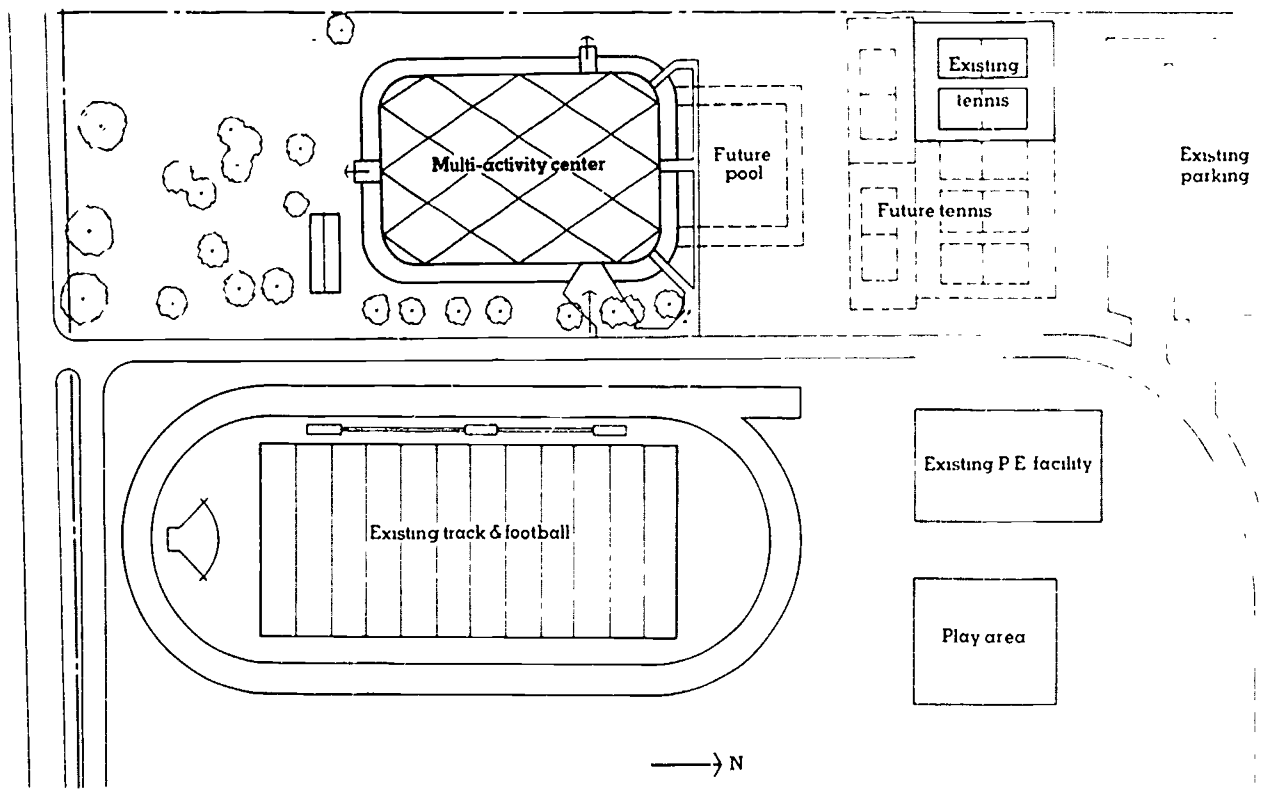
Shaped like a giant Quonset hut, the proposed fieldhouse for Lane College, Jackson, Tennessee, is estimated to cost less than $1 million. The facilities include a basketball court with moveable seating, tennis and badminton courts and a swimming pool. Changing rooms, offices and mechanical services will be located between the pool and fieldhouse in order to serve the whole building. Lane plans to lower the cost-per-use of this sports center by running complete programs for its own students, secondary and primary school students, the community and intercollegiate events.



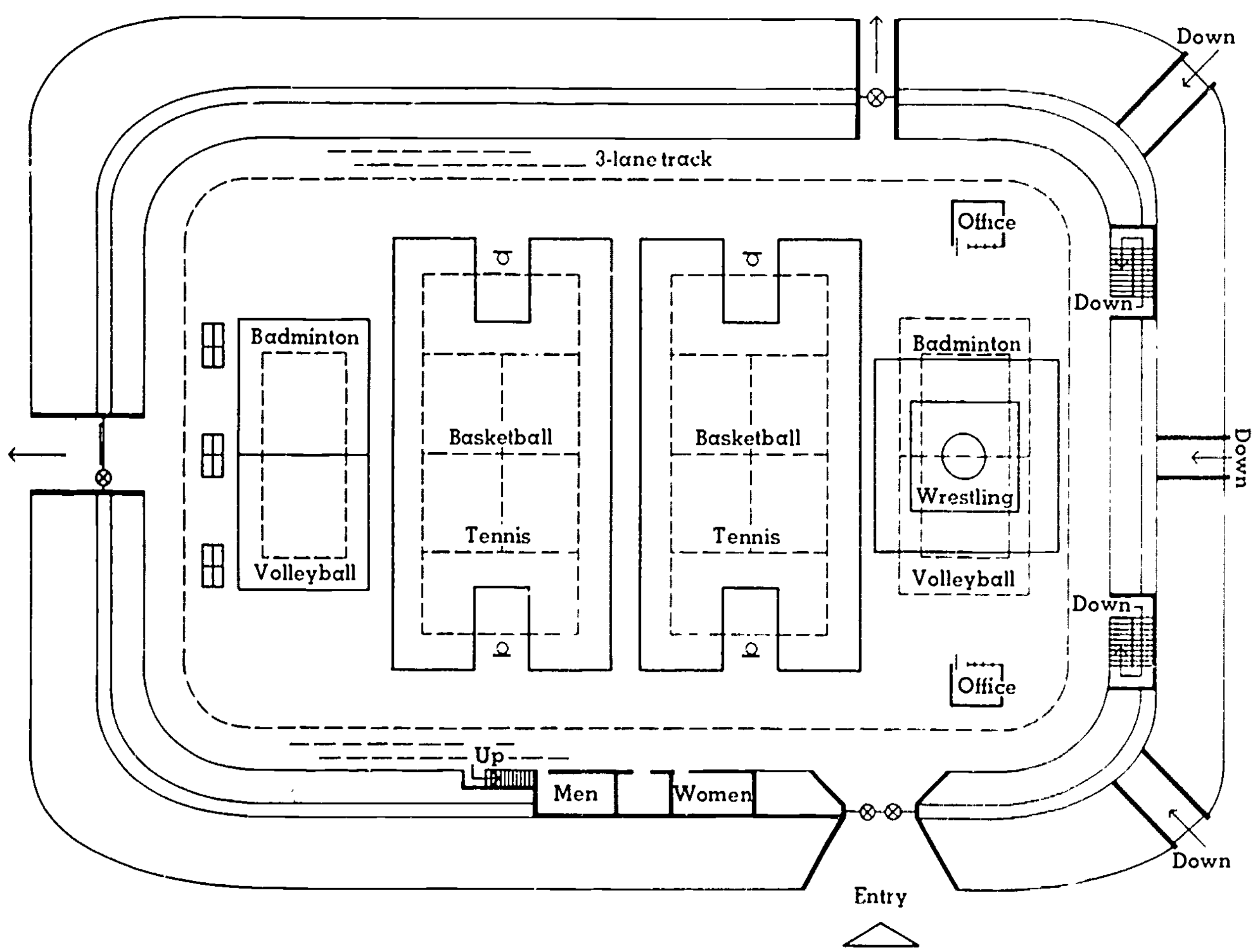


A private school in Tacoma, Charles Wright Academy, plans to build an air structure to enclose a sports arena that would also provide the right type of environment for learning activities, conferences, concerts, etc. The arena will have about 30,000 sq ft of uninterrupted space with a clearance of 34 ft. To roof this 240-ft by 150-ft space, the designers have proposed a Teflon-coated membrane restrained with cables anchored to a ring beam supported atop an earth berm. One of the innovations in this project is the use of off-the-shelf-heating and airconditioning equipment, mounted in the earth berm, to maintain the interior climate and the extra air pressure to support the roof. During the preliminary design stage, costs for the complete facility were estimated at $12 a sq ft. Further into the future, the school hopes to locate a swimming pool adjacent to one end of the arena. In anticipation of this, the arena locker rooms are to be built underground at the pool end of the arena where they can serve both facilities.



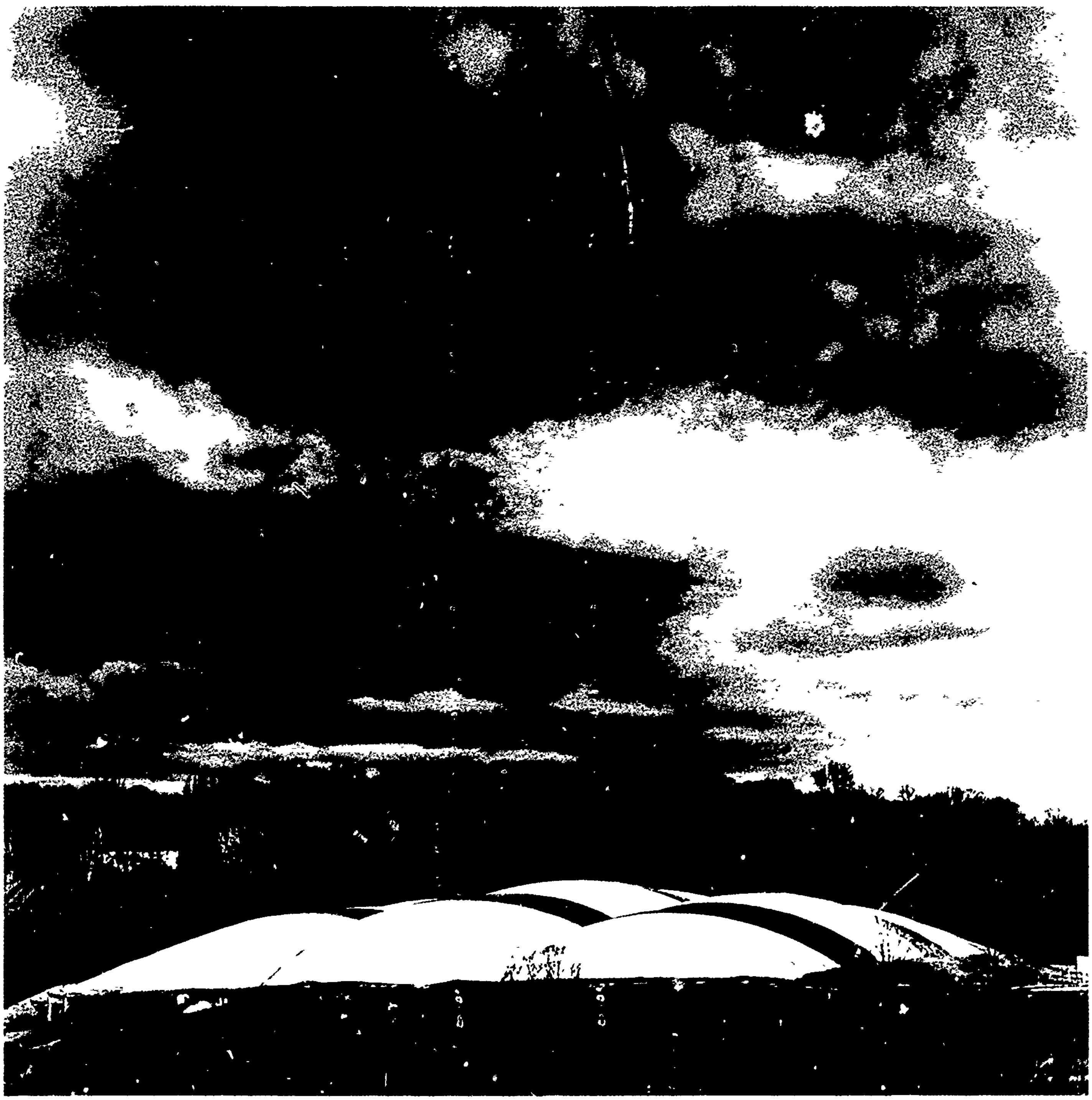


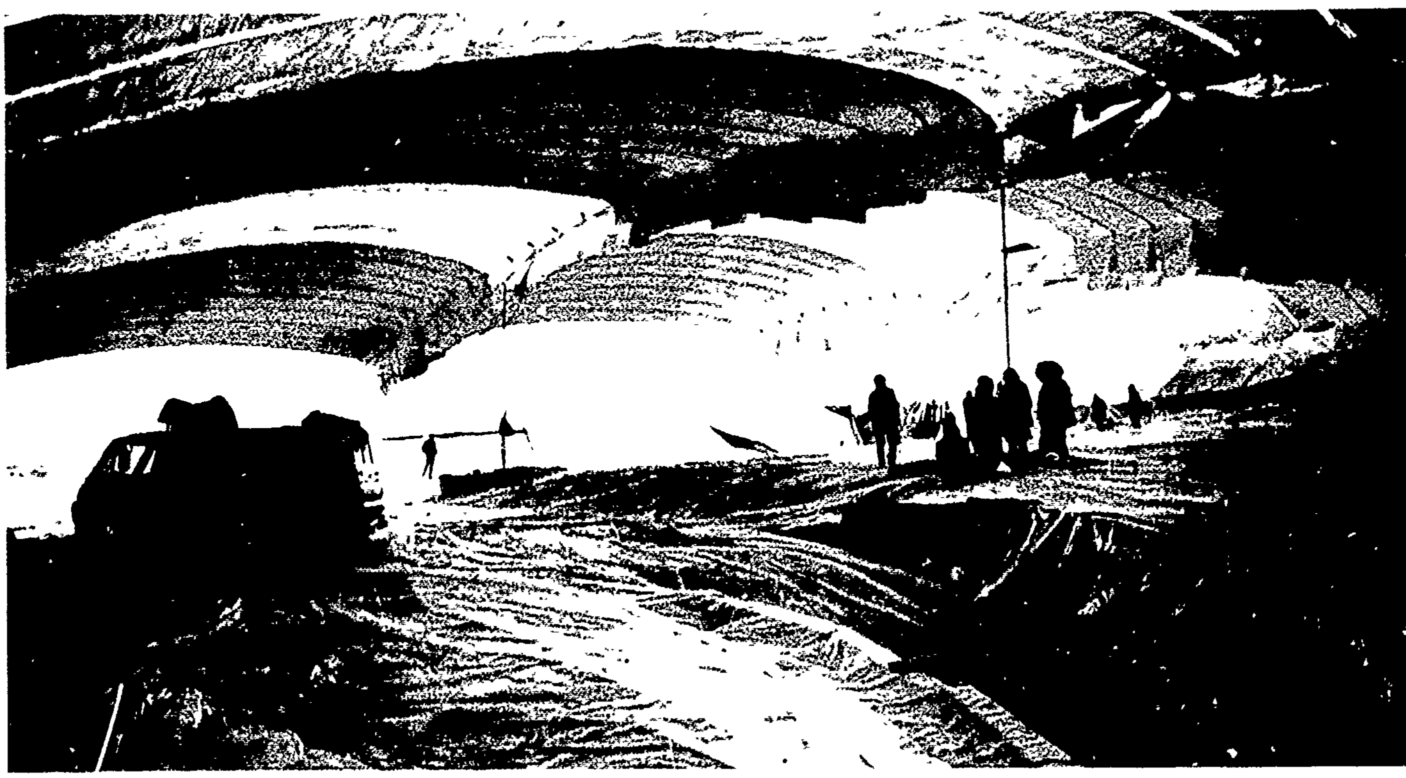
Site plan of proposed multi-activity center

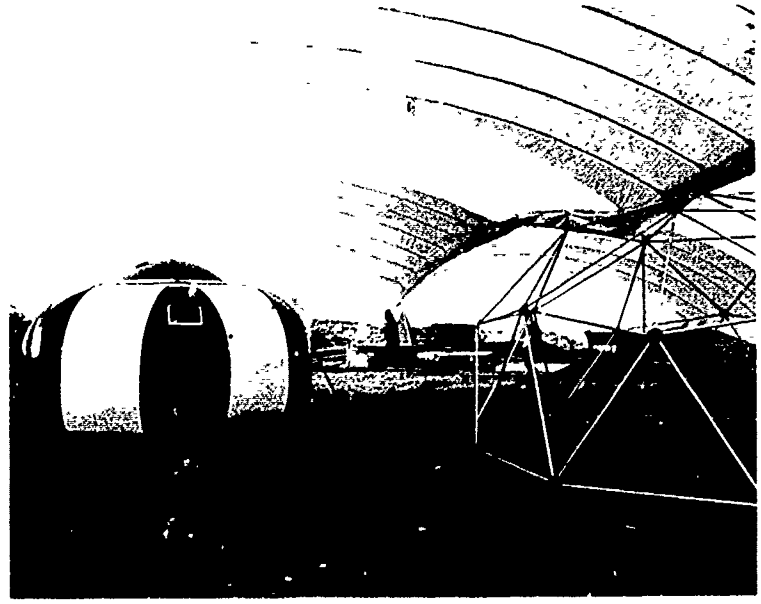


The academic and administration spaces of the Maryland campus of Antioch College are housed under an air structure that makes minimal encroachment on the rolling countryside. Earthmoving equipment banked an earth berm around the perimeter of the space, and volunteers helped to assemble the roof membrane before it was inflated.

Two cables span the roof in each direction to hold the billowing membrane in position. Antioch does not have the massive ring beam usually associated with these structures. Instead, the thrust of the roof cables is transferred from the four intersection points through vertical cables into the ground. This divides the 180-ft x 180-ft interior into nine 60-ft-sq bays.

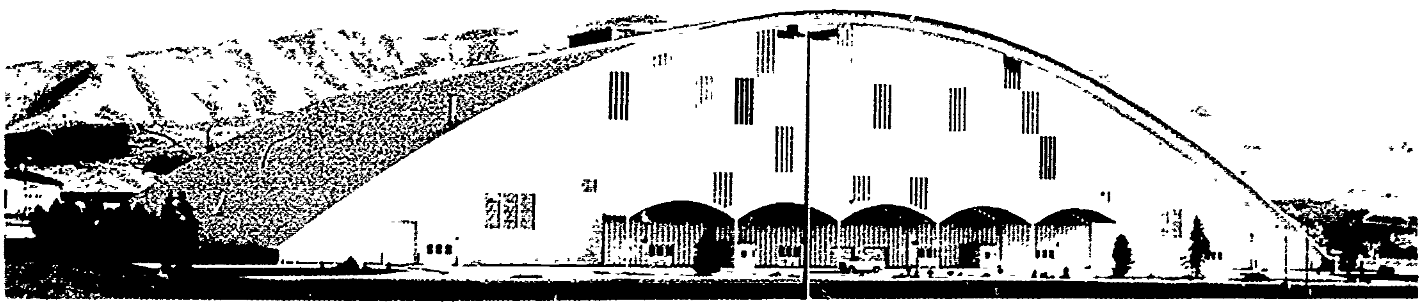


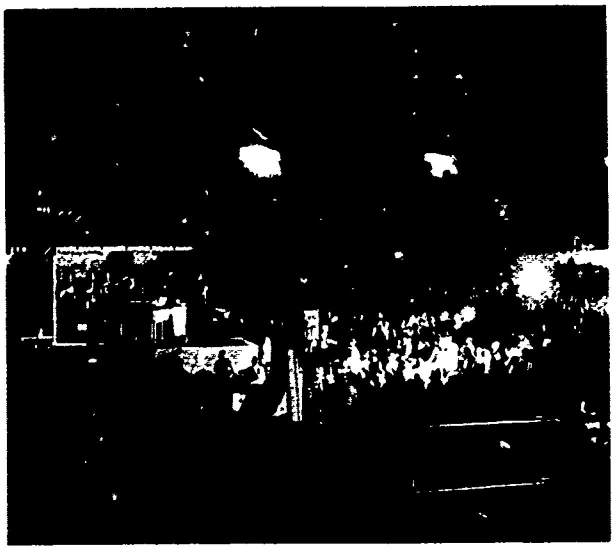


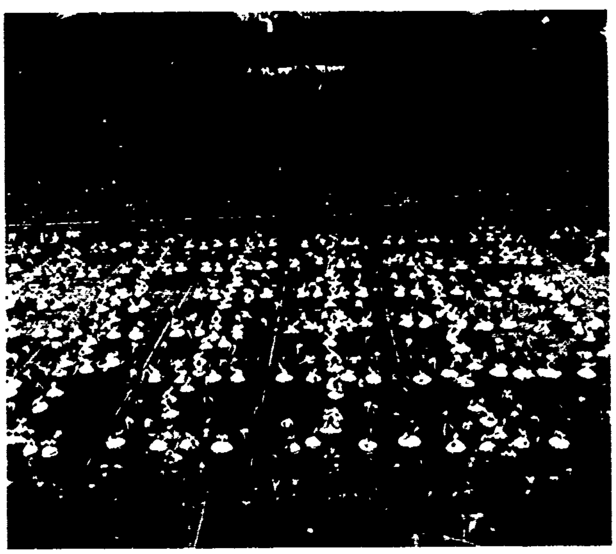


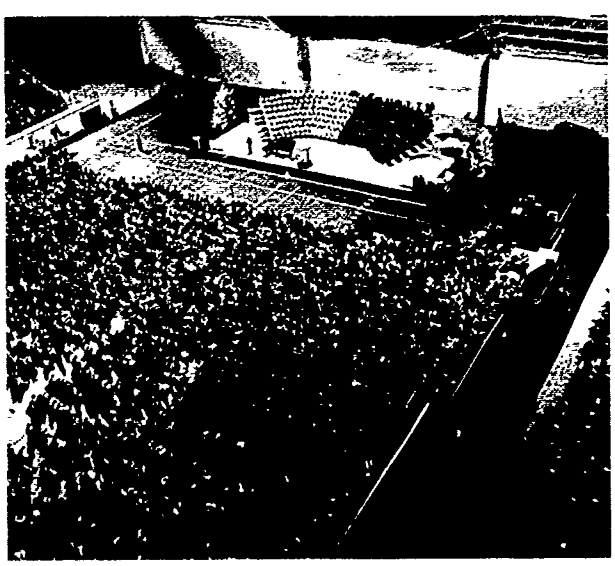
The best way to get the most value for your construction dollar is to put the building to as many uses as possible. This requires planning during the design of a physical recreation project so that the arena is versatile enough to draw paying crowds for non-sports events such as music or dancing.

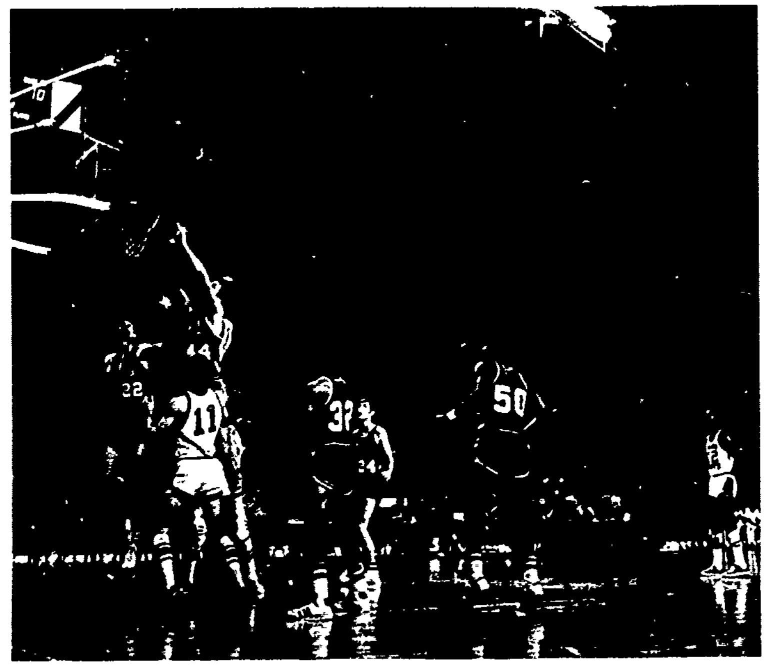
Some colleges have built gigantic arenas at enormous cost and regretted the attempt because the interiors were never really suitable for all kinds of events. An outstanding exception is Idaho State University's $2.8-million (1970) enclosed football stadium that looks rather like an early-model supermarket on the outside. Inside, the stadium contains a large column-free space that accommodates a variety of events. Obviously the stadium could not have been built before synthetic turf was developed, because the football "field" now serves as a carpeted floor for the other events.







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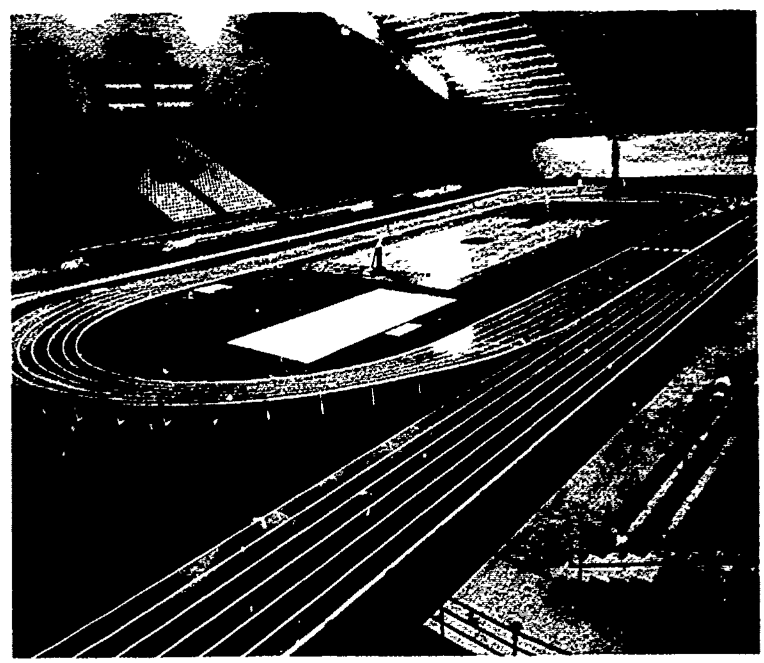

Information Sources

Page

8 Director of Athletics
University of Wisconsin
Madison, Wis. 53706

9 Sports Information Director
Portland State University
Box 751
Portland, Ore. 97207

10 Director of Athletics
Brooklyn Polytechnic Institute
333 Jay Street
Brooklyn, N.Y. 11201

12 Director of Athletics
Friends Select School
Parkway & 17th Street
Philadelphia, Pa. 19103
Architect:
Mirick, Pearson, Ilvonen, Batcheler
3 Parkway
Philadelphia, Pa. 19103

13 Director of Athletics
Long Island University
385 Flatbush Avenue Extension
Brooklyn, N.Y. 11201
Architect:
Lionel K. Levy
158 East 35th Street
New York, N.Y. 10016

14 Director of Athletics
University of Minnesota
Minneapolis, Minn. 55455
Architect:
Gassner Nathan Browne
265 Court Avenue
Memphis, Tenn. 38103
Engineer:
Geiger Berger Associates, P.C.
500 Fifth Avenue
New York, N.Y. 10036

17 Superintendent of Schools
Carroll County School District
Carrollton, Miss. 38917

18 The Chairman
Physical Education Department
Arizona State University
Tempe, Ariz. 85281
Engineer:
Sergent, Hauskins & Beckwith
3940 West Clarendon Avenue
Phoenix, Ariz. 85019

20 Director of Athletics
The Forman School
Norfolk Road
Litchfield, Conn. 06759

20 Director of Athletics
Harvard University
60 Boylston Street
Cambridge, Mass. 02138

22 The Principal
Wilton Senior High School
Wilton, Conn. 06897
Architect:
Schofield Colgan
Hudson River Marina
Box 551
Nyack, N.Y. 10960

22 The Building Leader
Juanita High School
10601 N. E. 132nd Road
Kirkland, Wash. 98033
Architect:
Kirk Wallace McKinley AIA & Associates
2000 Fairview Avenue East
Seattle, Wash. 98102

24 Director of Public Relations
La Verne College
1950 Third Street
La Verne, Calif. 91750
Architect:
The Shaver Partnership
205½ South Santa Fe
Salina, Kan. 67401

25 Study for Anchorage, Alaska
Architect:
The Shaver Partnership
205½ South Santa Fe
Salina, Kan. 67401

28 The Principal
Thomas Jefferson Junior High School
125 South Old Glebe Road
Arlington, Va. 22204
Architect:
Vosbeck, Vosbeck, Kendrick & Redinger
720 North St. Asaph Street
Alexandria, Va. 22314

29 The Principal
Boulter Junior High School
Tyler, Texas 75701
Architect:
E. Davis Wilcox & Associates
833 South Beckham Avenue
Tyler, Tex. 75701

29 The Principal
Riverside Elementary School
Princeton Township, N.J. 08540
Architect:
Gruzen & Partners
1700 Broadway
New York, N.Y. 10019

30 The Principal
Hommocks Middle School
Boston Post Road
Larchmont, N.Y. 10538
Architect:
The Perkins & Will Partnership
1 North Broadway
White Plains, N.Y. 10601

31 Community School Coordinator
Whaley Park & Williams Elementary School
3501 Minnesota Avenue
Flint, Mich. 48506
Architect:
Nelson, McKinley, Reed & Associates, Inc.
624 South Grand Traverse
Flint, Mich. 48503

31 Aquatic Director
Cuyahoga Falls Natatorium
Department of Parks
2351 Fourth Street
Cuyahoga Falls, Ohio 44222
Architect:
James Montalpo
1666 State Road
Cuyahoga Falls, Ohio 44222

33 Director of Athletics
Graceland College Fieldhouse
Lamoni, Iowa 50140
Architect:
The Shaver Partnership
205½ South Santa Fe
Salina, Kan. 67401

34 Director of Athletics
College of DuPage
2S100 Lambert Road
Glen Ellyn, Ill. 60137

35 Chapman College
Orange, Calif. 92666
Architects:
Richard Hawley Cutting & Associates
2806 South Dixie
West Palm Beach, Fla. 33405
Charles M. Wickett
1001 North Harbor
Fullerton, Calif. 92632

36 Knoxville College
Knoxville, Tenn. 37921
Architect:
Gassner Nathan Browne
265 Court Avenue
Memphis, Tenn. 37103

37 Director of Public Relations
Miles College
Willie Mays Center Project
Birmingham, Ala. 35208
Architect:
Gassner Nathan Browne
265 Court Avenue
Memphis, Tenn. 38103

38 The Principal
Agua Fria Union Senior High School
Avondale, Ariz. 85323
Architect:
Rossman & Associates
4601 East McDowell Road
Phoenix, Ariz. 85008

40 Director of Athletics
Essex County Community College
Newark, N.J. 07102

44 Director of Athletics
Milligan College
Johnson City, Tenn. 37601
Architect:
The Shaver Partnership
205½ South Santa Fe
Salina, Kan. 76401

45 Director of Athletics
Lane College
Jackson, Tenn. 38301
Architect:
Gassner Nathan Browne
265 Court Avenue
Memphis, Tenn. 38103

46 The Headmaster
Charles Wright Academy
7723 Chambers Creek Road
Tacoma, Wash. 98467
Architect:
Donald F. Burr AIA & Associates
Box 3403—Lakewood Center
Tacoma, Wash. 98499

48 The Director
Antioch College
200 Wilde Lake Village Green
Columbia, Md. 21044
Architect:
Rurik Engstrom, AIA
10351 Barcan Circle
Columbia, Md. 20143

50 Director of Athletics
Idaho State University
Pocatello, Idaho 83201
Architect:
Cedric M. Allen &
Tom H. Myers, Associated Architects
403 North Main
Pocatello, Idaho 83201

Reports

The following publications are available from EFL, 477 Madison Avenue, New York, N.Y. 10022.

CAREER EDUCATION FACILITIES
A programming guide for shared facilities that make one set of spaces or equipment serve several purposes. (1973) $2.00

DESIGN FOR ETV—PLANNING FOR SCHOOLS WITH TELEVISION
A report on facilities, present and future, needed to accommodate instructional television and other new educational programs. Prepared for EFL by Dave Chapman, Inc., Industrial Design. (1960) (Revised 1968) $2.00

THE EARLY LEARNING CENTER
A Stamford, Conn., school built with a modular construction system provides an ideal environment for early childhood education. (1970) $0.50

EDUCATIONAL CHANGE AND ARCHITECTURAL CONSEQUENCES
A report on school design that reviews the wide choice of options available to those concerned with planning new facilities or updating old ones. (1968) $2.00

ENVIRONMENTAL EDUCATION/FACILITY RESOURCES
Illustrates where and how students learn about the environment of communities and regions using existing and designed facilities. (1972) $2.00

FOUND SPACES AND EQUIPMENT FOR CHILDREN'S CENTERS
Illustrations of premises and low-budget materials ingeniously converted for early education facilities. Booklet lists general code requirements and information sources. (1972) $2.00

THE GREENING OF THE HIGH SCHOOL
Reports on a conference on how to make secondary school healthy. Includes the life-styles of adolescents and ways to accommodate them, open curriculums and alternative education programs. (1973) $2.00

GUIDE TO ALTERNATIVES FOR FINANCING SCHOOL BUILDINGS
Chart and book explore conventional and unconventional routes for financing school construction. Includes case histories. (1971) $2.00

HIGH SCHOOL: THE PROCESS AND THE PLACE
A "how to feel about it" as well as a "how to do it" book about planning, design, environmental management, and the behavioral and social influences of school space. (1972) $3.00

THE IMPACT OF TECHNOLOGY ON THE LIBRARY BUILDING
A position paper reporting an EFL conference on this subject. (1967) $0.50

JOINT OCCUPANCY
How schools can save money by sharing sites or buildings with housing or commerce. (1970) $1.00

PATTERNS FOR DESIGNING CHILDREN'S CENTERS
A book for people planning to operate children's centers. It summarizes and illustrates all the design issues involved in a project. (1971) $2.00

PLACES AND THINGS FOR
EXPERIMENTAL SCHOOLS
Reviews every technique known to EFL for improving the quality of school buildings and equipment: Found space, furniture, community use, reach out schools, etc. Lists hundreds of sources. (1972) $2.00

PLACES FOR ENVIRONMENTAL EDUCATION
Identifies types of facilities needed to improve environmental education. (1971) Single copies free, multiple copies $0.25

THE SCHOOL LIBRARY: FACILITIES FOR
INDEPENDENT STUDY IN THE
SECONDARY SCHOOL
A report on facilities for independent study, with standards for the size of collections, seating capacity, and the nature of materials to be incorporated. (1963) $1.25

SCHOOLS FOR EARLY CHILDHOOD
Ten examples of new and remodeled facilities for early childhood education. (1970) $2.00

SCHOOLS: MORE SPACE/LESS MONEY
Surveys the alternatives for providing school spaces in the most economical manner. Includes extending school year, converting spaces, sharing facilities, open campus, etc. (1971) $2.00

SCHOOLS WITHOUT WALLS
Open space and how it works. (1965) $0.50

STUDENT HOUSING
A guide to economical ways to provide better housing for students. Illustrates techniques for improvement through administrative changes, remodeling old dorms, new management methods, co-ops and government financing. (1972) $2.00

SYSTEMS: AN APPROACH TO
SCHOOL CONSTRUCTION
Toronto, Montreal, and Florida projects and how they developed from the SCSD program. (1971) $2.00

Films

The following films have resulted from EFL-funded efforts and are available for loan or purchase as indicated:

ROOM TO LEARN
A 22-minute color film on the Early Learning Center in Stamford, Connecticut, an open-plan early childhood school with facilities and program reflecting some of the better thinking in this field. Available from New York University Film Library, 26 Washington Place, N.Y., N.Y. 10003, rental $7.50, purchase $125.00.

NEW LEASE ON LEARNING
A 22-minute color film about the conversion of "found space" into a learning environment for young children. The space, formerly a synagogue, is now the Brooklyn Block School, one of New York City's few public schools for children aged 3-5. Available from New York University Film Library, 26 Washington Place, New York, N.Y. 10003, rental $7.50, purchase $125.00.

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28	Day Walters
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Designed by Michel Goldberg
Printed by Wintry Press Ltd.