Design Concepts Concerning the Multiple Use of Transportation Rights-of-Way

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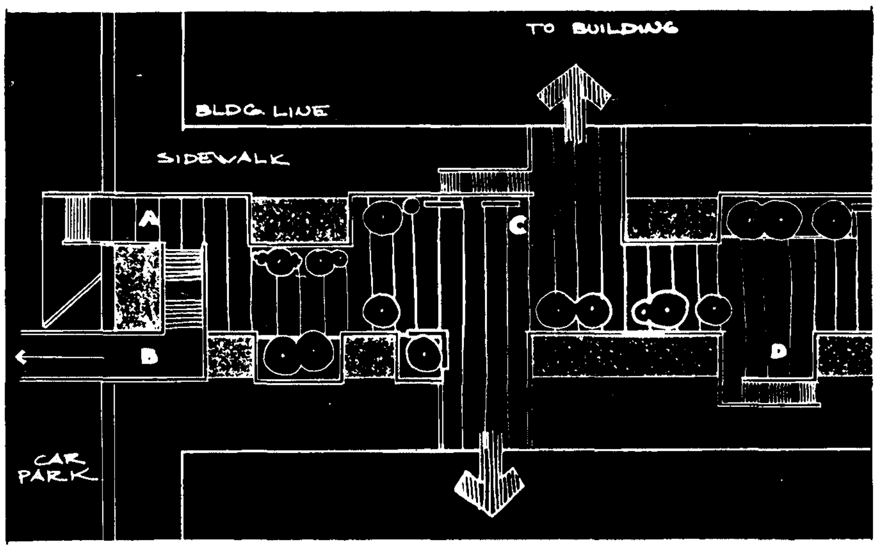
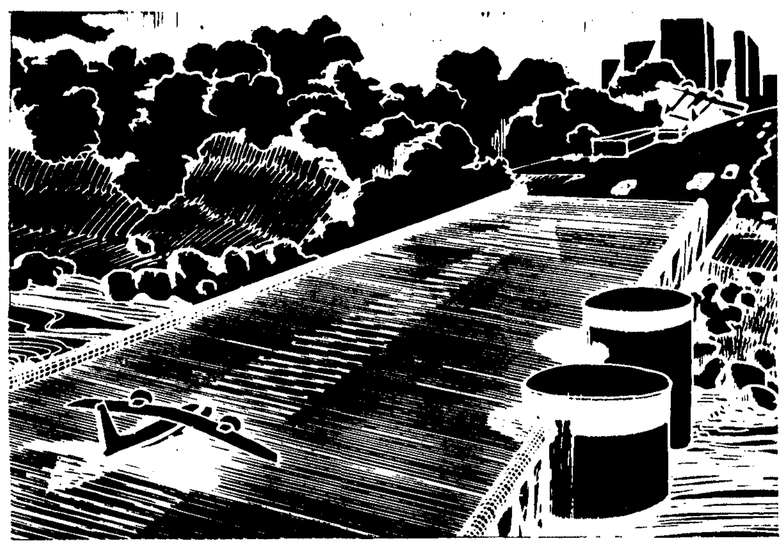

TO BUILDING
BLDG LINE
SIDEWALK
A
B
C
D
CAR PARK

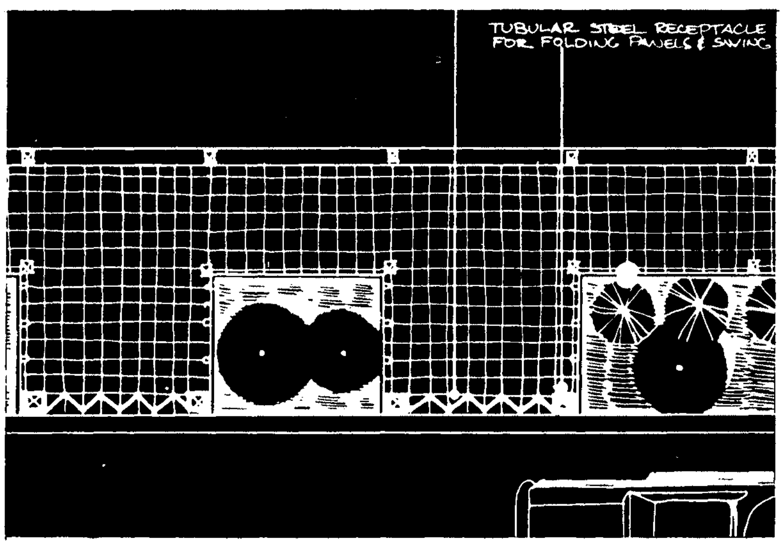


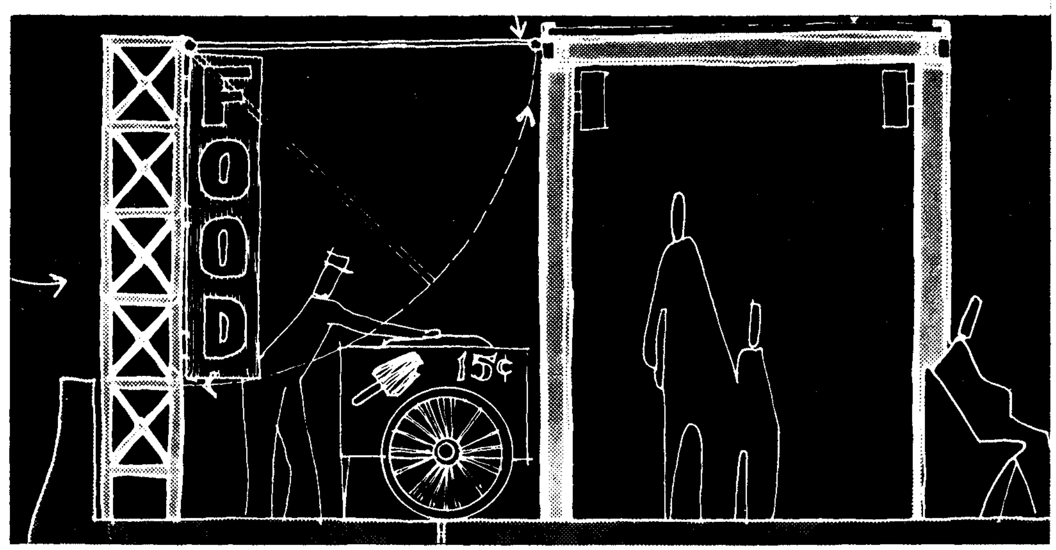
Summary

The growing shortage of available land is generating a great deal of interest in the utilization of transportation rights-of-way for uses other than for vehicles. Such structures as air-rights buildings and enclosed pedestrian bridges between buildings are examples of some of the ways rights-of-way are currently being used for purposes other than vehicles.

This study explores a number of other possible ways such transportational space might be used. Included are bridge promenades and recreational towers, aerial car and people parks, STOL ports and solar energy collectors.

The drawings provide a visual interpretation of these ideas and aided in the final development as is presented here as a stimulus to future study.





SOME DESIGN CONCEPTS CONCERNING THE MULTIPLE USE OF TRANSPORTATION RIGHTS–OF–WAY

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INTRODUCTION

Approximately 25 million acres (10 Mha) of the land area in the United States are devoted to various transportation uses. Each year, about 400,000 acres (160 kha) of additional land are used for transportation. With pressures for use of available land increasing, not only for transportation, but also for housing, commerce, industry, agriculture, recreation, and the like, it is obvious that more efficient use must be made of land. One place to look for increased efficiency is at public owned transportation rights-of-way. Multiple or joint use of such rights-of-way could be an answer.

The object of this study is to explore various design possibilities concerning the multiple use of bridges, rural highways, and urban streets. Potentially, space exists under, over and, in many cases, alongside of such transportation facilities. Economic feasibility, of course, will control the utilization of such space. However, as land crowding continues, the economics of utilizing transportation land for additional uses becomes increasingly more realistic.

In many cases, utilization of such space has already proven to be economical. Utilities such as water, sewer, and gas have virtually from their beginnings been placed under urban streets. Similarly, electrical power and telephone lines have occupied the air space adjacent to and over highways and streets.

Different transportation systems using the same rights-of-way commonly coexist. Pedestrians (using sidewalks), bicyclists (using bike paths), and motorists (using roadways) are an everyday mix of adjacent space. Frequently one finds subways in tunnels below surface roadways and elevated trains or monorail vehicles on structures above roadways. Elevated freeways for high speed vehicles are often found over surface roadways for slow speed vehicles. Roadside parking may also be considered as joint use where moving vehicles are separated from stationary vehicles.

Still other examples of current multiple or joint use can be cited. Crossing intersections of surface roads or railroads is a joint use situation. To avoid vehicular conflicts, these types of intersections are often separated vertically; making use of space above or below. Currently, a number of interchanges exist where there are as many as four levels of roadway overlaying each other. Land in and around such multi-layer interchanges generally is left underutilized, except for their landscape or esthetic benefit. The utilization of this land has received attention by a number of people who have proposed that it be used for commercial structures and subterranean parking. Of greater concern, however, is the utilization of land under the great number of elevated highways or railways in existence. Examples of actual use of this space include playgrounds, parks, parking lots, storage facilities and, in a few cases, commercial buildings. In one situation in Florida, a new school building was seriously considered for construction under an elevated freeway. Interested organizations would of course rent this space and thus provide income to the city or state.

Rather different uses of highway rights-of-way are for scenic vistas and farming. Natural or created topography and landscaping along highways certainly are non-transportation features of a highway, qualifying them for the joint use appelation. Considerable sums of money are spent on beautification, even though without direct productive returns. In some locations, farmers are permitted to harvest the hay growing along the highway for their own use. They in return relieve the state of the expense of maintaining this property. Rest and scenic stops along highways provide additional cases where non-transportation functions are incorporated into transportation rights-of-way.

Perhaps the most dramatic of current multiple use is in connection with air-rights buildings. Numerous buildings have already been constructed over highways and railroad tracks. Included are high-rise office buildings, parking garages, restaurants and, in one known case, a library.(1) Pedestrian bridges connecting buildings over streets may also be considered such an air-rights structure, one that is rapidly proliferating in almost every urban area. In most cases, the city or state government gains financially in leasing such air-rights space for development.

It is thus seen that many examples of multiple or joint use of transportation rights-of-way already exist. Land "crunch" alone will certainly cause these rights-of-way to be used more effectively in the future. Ways no doubt will be sought to generate additional incomes for city and state governments by leasing appropriate space adjacent to, over, or under rights-of-way for other uses. Still another reason for developing multiple use of such land is to gain a broader base acceptance of transportation corridors. Many individuals and public groups are beginning to resist the use of land for highway purposes. Ways should be found to use highway rights-of-way for a variety of purposes so as to directly benefit the population living adjacent to them as well as the commuter.

This study concentrates on examining various new design possibilities with the purpose of suggesting uses perhaps not heretofore considered by others. This is not to say that the multiple or joint uses already mentioned are fully resolved; but only that other new ideas should also be explored. Some of these to be discussed in the next section are immediately realizable, while others require further technological development. In either case, the purpose of this study is to stimulate thought and to give physical and visual form to the concepts proposed.

case studies

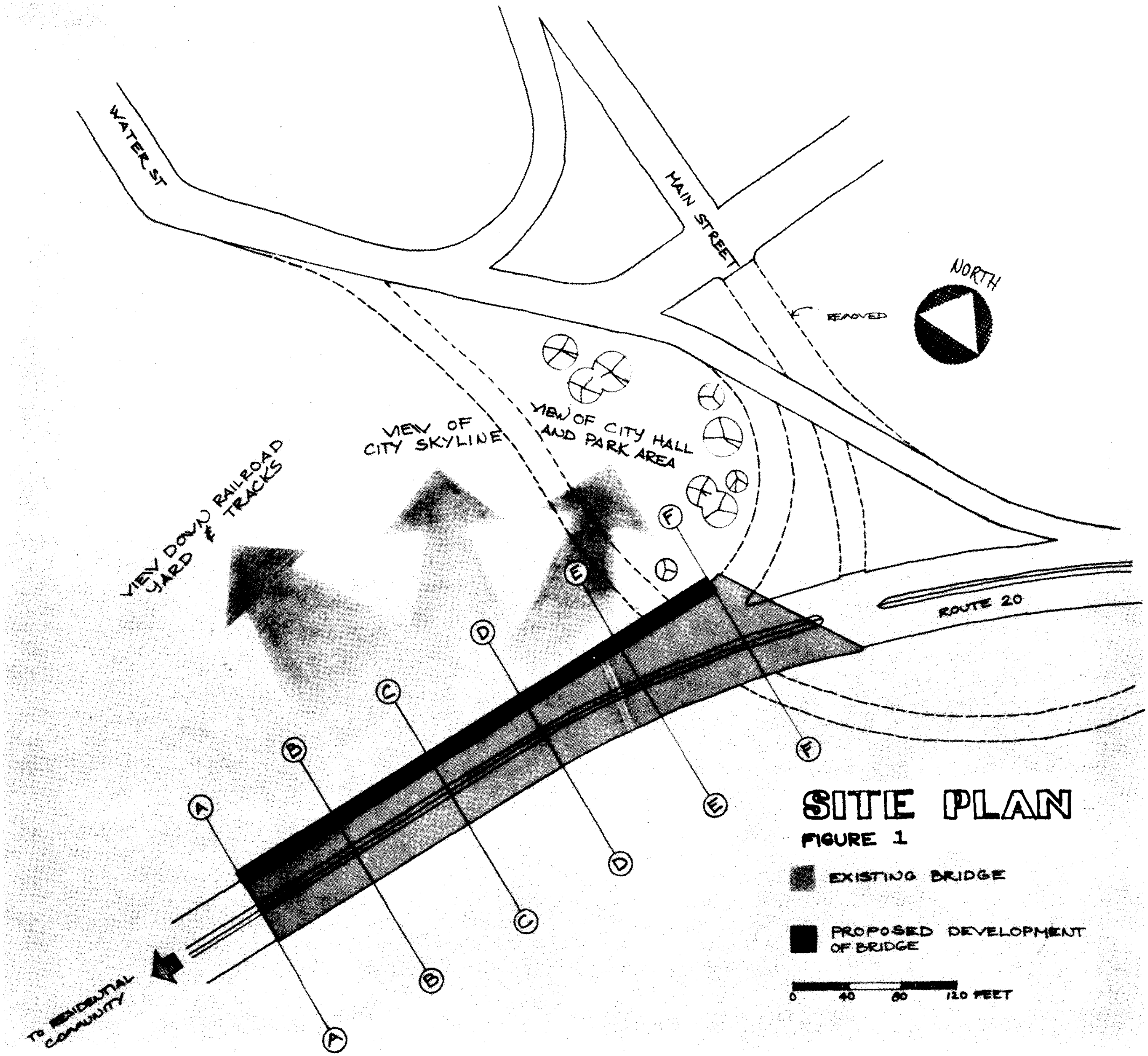
Bridges

Highway bridge structures as currently designed place most of their emphasis on providing a surface for the rapid and safe movement of automotive vehicles. Occasionally a narrow sidewalk is added for pedestrians, which from the point of view of the pedestrian is anything but safe and pleasant. Views from the vantage point of a bridge are generally unique. From the height of the bridge, panoramas of nature or sights of a city unlike those found elsewhere can be seen. Yet, generally little or no provision is made to perceive these views. At best, passengers in vehicles moving across the bridge might get a tantalizingly quick view through the railings. Provisions to park the vehicle at the end of the bridge and walk across or rest on the bridge are also discouraged. Bicycling across bridges also is generally discouraged. One known exception to this pattern in Virginia is the Chesapeake Bay Bridge Tunnel. At the Thimble Shoal Island, parking, eating facilities, gift shops, viewing telescopes, and a long fishing pier are included. The facilities are well used, which attests to their possible acceptance elsewhere.

Historically, there have been other bridges built to accommodate not only fast moving vehicles but also pedestrians and slow moving vehicles as bicycles, principally through having very wide sidewalks. Because of the wide sidewalks, other activities besides walking take place, such as sitting, eating, fishing, and selling of flowers, refreshments, souvenirs, and jewelry. Perhaps the most accommodating of all bridges in this regard is the Khaju Bridge at Isfahan, Iran, built in the seventeenth century. A two-level masonry bridge over a river, it provides for fast traffic at the upper level and a variety of facilities for pedestrians and cyclists at the lower level. Included are a number of "rooms," with seats, looking out over the water. One is large enough to be used for functions as wedding parties, while smaller rooms are used for singers and dancers to entertain travelers or for simply resting and enjoying the sights and sound of the water. An open, low-level terrace along the bridge leads out to the water where people might rest or meditate. In addition to providing these facilities, the bridge also functions as a water control dam.

It is seen that bridges in the past have incorporated such features for the enjoyment and enrichment of people living near or traversing the bridge. Bridge designers of today might well study what multiple or joint use could be made of bridges built for the society of today.

Two recently constructed bridges in Virginia have been chosen as case studies to explore such possibilities. One is essentially an urban bridge and the other is essentially a rural bridge. The studies deal with the bridges as built, in which structural additions must be made that would necessitate less than perfect solutions. In new bridges, these same concepts could be introduced wherein the entire structure could be more compatibly and economically designed.



SITE PLAN

FIGURE 1

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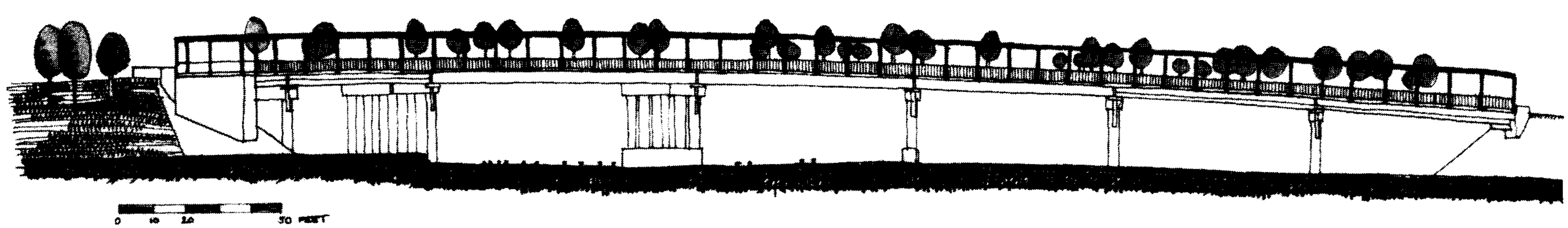
Figure 1 shows the basic plan of the Belmont Bridge on Rt. 20 on the east end of the central business district of Charlottesville, Virginia. Constructed in 1962, it is a 450 ft. (135 m), seven-span steel girder structure arching up approximately 27 ft. (8.1 m) over a series of railroad tracks. Very interesting views exist toward the city center and over the tracks toward the train station, both seen when facing west. Presently, a 6 ft. (1.8 m)-sidewalk exists on both the west and east sides of the bridge, which is used by pedestrians in getting from the residential area on the south end of the bridge to the city on the north end. There is no bike lane, so cyclists use the roadway itself.

Because the bridge serves as a link between the city center and a nearby residential area, it is proposed in concept that this bridge could usefully support considerably more pedestrian related activity than it does now. Essentially, as seen in Figure 1, it is proposed that the sidewalk be enlarged on the west side to take advantage of the special views. This sidewalk could be more than just a sidewalk; it would incorporate a number of other landscaping and architectural features as well. These would include grass, shrubs, trees, benches, a covered walkway, viewing areas, information stands, art displays, and possibly mobile vendors.

Figure 2 shows the west elevation of the bridge with the proposed multipurpose walkway spanning the full length of the structure.

Shown in Figures 3A through 3E are more detailed plans of how the length of the walkway might be laid out, in segments of about 80 ft. (24 m). A variety of different types of spaces are shown to create pedestrian interest and encourage multiple use. In other bridges employing this promenade concept, other uses or arrangements appropriate to the location could, of course, be incorporated.



WEST ELEVATION

FIGURE 2

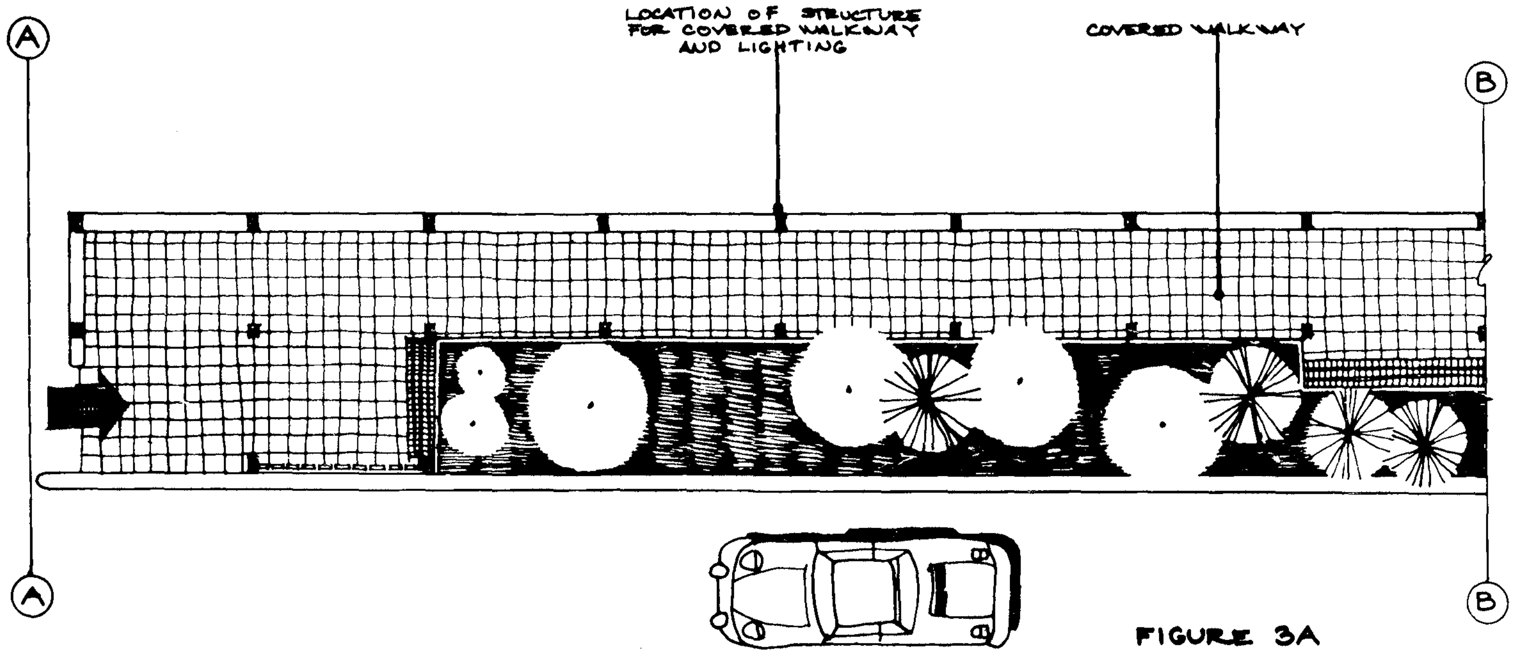


FIGURE 3A

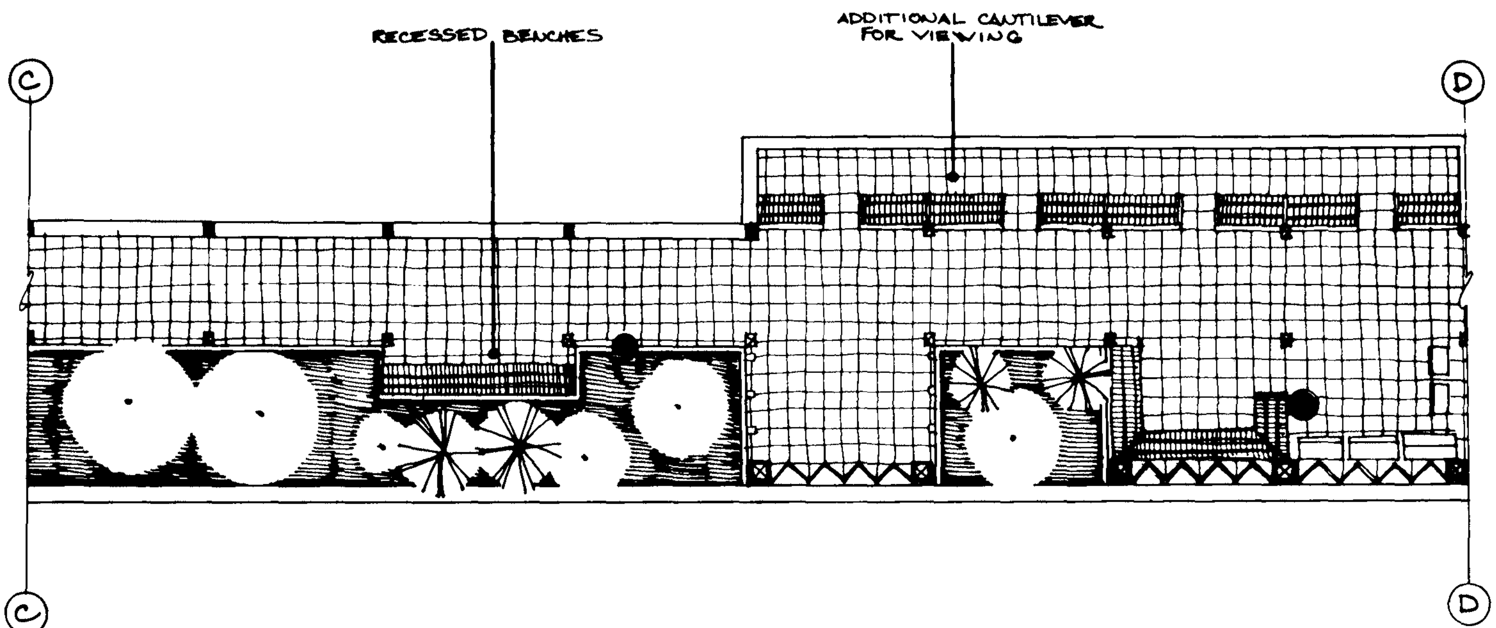


FIGURE 3B

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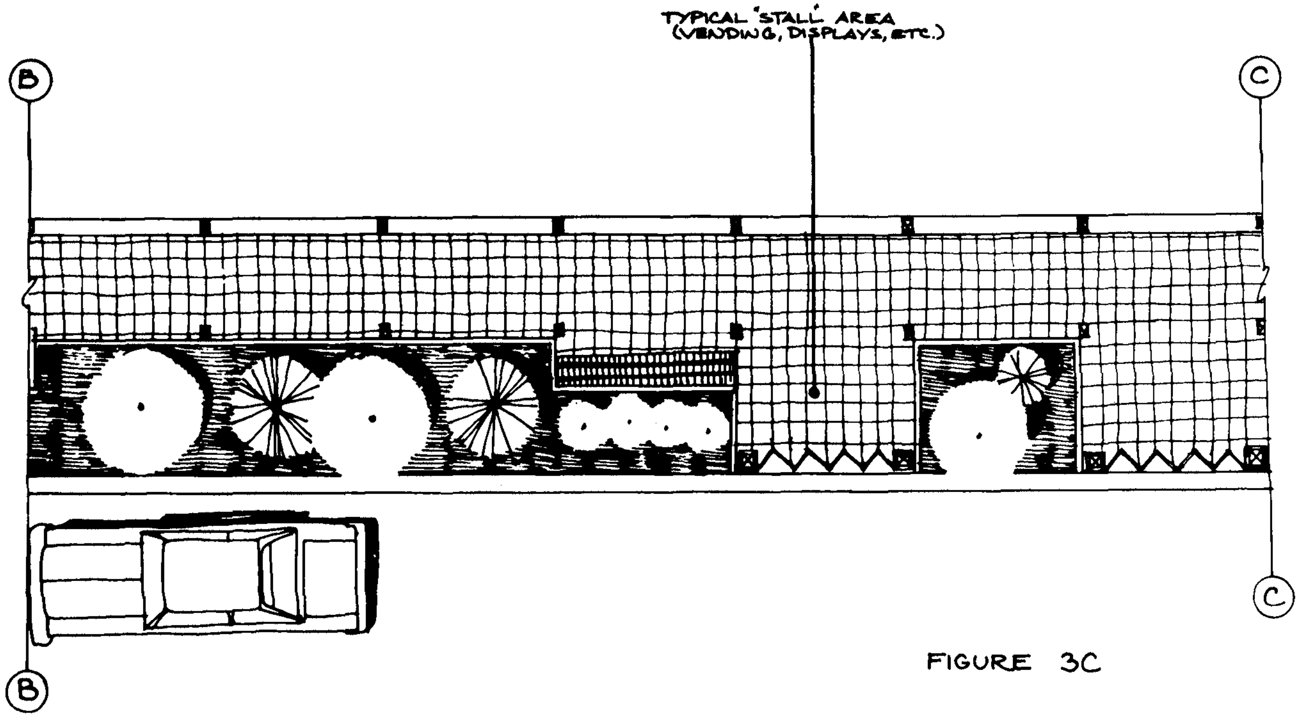

FIGURE 3C

Proceeding along the walkway from south to north, as a pedestrian would experience this bridge, the events will be described sequentially. Pedestrians would also experience the bridge approaching it from the north or city center end, enjoying the features on the bridge and perhaps not going all the way across. However, for purpose of explanation, the south end of the bridge, between stations A and B (Figure 3A) will be described first. For a sense of scale, each grid square marked on the pavement is one foot (0.3 m).

Walking onto the bridge, one sees a planter of shrubs, trees and grass separating the pedestrian from the vehicular traffic. This feature serves as a safety, sound, esthetic, and psychological barrier for the pedestrian. Adjacent to the planter is a covered walkway for year-round use. Lighting is provided in the walkway for night use. A few benches are provided here for resting.

Through segment B-C (Figure 3B), the covered walkway continues. The covered walkway is in fact continuous along the entire length of bridge. A few more benches are also provided. For variety and interest, several recesses in the planter are provided for vendors, displays, or other similar activities. Note that even in these recessed areas, a shield of wall panels is shown separating the pedestrians from the vehicles.

In segment C-D (Figure 3C), many more benches are provided. At this point the views toward the city become particularly interesting. The visual drama of the city can be experienced here with the trains, tall buildings and general bustle of the city center. For those whose wish is to see the views undistracted by pedestrians, the walkway width is extended as shown as scenic overlooks. More recessed areas for vending, displays, or benches are provided. Note that these features are slightly different along the walkway for added interest and varied use. All of these features are designed at a personal, "human" scale.

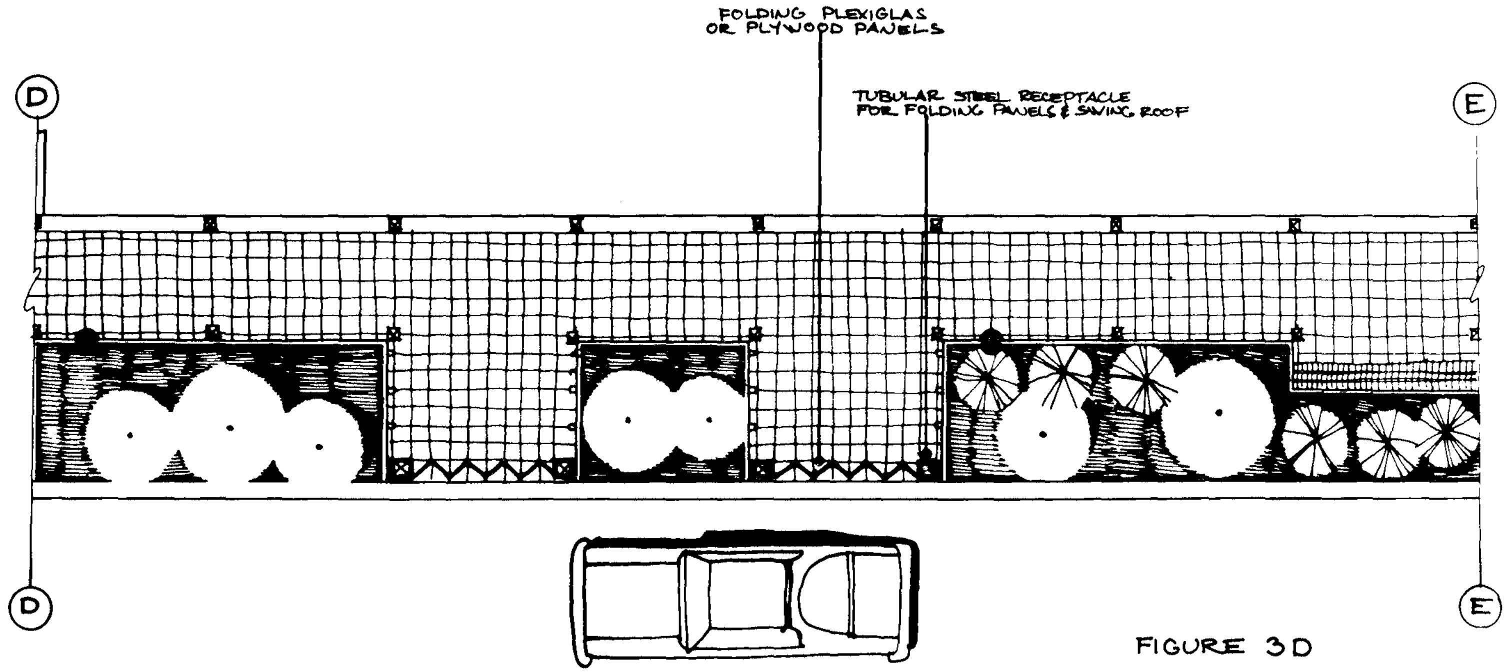

FIGURE 3D

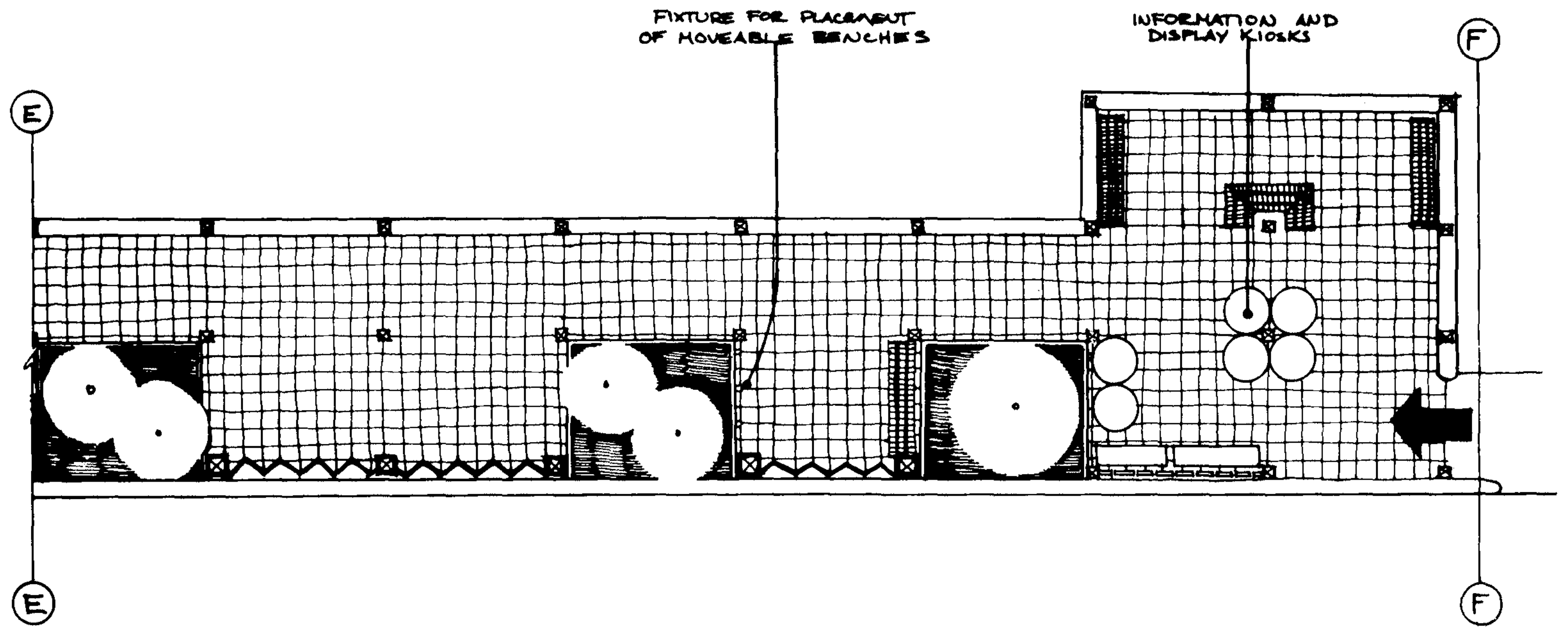

FIGURE 3E

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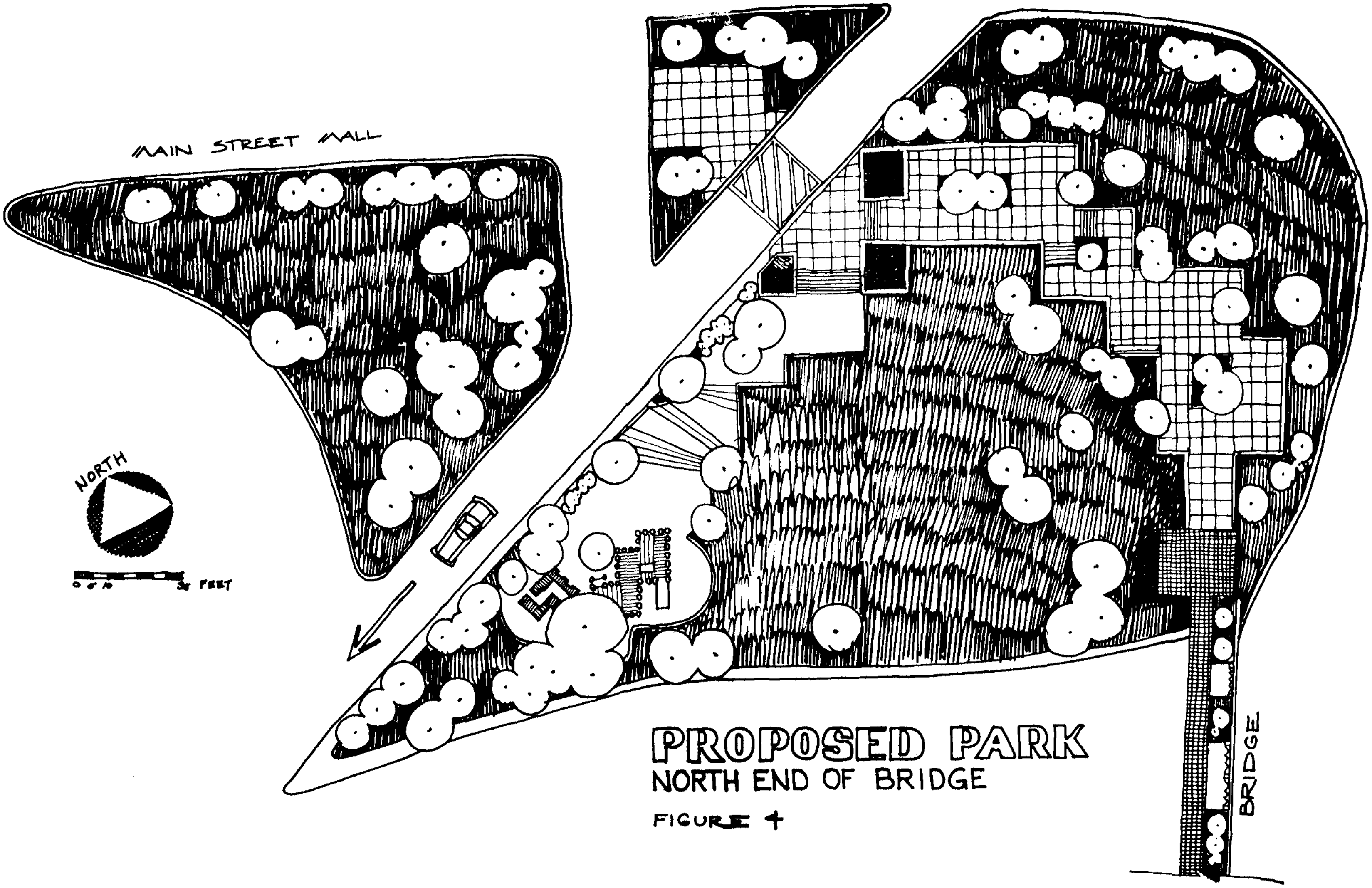


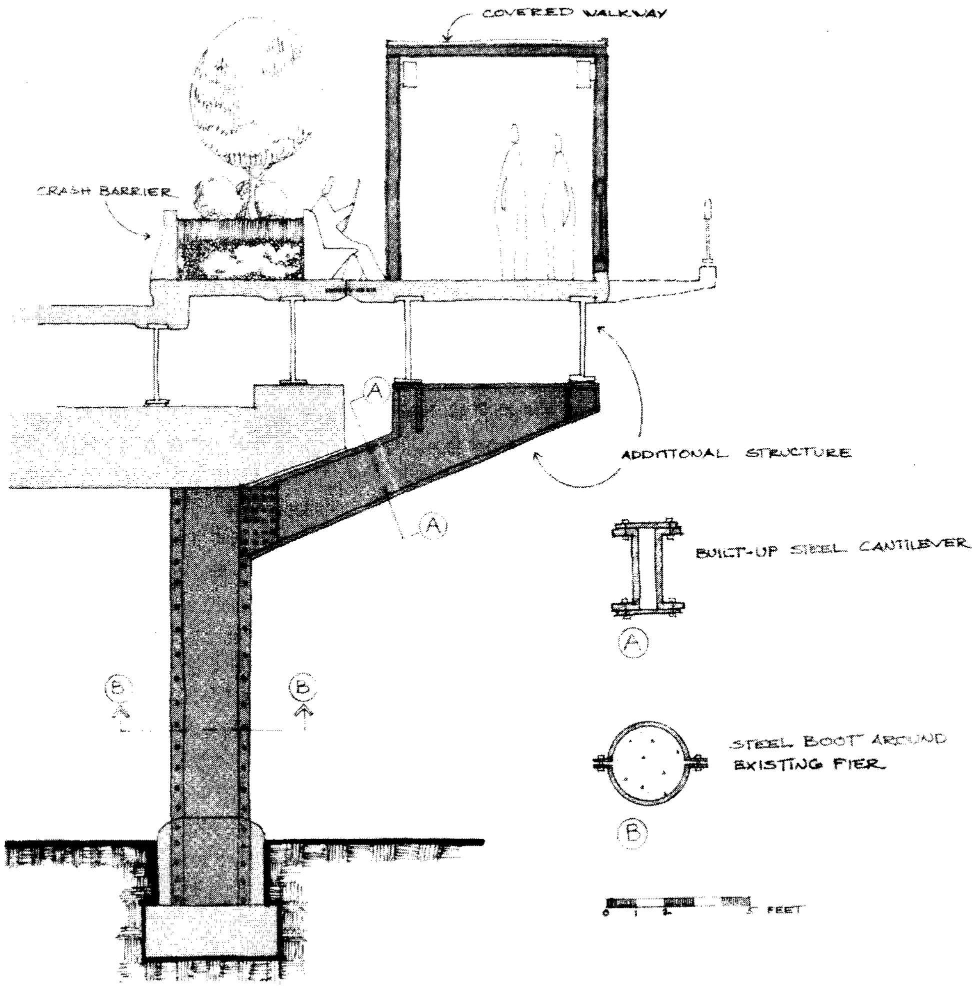
PROPOSED PARK
NORTH END OF BRIDGE
FIGURE 4

Segment D-E (Figure 3D) has more planters, recessed areas, benches, and, of course, a covered walkway. For greater year-round use, one of the recesses has a swing up roof for use on inclement days or for sun control.

Segment E-F (Figure 3E) is the terminal (or entrance) to the bridge walkway. Since most people coming from the city center will probably enter at this end, an enlarged walkway is provided with information and display kiosks, along with many more benches. (The enlarged sidewalk width here is built on earth fill.)

Figure 4 shows a proposed park development at the north end of the bridge. Presently, the site exists as an open grassy area. Several ramp roads leading to and from this end of the bridge have recently blocked off for through traffic in conjunction with the construction of a new shopping mall on Main Street. It is expected that in the future these old ramps will be torn up and incorporated into a park area. Such a mini-park would serve as a pleasant pedestrian extension of the mall to the bridge walkway. Included in this park would be some children's play sculpture, stepped paths, grass, shrubs, flowers, and trees. Auto parking (if needed) would be at any one of the many parking lots or parking garages nearby.

It may be noted that with pedestrians encouraged to use the sidewalk on the west side of the bridge, the existing 6 ft. (1.8 m) sidewalk on the east side of the bridge could become a bicycle lane. With over 100 million bicycles in the country today and 15 million new ones purchased every year, bicycles as a mode of transportation can no longer be ignored.



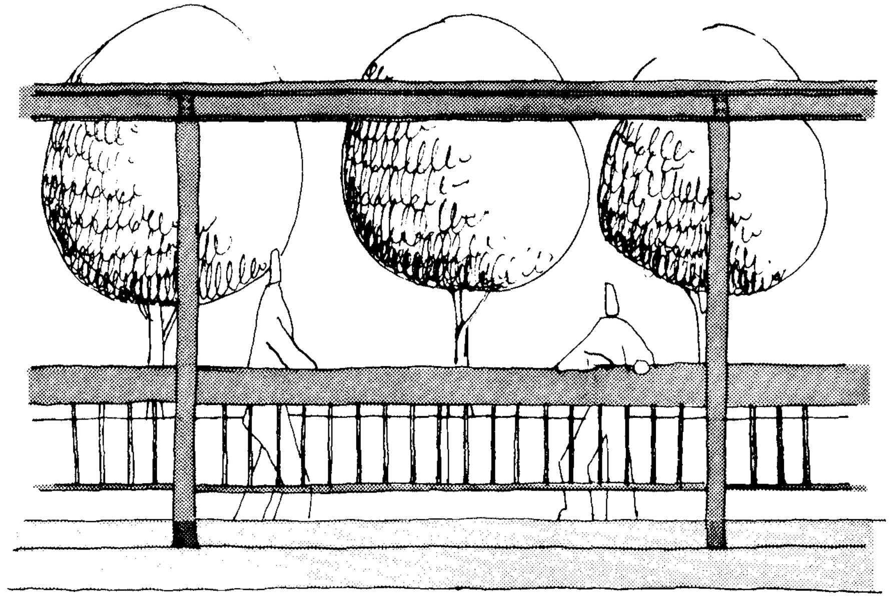
PROPOSED STRUCTURE

FIGURE 5

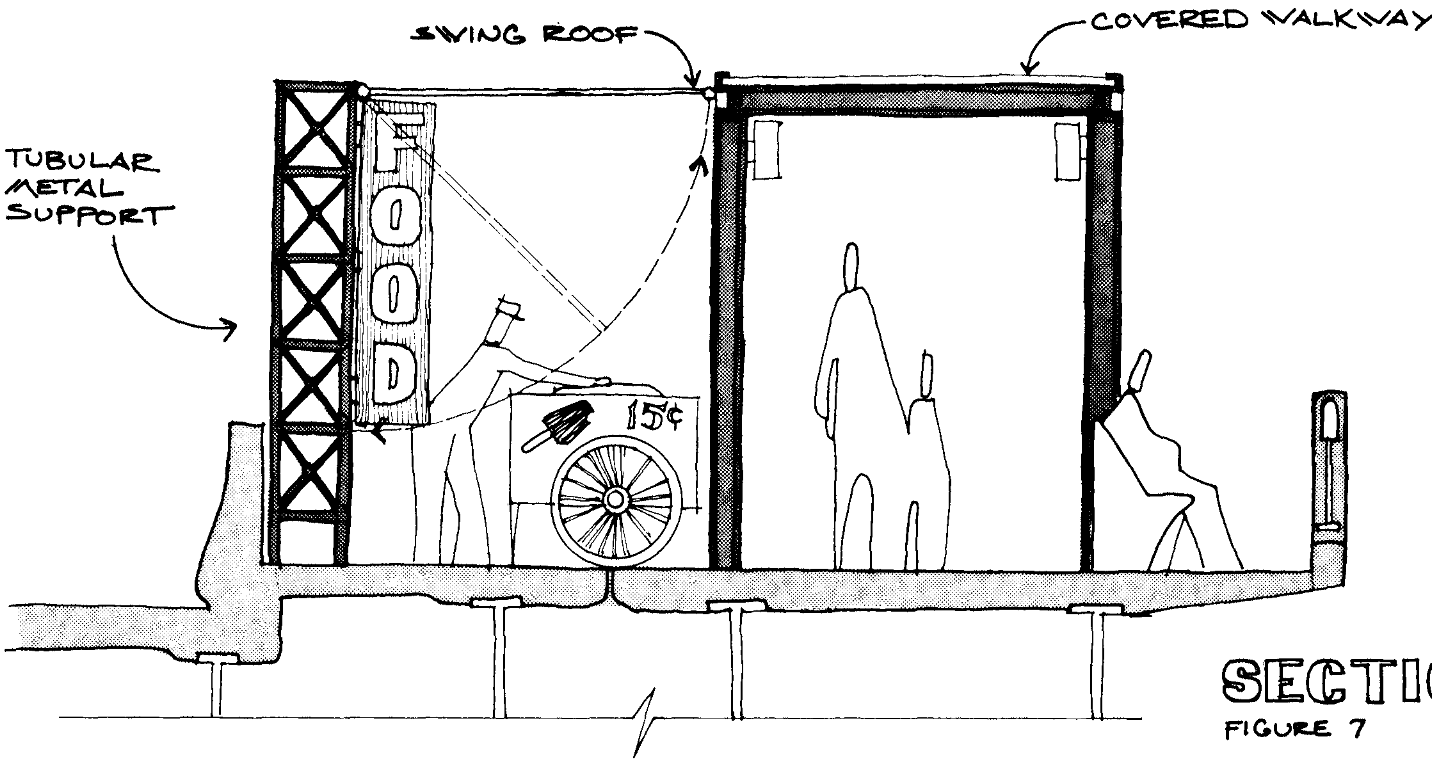
The structuring of the additional sidewalk is shown in Figure 5. In concept, steel "boots" are clamped around the existing piers. These boots will reinforce the existing concrete piers as well as provide a method of attaching the sloping steel cantilever arms which hold up the added walkway. The existing sidewalk (with parapet removed) would be joined to the new sidewalk at the same elevation. A concrete crash barrier (serving also as the planter wall) would be added for safety at the curb line. To minimize the weight of the soil in the planters, the lower soil can be chemically treated vermiculite, with only a thin layer of normal soil over the roots for cover. The "overlook" section of the walkway (see Figure 3C) can be structured by simply cantilevering the concrete deck out another 5 ft. (1.5 m). The covered walkway would be made of standard steel or aluminum sections. The roof would be of reinforced plastic, perhaps color tinted.

Figure 6 illustrates some architectural details relating to the covered walkway and vending areas. Figure 7 similarly shows a portion of the covered walkway with safety railings. Putting it all together as a pedestrian along the walkway might see it, Figure 8 shows a perspective of the sidewalk scene. The atmosphere is clearly pleasant and inviting.

In the event that funds for such a complete pedestrian promenade cannot be secured at any one time, construction could easily proceed in stages. Stage one would involve constructing a concrete crash barrier between the sidewalk and the roadway. Stage two would include the removal of the existing rail and parapet and extending the sidewalk width. A railing would also be added at the edge. This stage in itself would transform the sidewalk into a much safer and more pleasant place to walk. Stage two could be followed by the addition of landscaping and benches. The last phase would be the construction of the covering over the walkway.



ELEVATION
FIGURE 6



SECTION
FIGURE 7

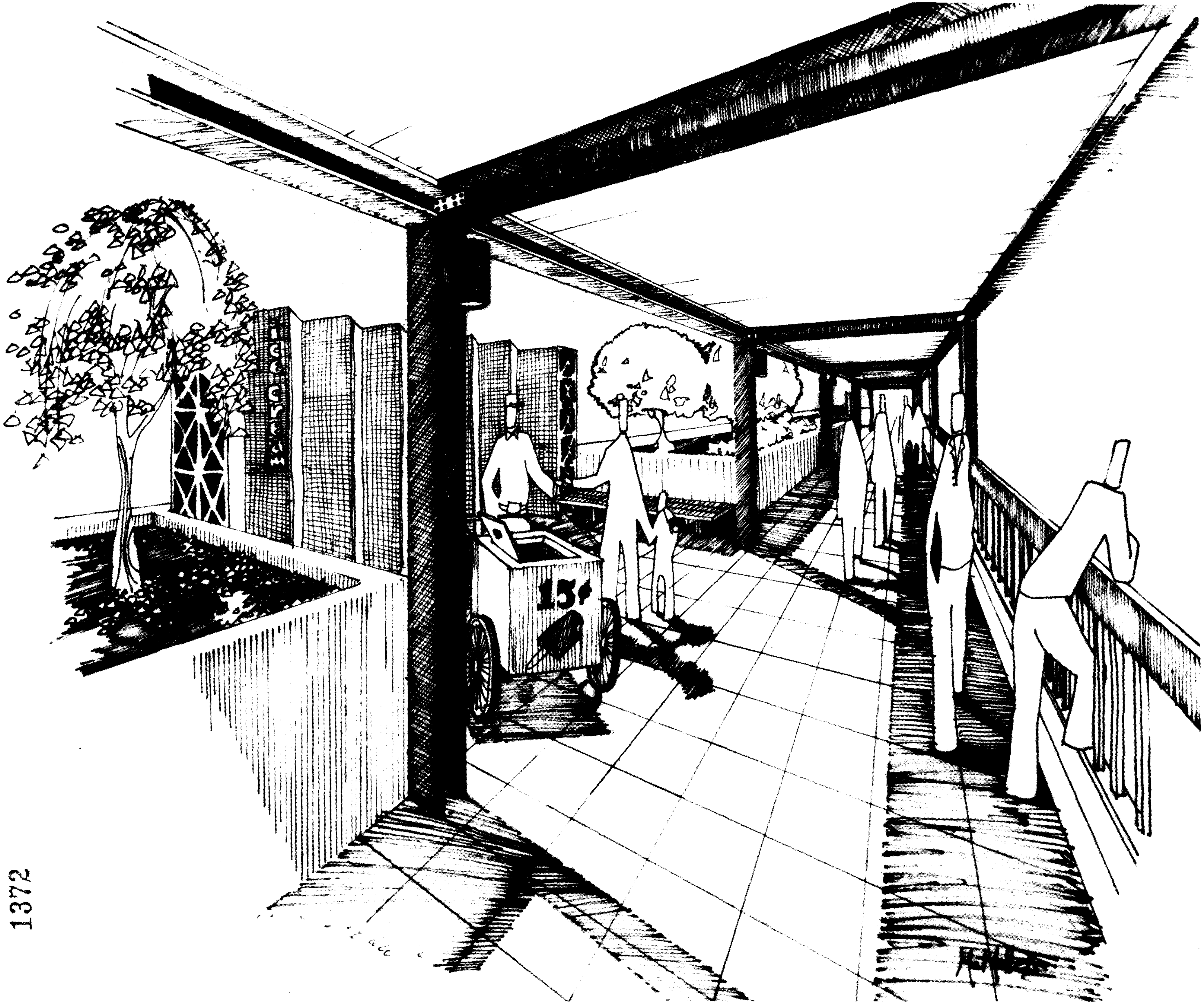


FIGURE 8

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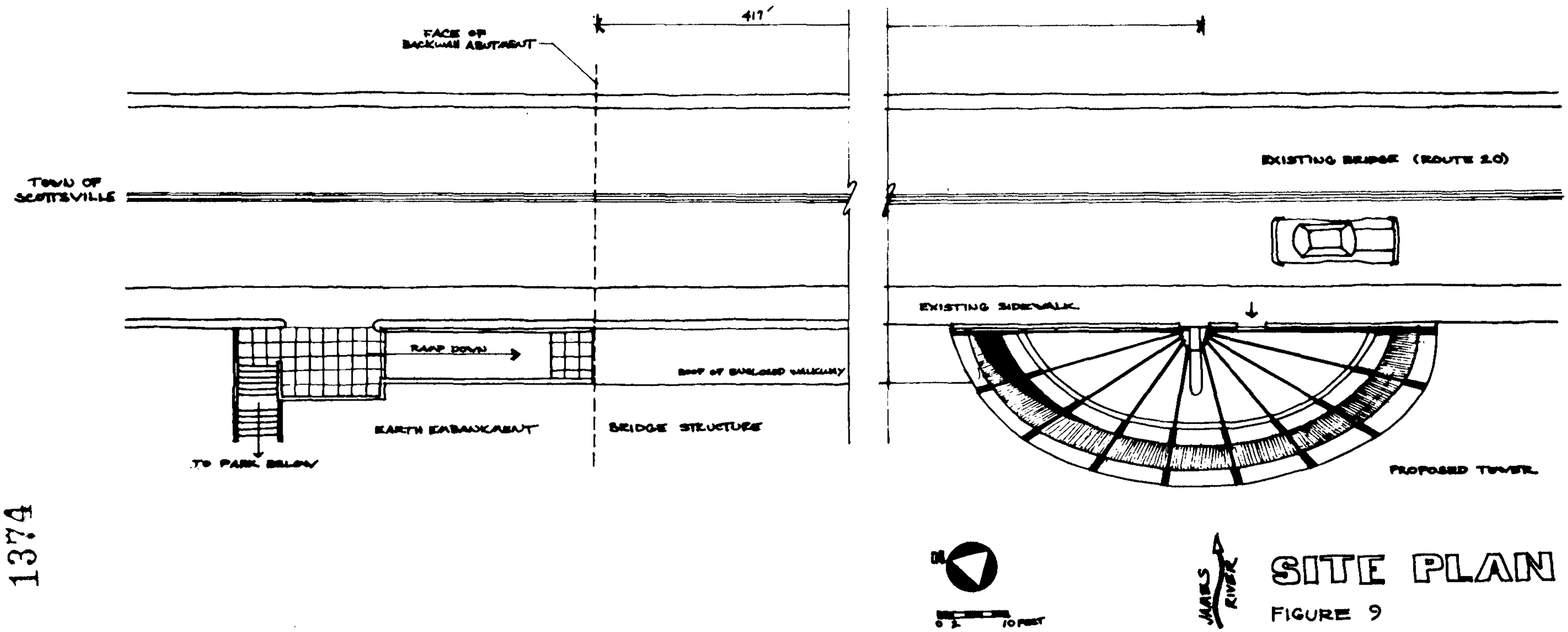
The second bridge case study relates to the multispan bridge on Rt. 20 crossing the James River at Scottsville, Virginia. Constructed in 1967, this is a 10-span steel girder structure supported on reinforced concrete tee shaped piers. It has a total length of 1,007 ft. (302 m) and a width of 37 ft. (11.1 m). The highest pier is about 57 ft. (17.1 m) above normal water level. There is a 5 ft. (1.5 m) sidewalk on he west side of the bridge and a 1.5 ft. (.45 m) wide curb on the east side. The small town of Scottsville is located on the north side of the bridge. The land is completely rural on the south side of the bridge.

Views from the height of the bridge are unusually beautiful, overlooking the tree lined James River as it takes a bend northward. To take advantage of the lovely views, it is proposed (for purposes of generating ideas) to construct a four-level tower near the center of the bridge, oriented westward.

Figure 9 illustrates the general plan and location of this tower. The tower is located on the west side of the structure because the sidewalk is located here and the westbound views are generally the most pleasing. Access to this tower is either through an enclosed walkway connecting the tower and the Scottsville (north) end of the bridge or along the existing sidewalk from either end. Most people would be expected to use the enclosed walkway. The town of Scottsville plans to construct a riverside park in this general location, which would relate directly to the proposed bridge tower.

Figure 9 also shows access to the tower through the enclosed walkway from Scottsville. (A ramp is proposed for the handicapped.) Tower access also may be had directly from the existing sidewalk through a doorway at the sidewalk level. A cross section through the tower is shown in Figure 10. The enclosed walkway would be located at a level approximately 9 feet (2.7 m) below the existing sidewalk. At the tower at this arrival level (level 1), a small enclosed observation area would be provided, along with stairways leading up and down. Going up the stairs one level to main level 2, one finds a larger enclosed area with tables and attached chairs. It is envisioned that functions as viewing, picnicking, and card or chess playing would occur here. In the evenings, small folk groups might even perform.



SITE PLAN
FIGURE 9

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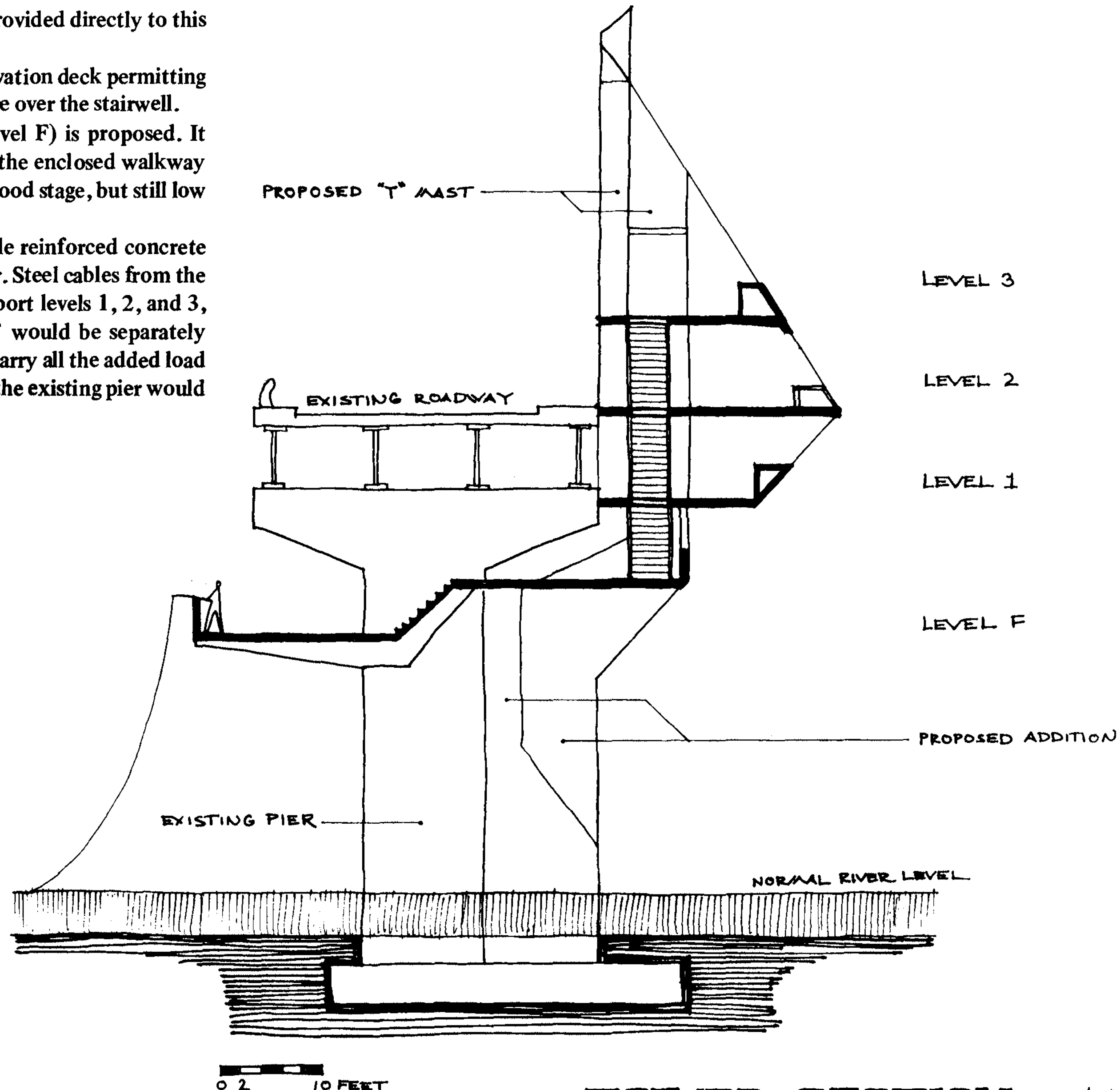
As this level is at sidewalk elevation, an opening is provided directly to this sidewalk.

At the top level (level 3) there is an open observation deck permitting views in all directions. A rain canopy is provided here over the stairwell.

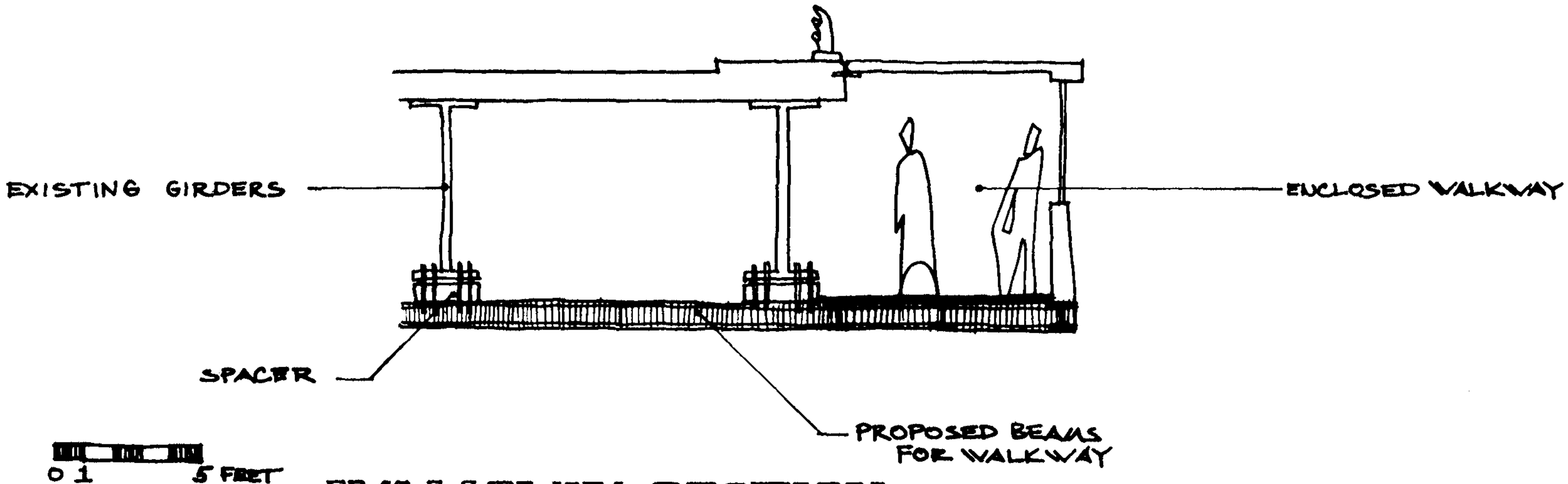
For the benefit of fishermen, a lower level (level F) is proposed. It would be reached by going down the stairs from the enclosed walkway level. This lowest level would be above maximum flood stage, but still low enough to the water surface for convenient fishing.

The entire tower would be supported by a single reinforced concrete mast constructued contiguous with the existing pier. Steel cables from the top of the tower would radiate downward to support levels 1, 2, and 3, which would be of reinforced concrete. Level F would be separately supported from the pier. The central mast would carry all the added load imposed on the bridge. Attachment of the mast to the existing pier would provide the needed lateral stability.

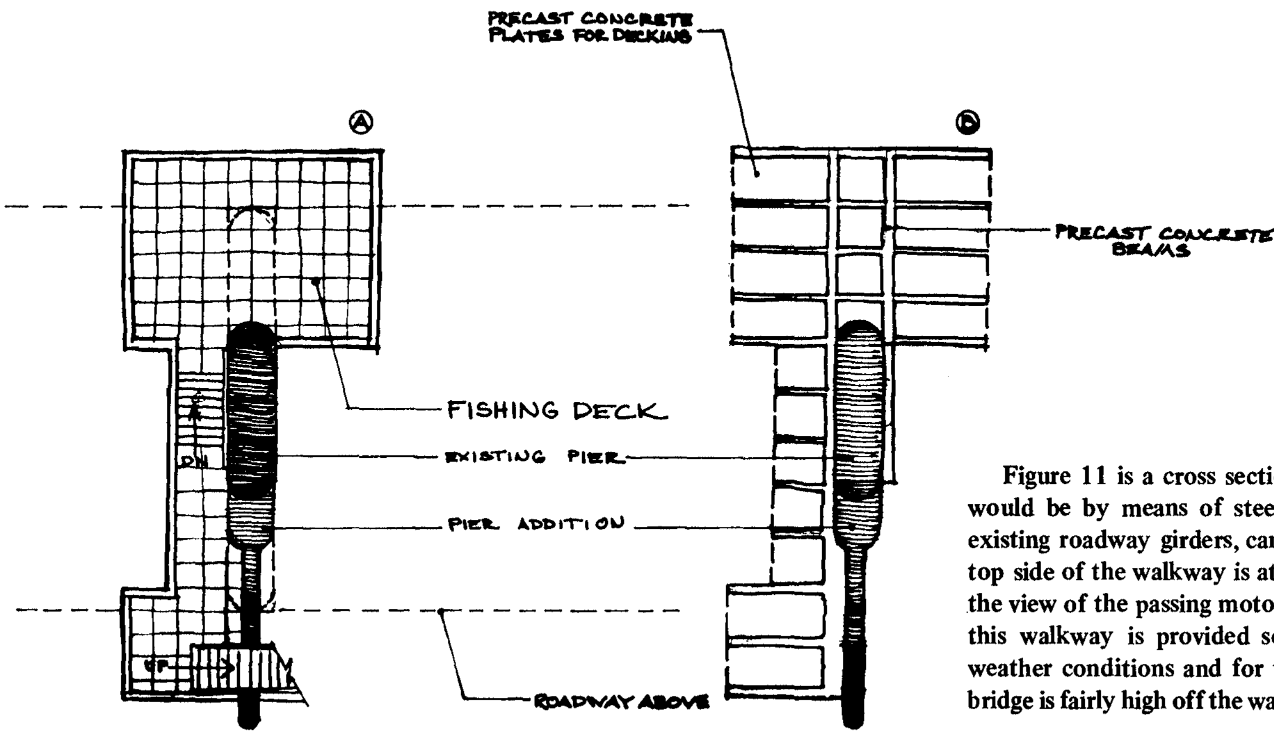


TOWER SECTION
TRANSVERSE

FIGURE 10

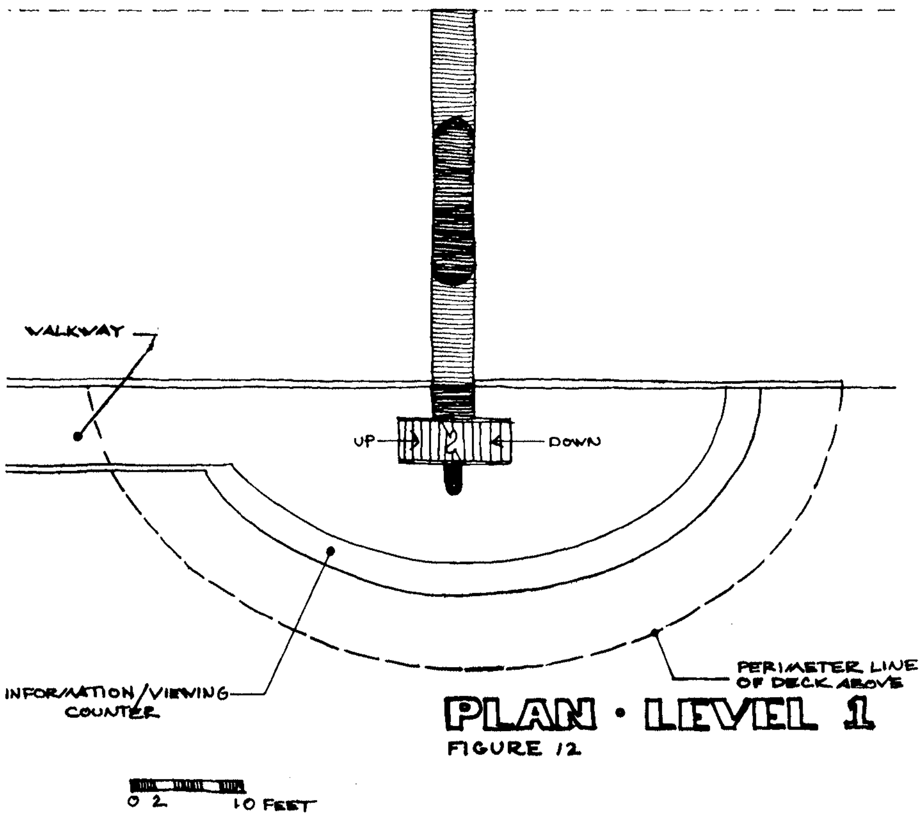


WALKWAY SECTION
FIGURE 11



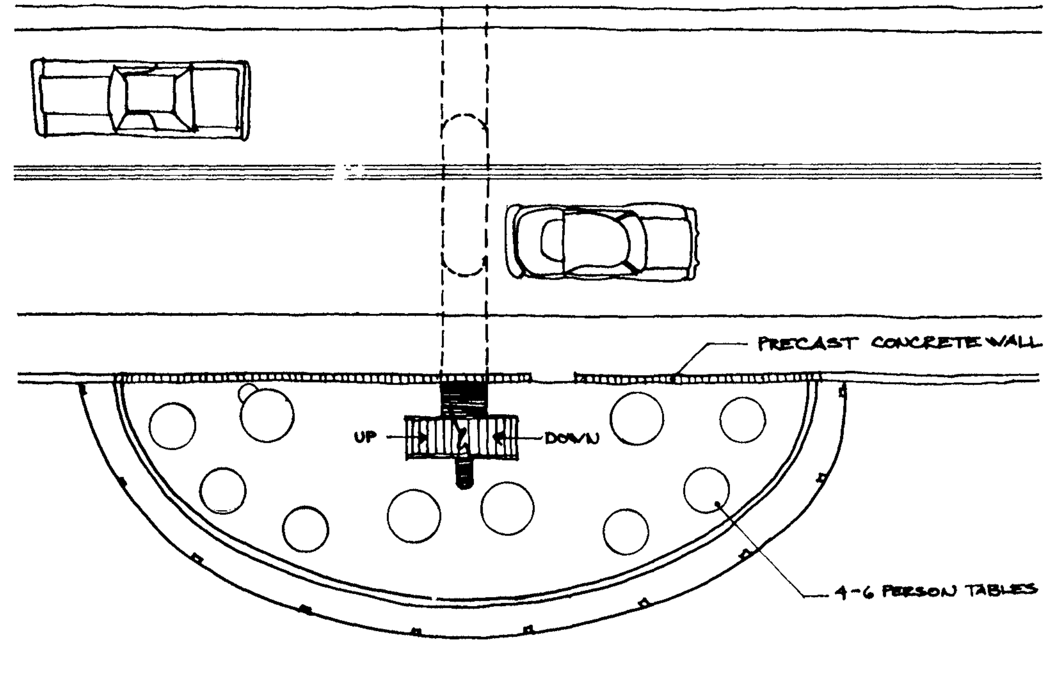
PLAN · LEVEL F
FIGURE 15Ⓐ & 15Ⓑ

Figure 11 is a cross section through the access walkway. Its support would be by means of steel beams attached to the underside of the existing roadway girders, cantilevering outward as shown. Note that the top side of the walkway is at the height of the existing sidewalk, so that the view of the passing motorist would not be blocked. Full enclosure of this walkway is provided so that the tower might be used under all weather conditions and for the general safety of the pedestrian (as the bridge is fairly high off the water).



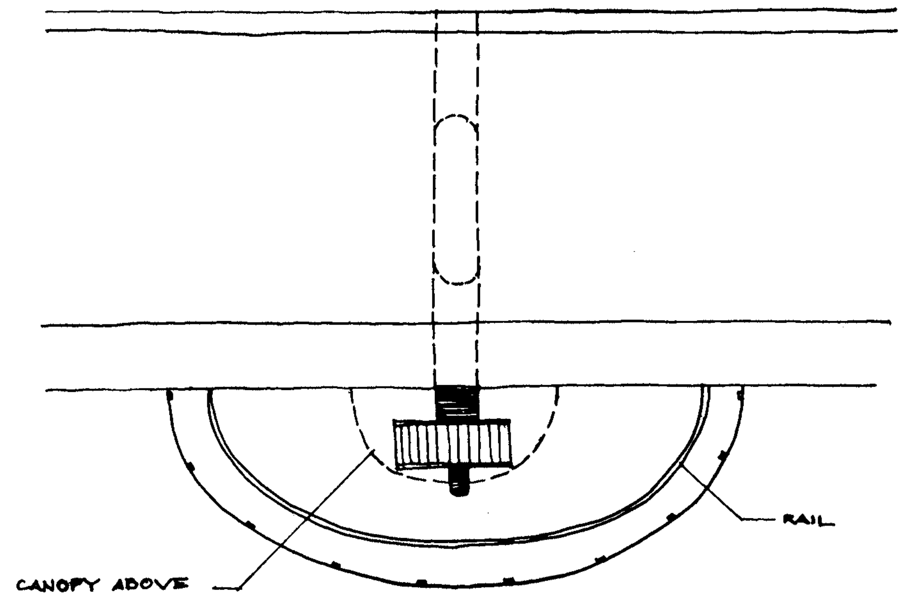
PLAN · LEVEL 1

FIGURE 12



PLAN · LEVEL 2

FIGURE 13



PLAN · LEVEL 3

FIGURE 14

Figures 12 through 15 show general plan views of the various levels. Figure 12 is he arrival or walkway level (level 1). Figure 13 is the main deck (level 2) and Figure 14 is the observation deck (level 3). Figure 15a shows the plan of the fishing deck (level F), while Figure 15b shows the basic structural support for this level. Precast reinforced concrete members would be anchor bolted to the pier, on which precast concrete plank decking would be placed. The fishing deck is located on the east side of the bridge as this is the downstream side, which is best for casting lines.

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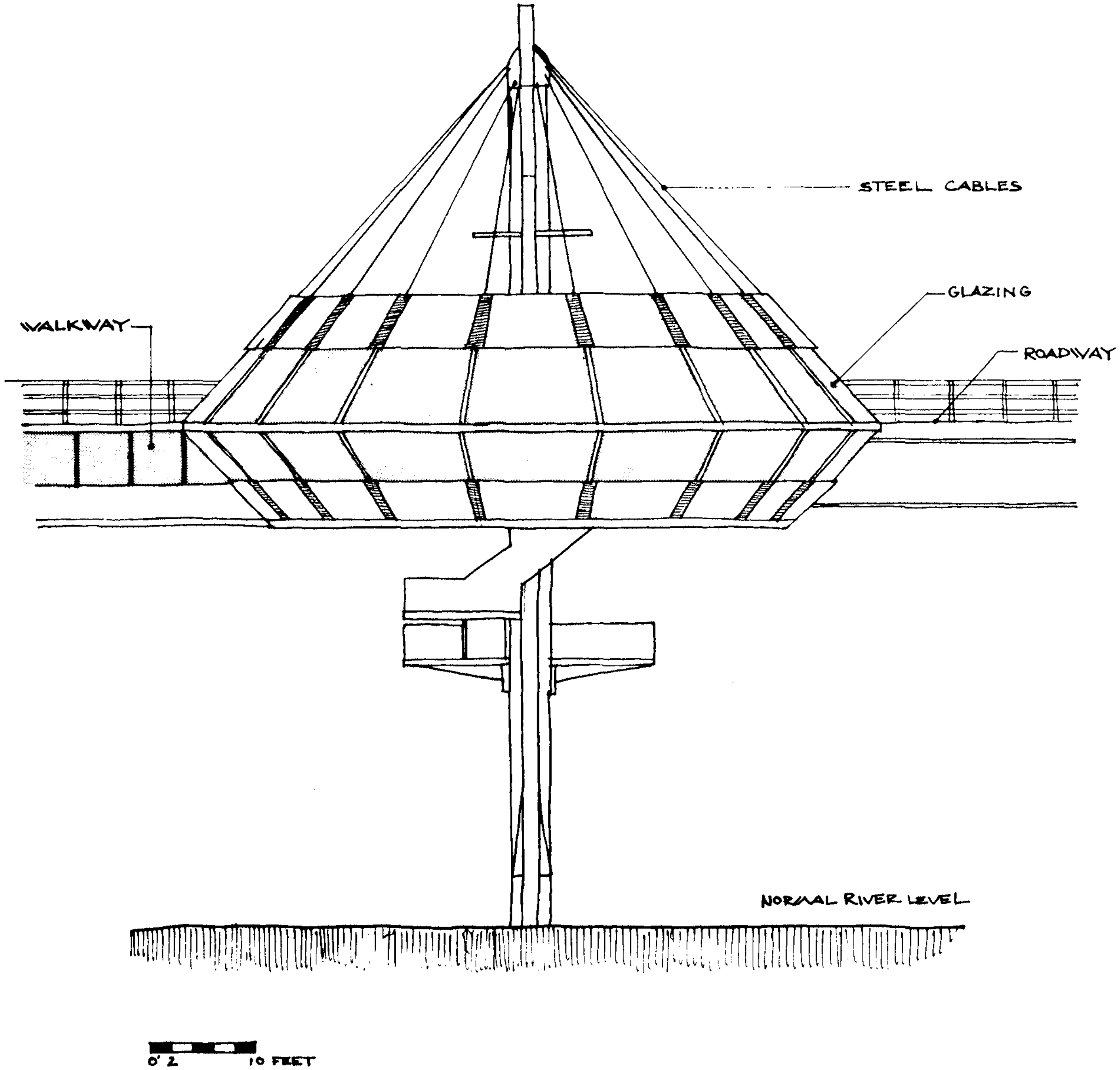
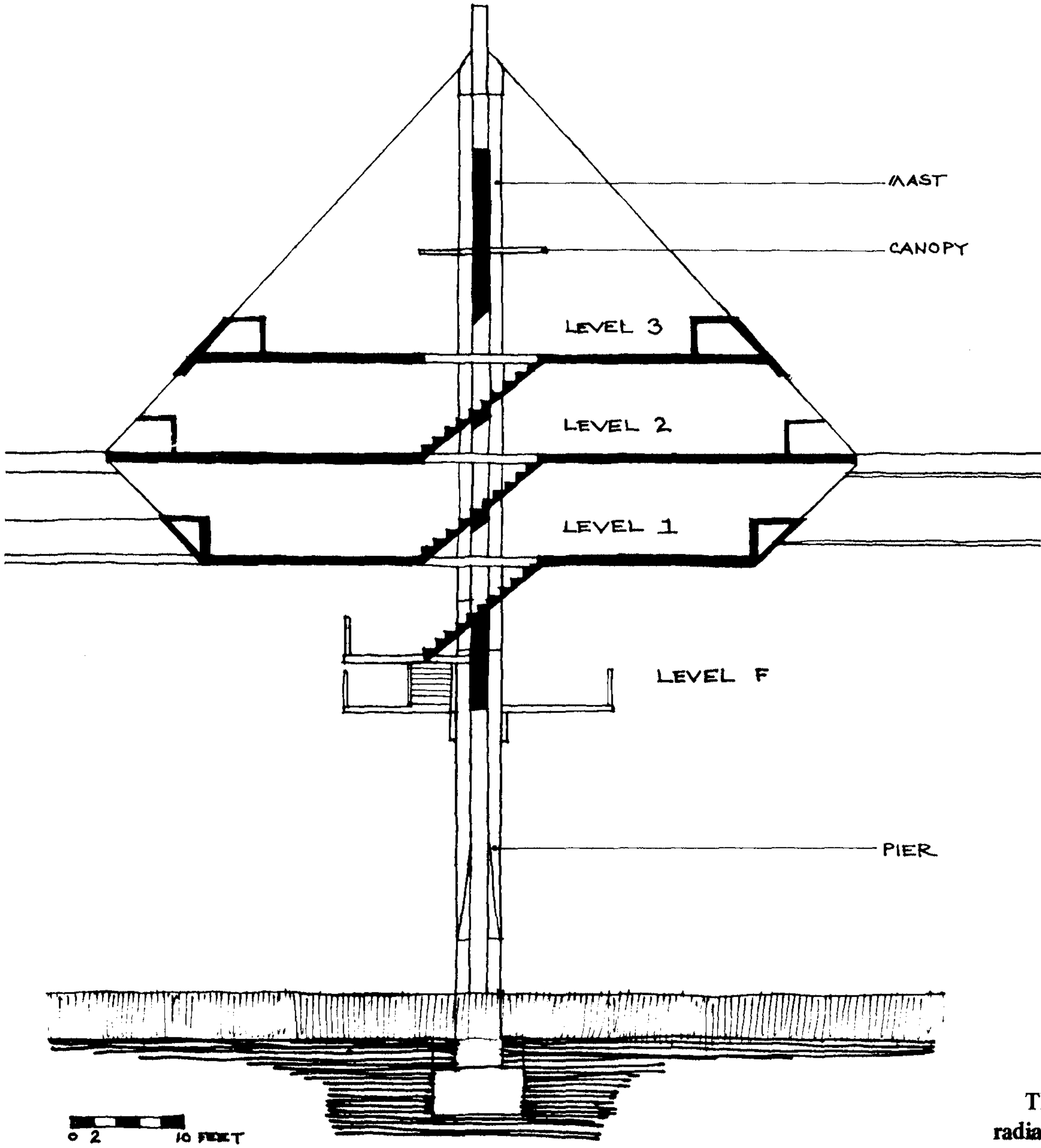


WEST ELEVATION
FIGURE 16



TOWER SECTION
LONGITUDINAL
FIGURE 17

The west elevation of the tower is shown in Figure 16. The steel cables radiating from the mast are clearly visible in this view. Figure 17 is similar, except that it is a cross section through this west elevation. The vertical circulation of the stairs is made apparent in this figure.

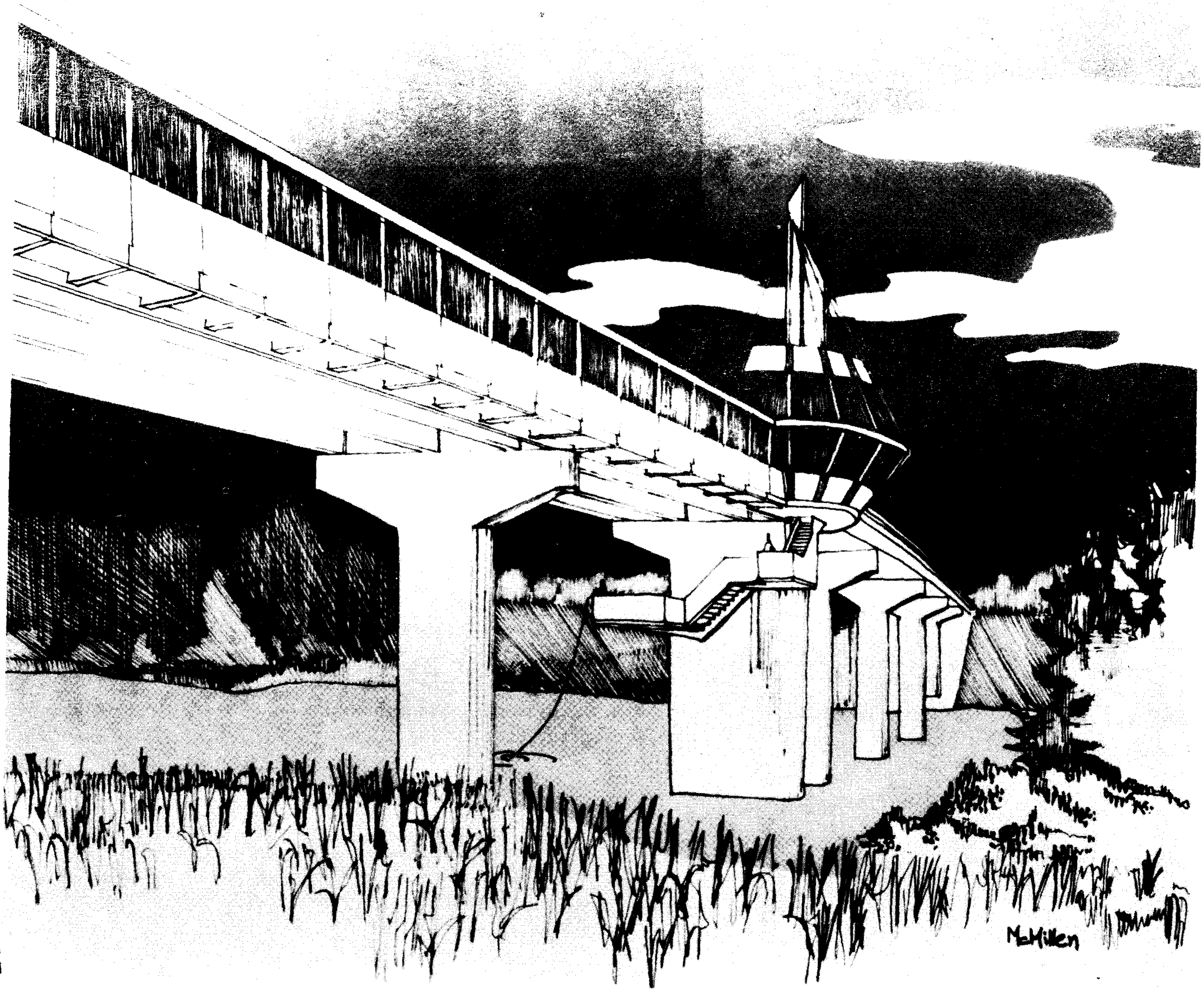


FIGURE 18

Openings in the stem of the vertical mast for the stairs would be compensated for by additional reinforcing around these openings. (Should a detailed stress analysis of the mast disclose that such reinforcing is excessive, the stairway could be designed so as to wrap around the stem instead of going through the stem as shown.) A perspective of the tower as viewed from below is shown in Figure 18. A bridge tower so unusual and dramatic transforms an "everyday" bridge to one of special architectural and engineering interest, as well as giving it human scale and personal qualities. The view of the James River and countryside as seen from the observation platform of the tower (facing west) is shown in Figure 19. Similar views would be seen facing east.

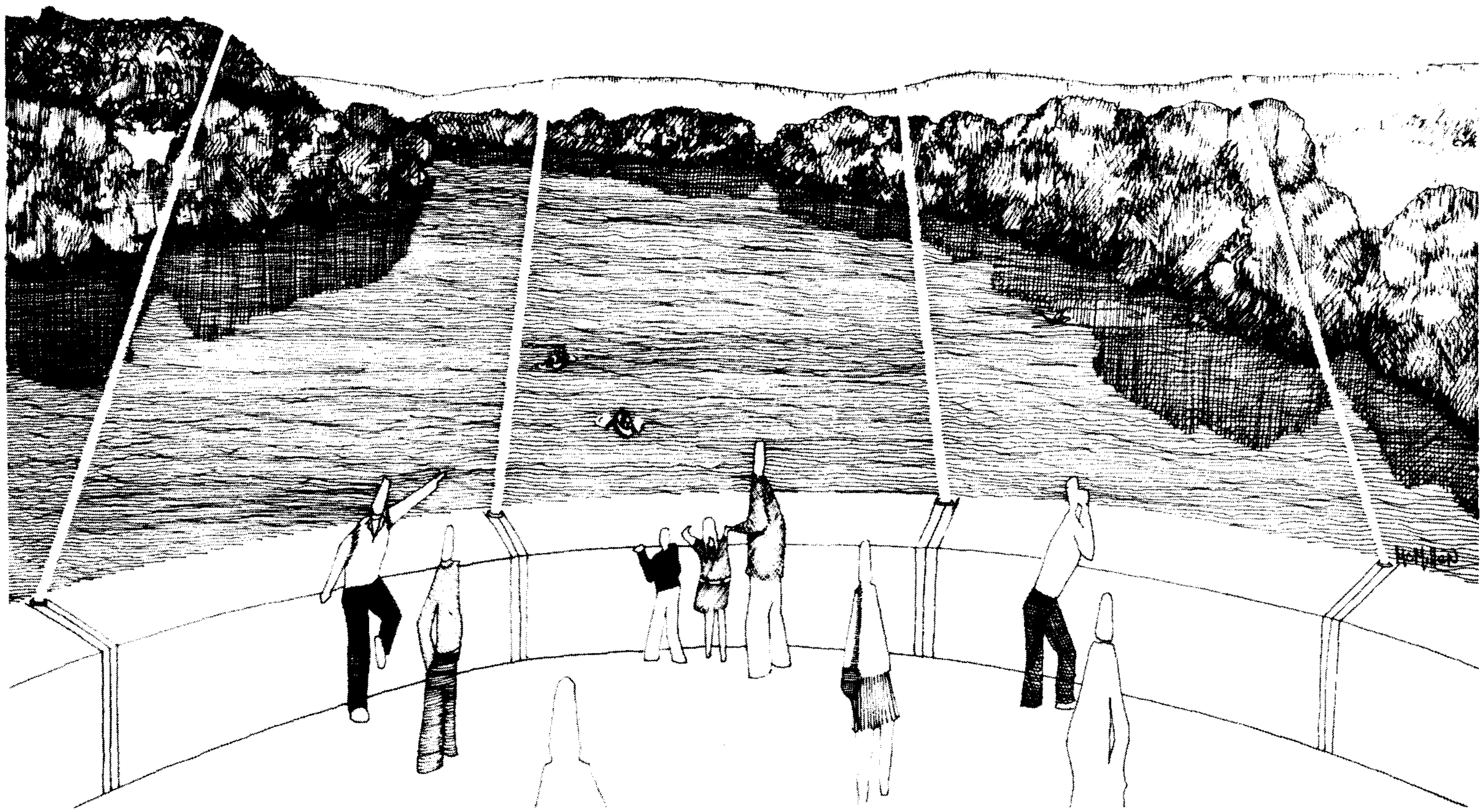


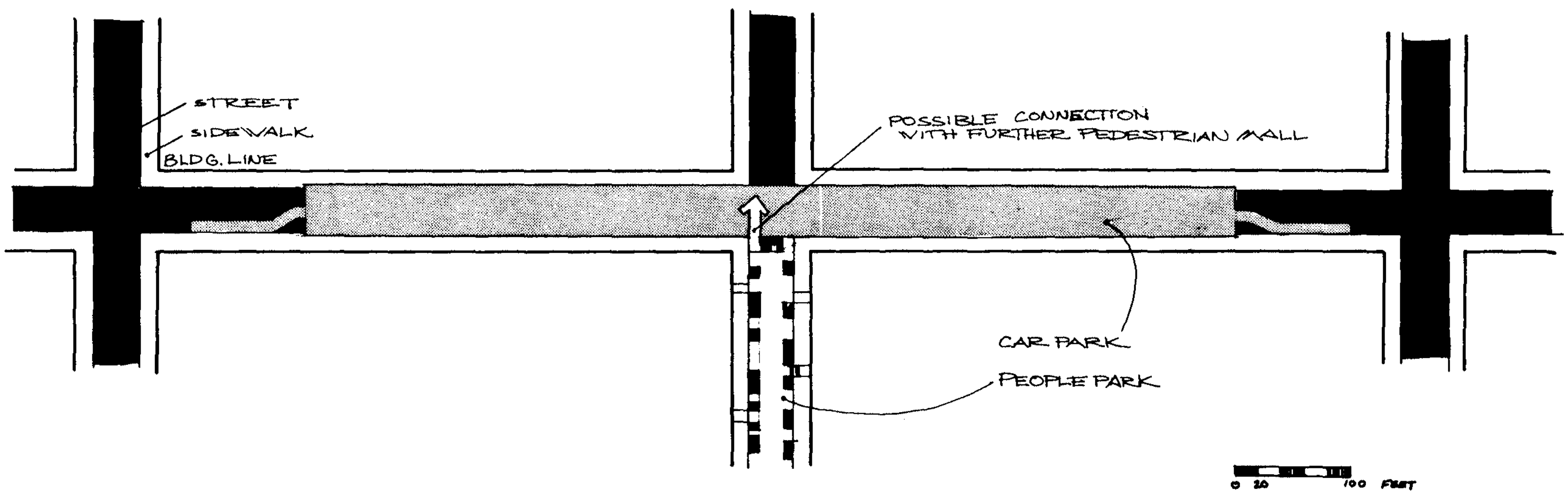
FIGURE 19

Overhead Car and People Parks

Land in urban regions is a highly valued commodity. For this reason, most buildings constructed in these places are multi-storied in order to make maximum use of the available land. Roadways and other transportation systems only occasionally utilize the third dimension of verticality by the layering of systems, even though it was first seriously proposed by Leonardo da Vinci in the fifteenth century. Among his many designs are roadways and bridges on which vehicle traffic and pedestrian traffic are separated vertically. Many more up-to-date solutions appear in the book "New Movement in Cities" by Brian Richards.(2)

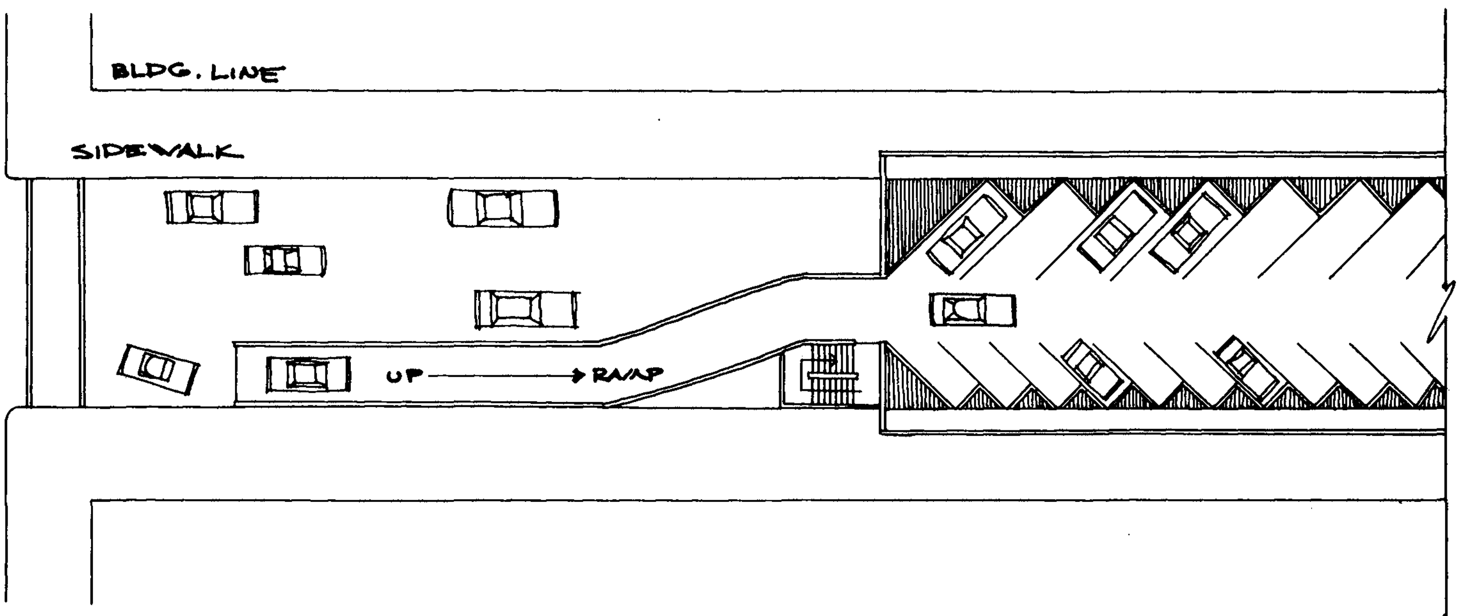
This study will focus on only two possibilities of using the air-rights above urban streets. One is to use this space for a car park and the other is for a people park. They may be used separately or collectively. The designs to follow will show how they might be used together in a "typical" urban situation.

Figure 20 shows a general plan of how an overhead car park and a people park might be situated in an urban area. The following assumptions are made. The roadway measures 40 feet (12 m) across and carries one-way traffic. Sidewalks on each side are 15 feet (4.5 m) wide. The centerline distances between street intersections are 570 feet (171 m). The right-hand lane of the street on which the car park is located would be restricted for ramping to and from the overhead car park and for street level curbside parking. This would still permit three lanes of unobstructed traffic flow.



SITE PLAN
COMBINED CAR AND PEOPLE PARK
FIGURE 20

Some additional details of the car park are illustrated in Figures 21, 22, and 23A and 23B. Concerning Figure 21, two lanes of 45 degree parking can be accommodated in a 40 ft. (12 m) width, provided one side is for compact cars (as shown). Of course for smaller widths, only one lane of parking is possible, while for larger widths more may be possible. Note the stairway for pedestrian circulation at the position of the vehicular ramps. These stairways would also provide structural support for the vehicular ramps. Additional pedestrian movement is provided directly to the people park at the above street level.

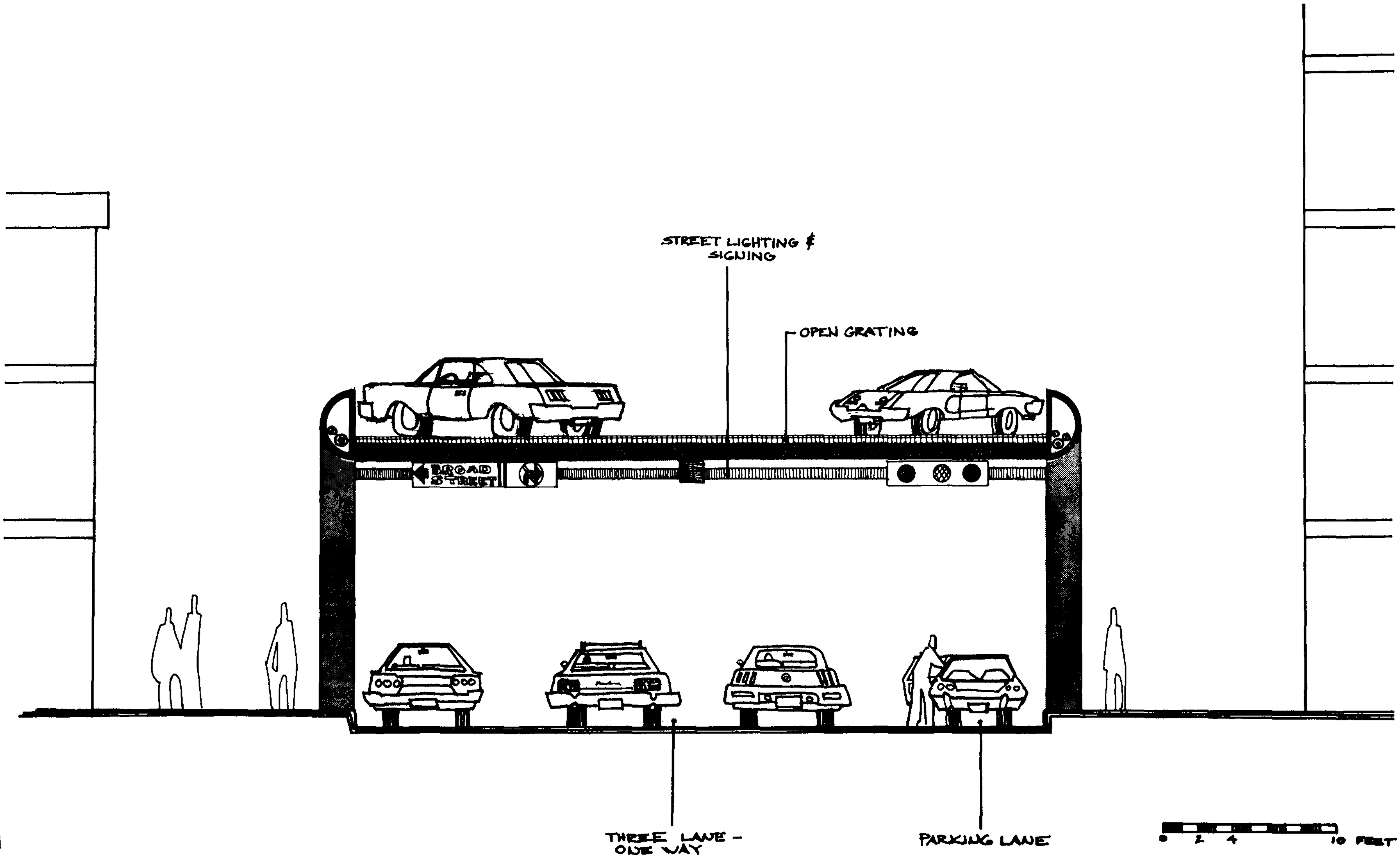


CAR PARK PLAN

0 5 25 FEET

FIGURE 21

Figure 22 shows the structure of the car park. The overhead clearance is shown as 14 feet (4.2 m), although it could be greater if necessary. One important feature of the overhead car park is the inclusion of open-steel grating for the deck to permit natural light to fall on the street below. An additional feature of the overhead structure is to incorporate virtually all the normal street wiring, lighting, and signing into the structure itself to minimize general street clutter. Even street items as trash containers could be localized around the legs of the structure.



CAR PARK SECTION

FIGURE 22

1384

The structure itself would be made of hollow steel tubes kept esthetically clean and attractive. Figure 23A shows the ramp and stair tower, while Figure 23B shows the intermediate support configuration. The exit ramp would be similar in nature to Figure 23A. Figures 23A and B show typical elevations of this structure. The piers would be spaced approximately 80 ft. (24 m) apart, but with the vee configuration the actual girder spans would be only 40 ft. (12 m). It is envisioned that after the vee supports are erected, prefabricated sections of the deck 40 ft. by 10 ft. (12 m by 3 m) would be attached to the split cylinder tube girders parallel to the roadway.

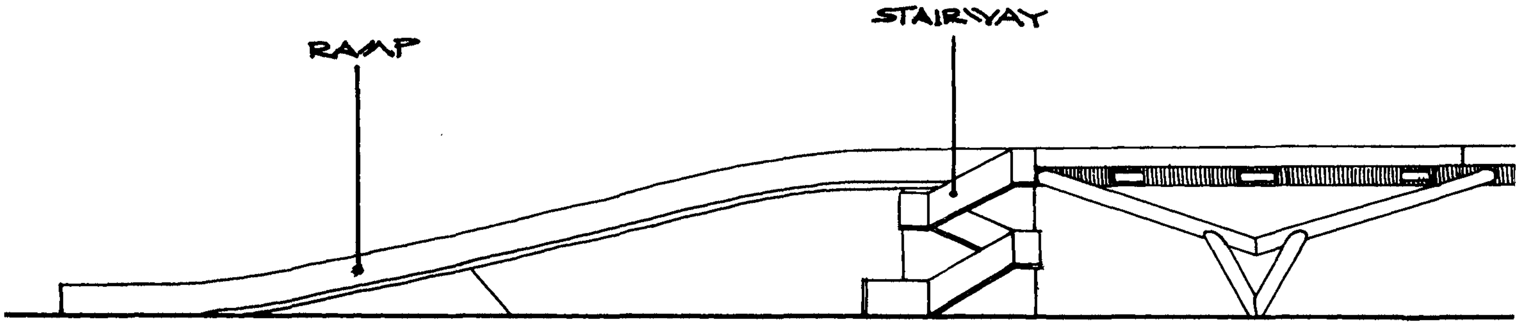


FIGURE 23A

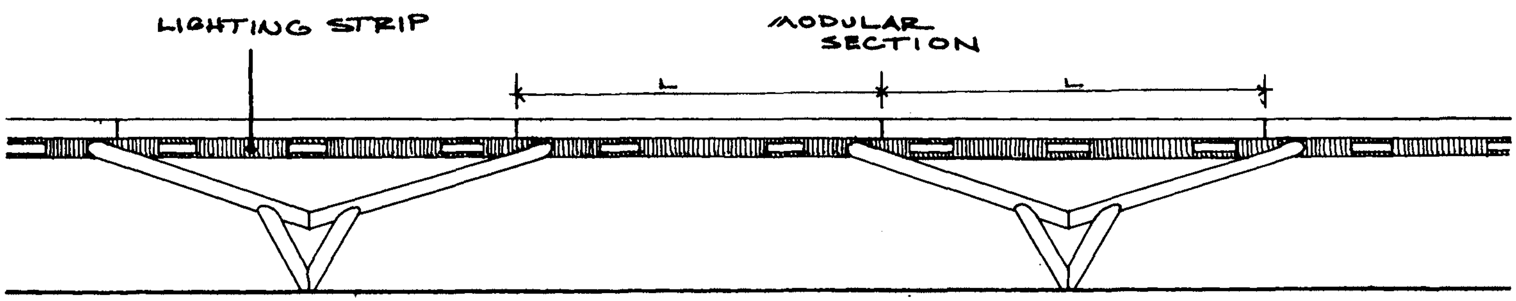
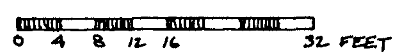
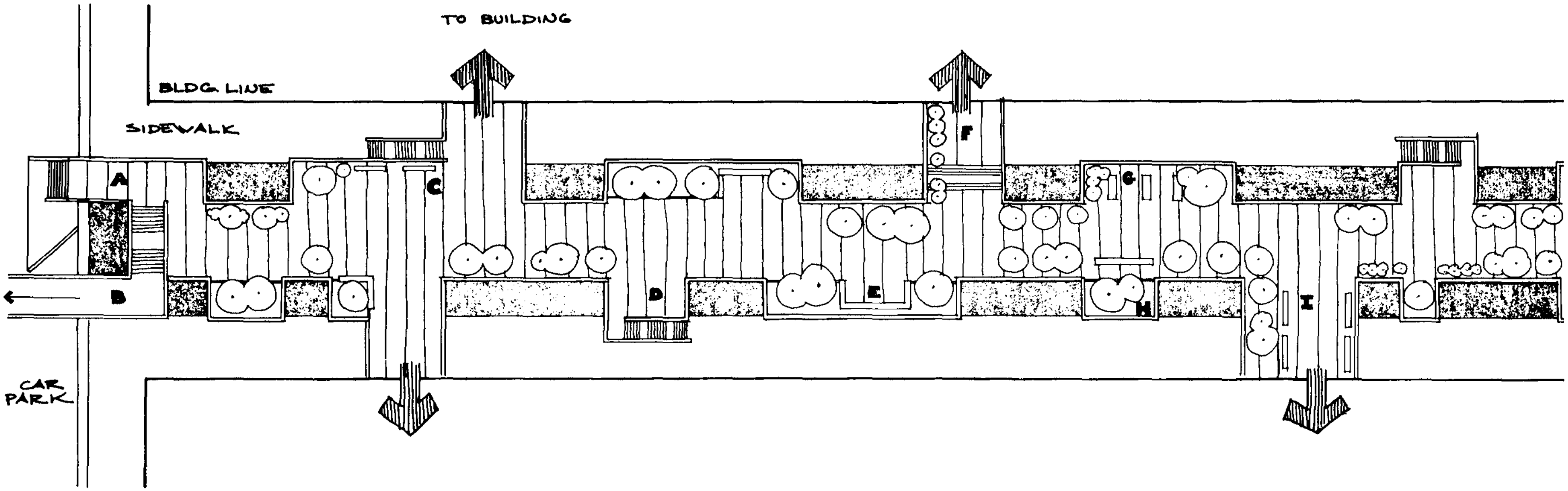


FIGURE 23 B

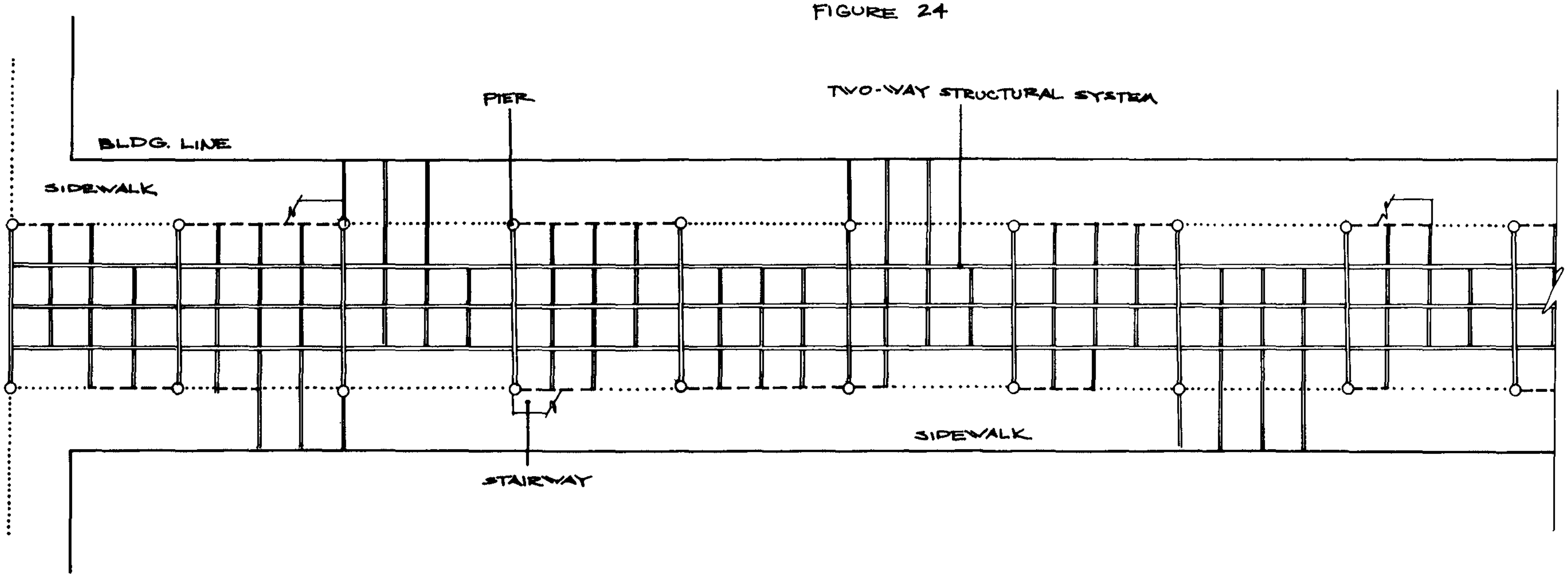
CAR PARK ELEVATION





PEOPLE PARK PLAN 0 5 25 FEET

FIGURE 24



STRUCTURAL PLAN 0 5 25 FEET

FIGURE 25

1386

The overhead people park or aerial mall plan is presented in Figure 24. A central aisle 20 feet (6 m) wide runs the full length of the mall while an articulated arrangement of coves for various purposes are extended out from the center aisle. The functions of the coves (labeled A through I) are as follows.

A. Bridge to car park

B. Possible overhead pedestrian bridge to mall on other side of car park

C. Space for sidewalk sales, promotional activities, etc.

D. Vertical circulation cove

E. Bench and garden cove

F. Bridge connecting mall to adjacent building. (Steps to accommodate possible level difference between mall and building floor.)

G. Cove with tables for eating

H. Green cove for shrubs and trees

I. Bridge connector to adjacent building and waiting area

The coves make the promenade more interesting and useful, while the gaps between the coves allow additional natural light to fall on the street below. Some portions of the mall could be covered, either permanently or temporarily, depending on the activities or climate.

The structure of the people park would be of steel with lightweight concrete used for the deck. To allow for the numerous light wells along the side a spine-cantilever system is suggested in Figure 25. Column supports would be on a 40 ft. (12 m) square grid. Intermediate beam and girder supports would be on a 10 ft. (3 m) square grid.

There would be no restriction on traffic at all under the people park as the stairways to and from the overhead park or mall would be within the confines of the sidewalk. Additional access to the overhead mall could be through pedestrian bridges from the park directly to stores or buildings at the second-story level.

Perspectives of these structures are shown in Figures 26 and 27. Figure 26 is a street level view of the car park and Figure 27 is an aerial view of the people park. Every attempt was made to make these structures pleasing to the eye, recognizing that they might have some objectional features in blocking out clear views of the sky from street level.

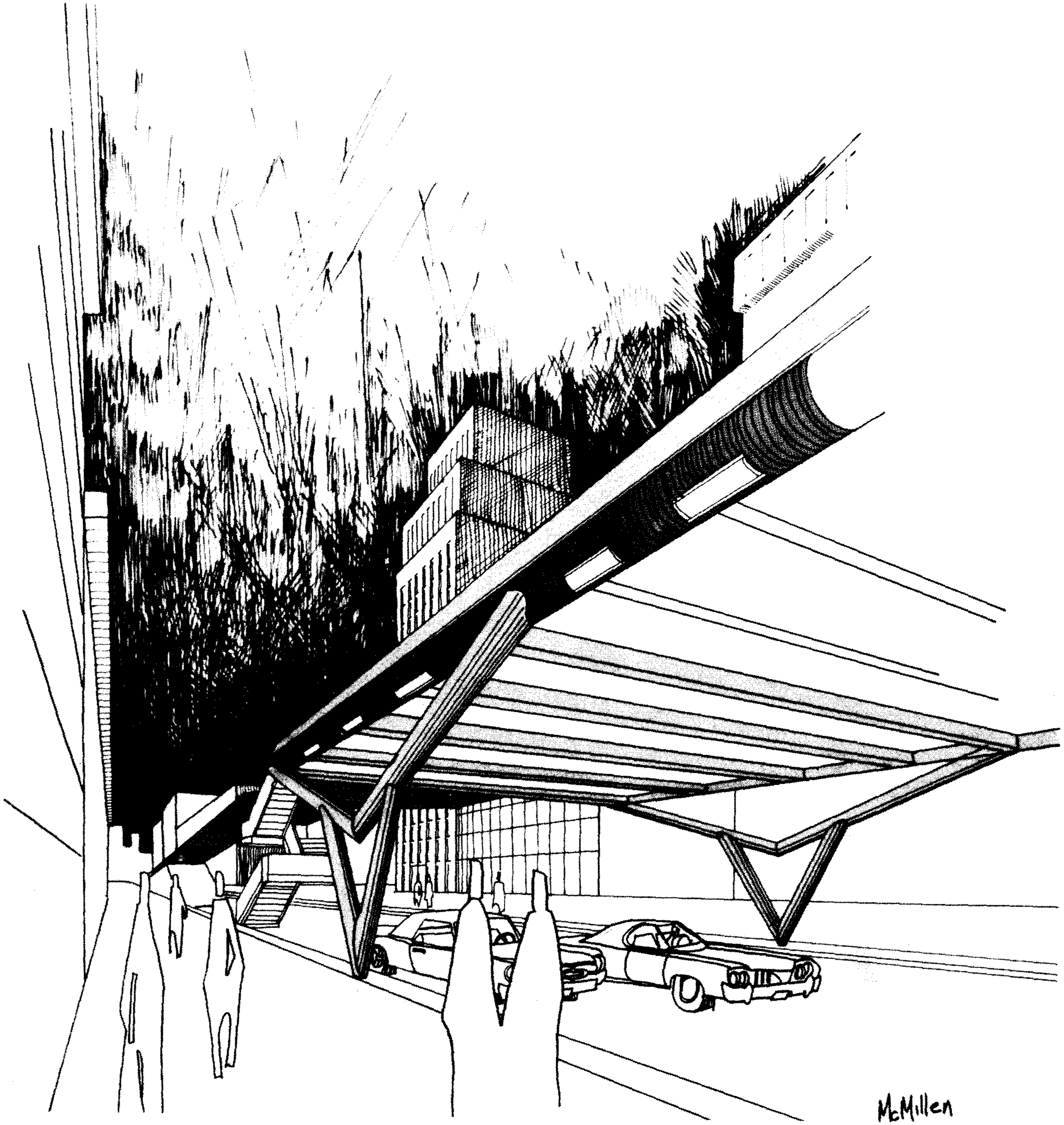


FIGURE 26

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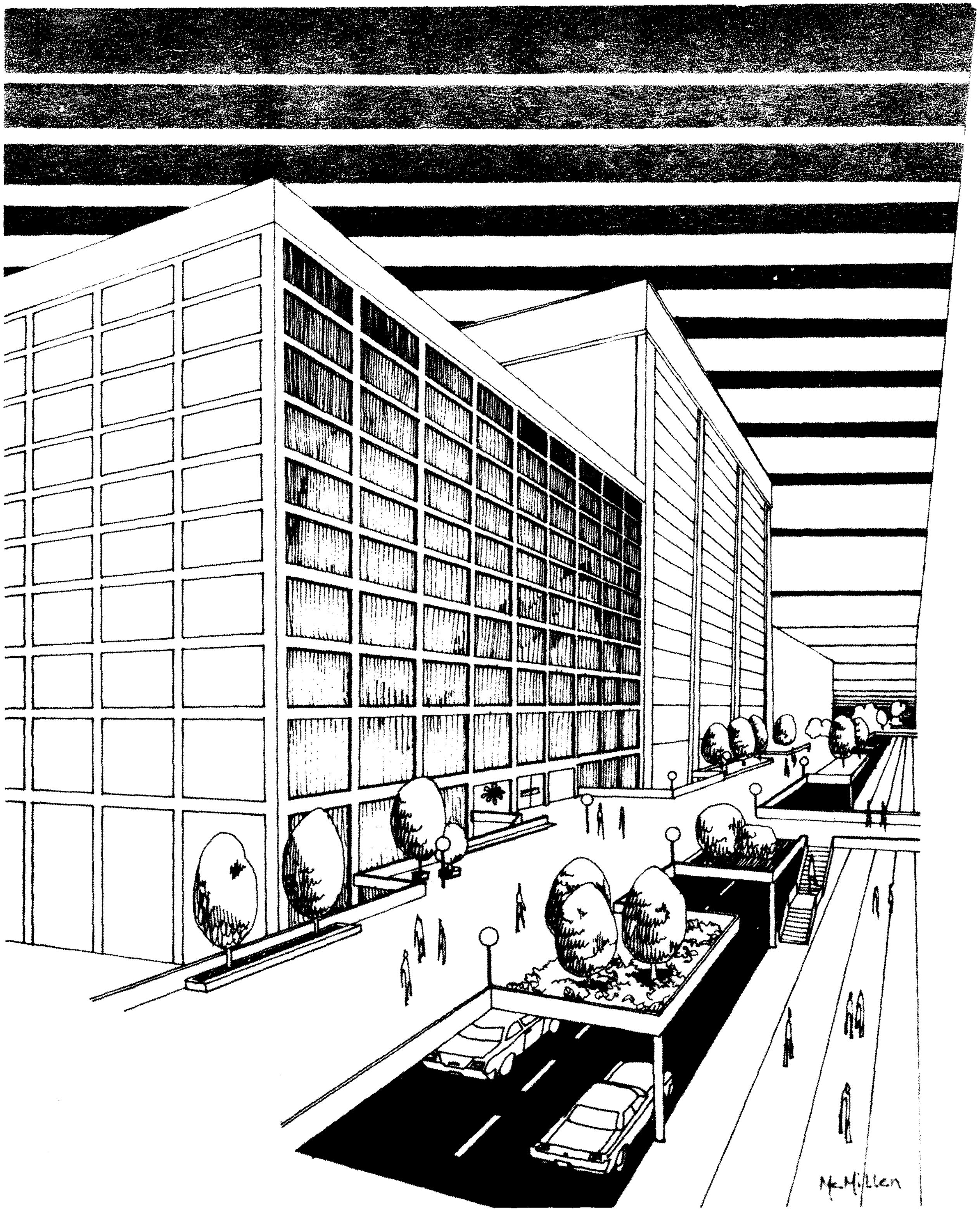

FIGURE 27

STOL Ports (Short Takeoff and Landing Airports)

Conventional airports have rather long landing strips and utilize a great deal of flat land. Because of this, airports are generally located many miles from a metropolitan center. Currently under extensive development is a new type of aircraft, called STOL craft, that requires much short landing and takeoff stripgs. Lengths as short as 1,000 ft. (300 m) to 2,000 ft. (600 m) are all that are necessary for this new type of vehicle. With air strips this short, such STOL ports may be located much closer to a city center than may conventional airports.(3)

Possible locations for STOL ports are the air-rights over highways or bridges in or near a city center. STOL port strips may be as narrow as 150 ft. (45 m), which would allow them to fit over many urban highways. Of course, such factors as wind direction, noise, building heights, power lines, and parking and maintenace facilities must be considered in the location of any STOL port over a highway or bridge. Nonetheless, many air-rights locations suitable for the purpose are believed to exist.

No detailed research has been done by the author on his subject regarding the economic feaisibility of air-rights STOL ports but an artist's rendering has been made of a possible STOL port over a water-crossing bridge located near a large city. This is seen in Figure 28. The two round shelters seen at the right of the runway are for passengers and for maintenance facilities. Parking and other support facilities would be located at the near end of the bridge on land.

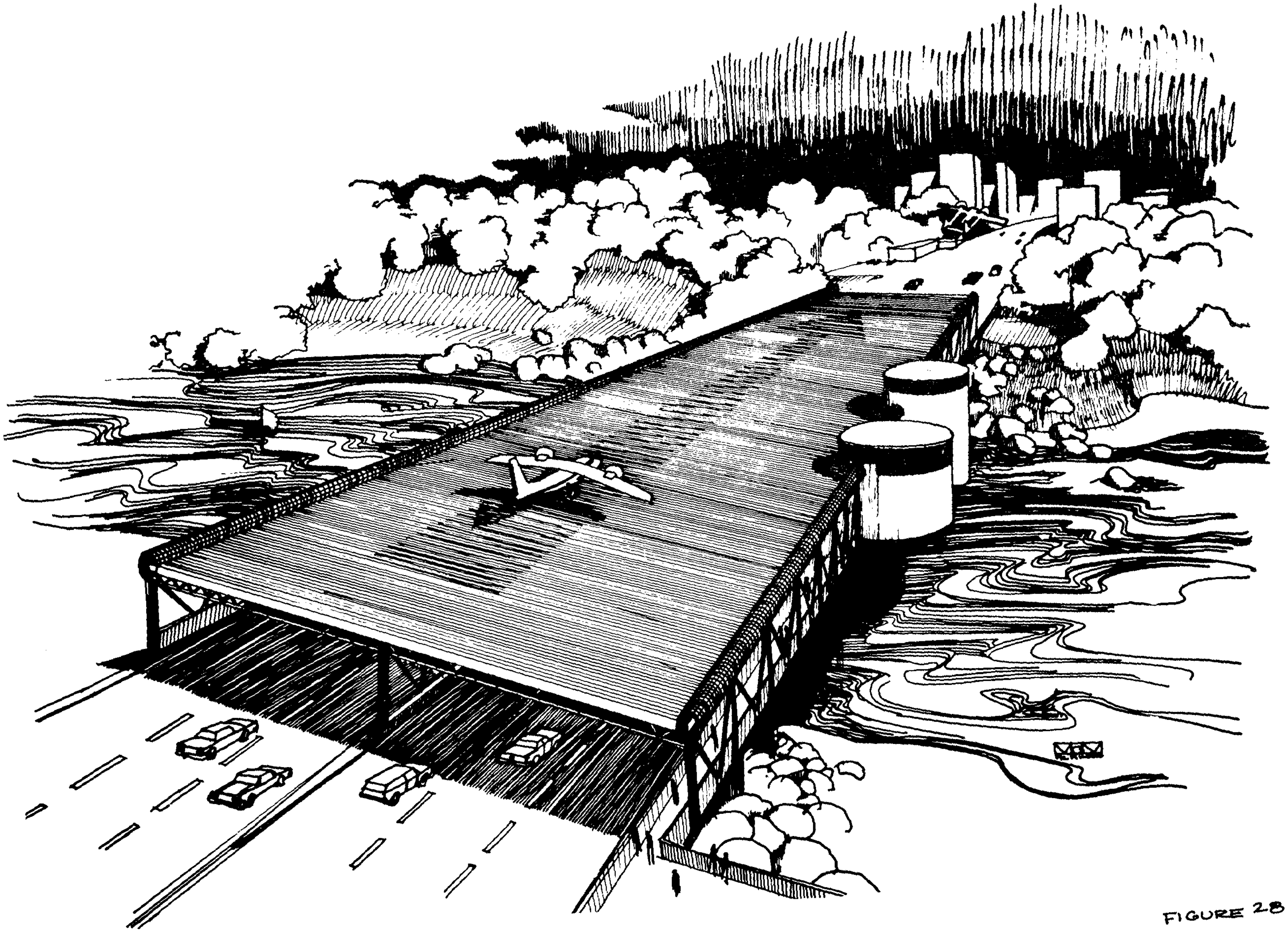

FIGURE 28

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Solar Collectors

Many investigators believe that a viable substitute for fossil fuels in the future is solar energy. At the present stage of technology, solar energy which converts the heat of sunlight into hot air or hot water has immediate application into heating buildings. However, it is also possible to convert the heat of sunlight directly into electricity through a photovoltaeic process. This is the mechanism used in all space exploration vehicles. Presently, such conversion units are very expensive and relatively inefficient. Ongoing research, however, promises to improve the efficiency of conversion and to reduce the cost. Research also is under way to develop better and more efficient means of storing electrical energy.

Conjecturing into the future, it may someday be possible to capture and convert enough sunlight into electrical energy to power highway vehicles. These vehicles would be nonpolluting electric cars. Solar energy could be collected on he highway right-of-way itself and stored in energizing stations for vehicles using the highway (similar to present day gasoline stations).

For the purpose of illustrating the amount of solar energy that it is possible to collect at present day efficiencies (about 8%), the sunlight falling on only the rights-of-way of the highways in Virginia could prove over 30 x 10^9 kw hrs. of electrical energy per year. This is the amount of electricity presently used by the entire state of Virginia per year.

Renderings on how such solar collectors might look are shown in Figures 29 and 30. Figure 29 is an example of overhead collectors and Figure 30 is a conception of side-of-the-road collectors. Either of these designs also could be used in open spaces around highway interchanges to create, in effect, large solar parks or solar farms. Details and arrangements of these solar collections might well change with future developments, but the basic concept of using highway space for the solar generation of power for transportation vehicles is one not to be excluded.

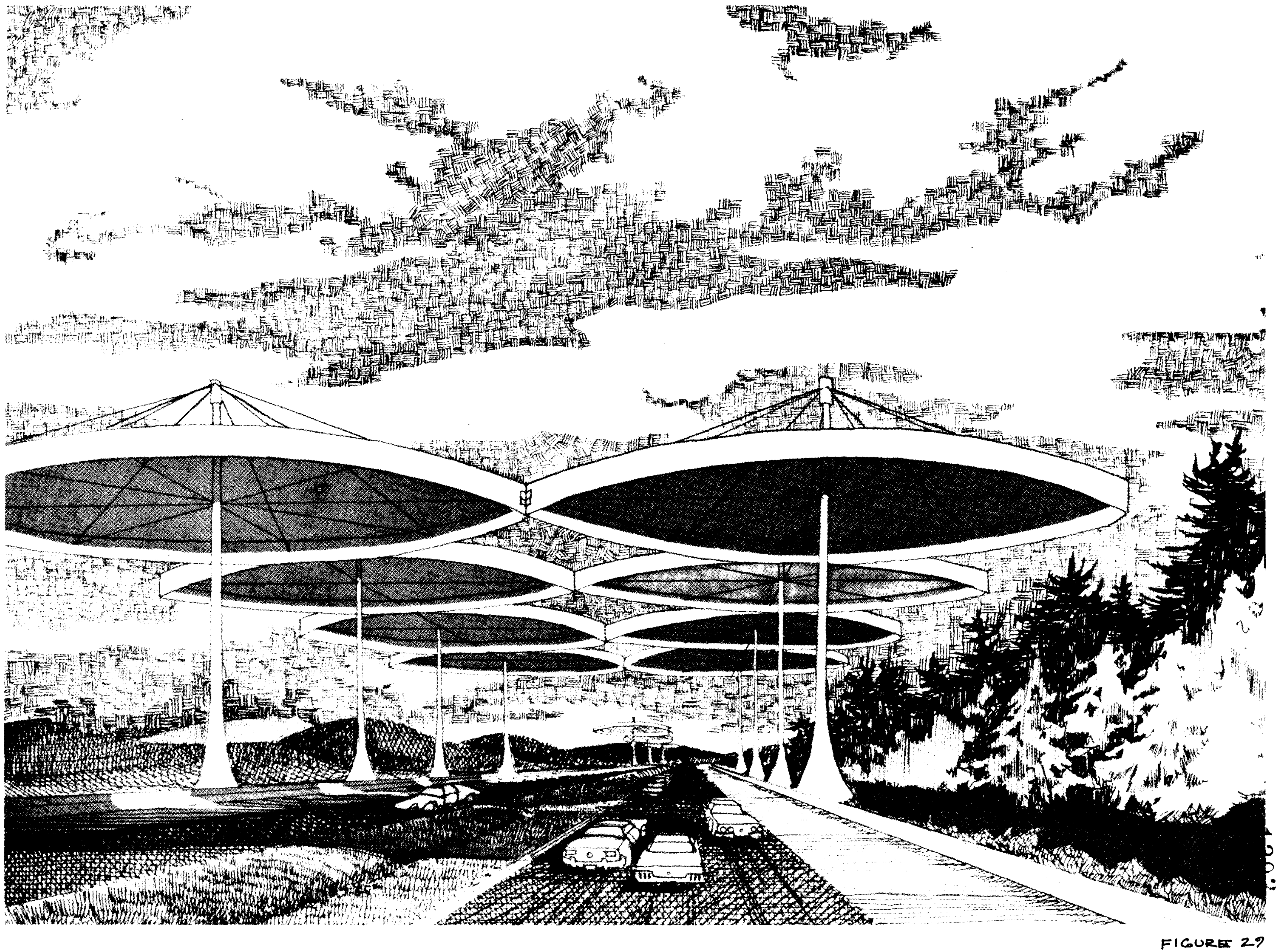

FIGURE 29

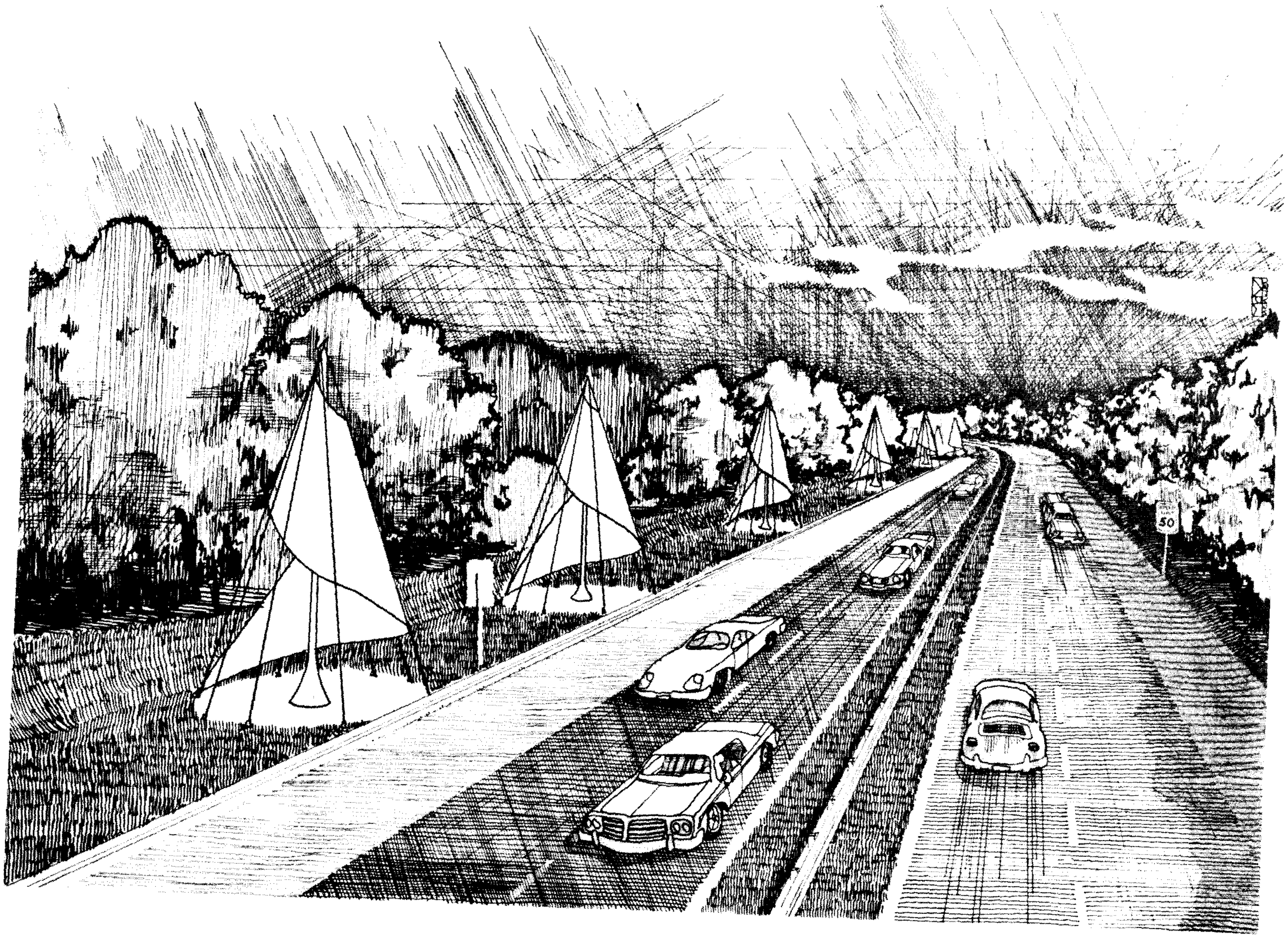

FIGURE 30

CONCLUSIONS

The conclusions drawn by the author are expected to be controversial largely on the grounds of economics. Nonetheless, the conclusions drawn from the various design concepts for the multiple or joint use of transportation rights-of-way are believed to bear consideration.

Three major conclusions are as follows:

1. Rights-of-way can have practical use over and beyond normal vehicular use.
2. Structures constructed on rights-of-way can be esthetically pleasing and compatible with the environment.
3. An appreciable capital outlay may be required for such structures, but compensation can be had in the form of improvement in the quality of life or in direct revenue.

All possible uses of transportation rights-of-way have not been explored in this study. Many other uses, as mentioned in the introduction, are being studied by others. This report has considered but six possible uses, heretofore unexplored, in order to promote interest in the subject. Through visually tangible solutions, it is hoped that the study has met its objectives.

ACKNOWLEDGMENTS

All of the drawings and many of the design ideas in this report are credited to Michael McMillen, a fifth-year architecture student at the University of Virginia.

General support from Wallace McKeel and Jack Dillard for this study is also acknowledged.