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CONCEPTUAL STUDY OF HANDICAPPED FACILITIES FOR NEW SUBWAY STATION DESIGNS

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16. Abstract

With the ever increasing trend to include the handicapped in the mainstream of United States society, coupled with modern day technological advances to assist them in their capacity to be mobile, much emphasis has been placed upon making streets, buildings, and transportation accessible to such persons.

Using the requirements set forth in Section 504 of the Rehabilitation Act of 1973, this report analyzes seven new subway station concepts which have been developed from similar types in Canada, Mexico, and Europe, and identifies what modifications could be incorporated into their design to facilitate their use by handicapped persons.

Most of the modifications entail the relocation or addition of the elevators to a location in the station structure such that potential difficulty and inconvenience to the handicapped person will be minimized.

This report assumes that the modifications made herein are made to those stations which are located in high density residential or business areas and, consequently, a significant portion of the station users will be handicapped.

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Chapter 1

INTRODUCTION

Objective

This report investigates conceptual designs for seven different types of subway stations and determines the design modifications which need be incorporated into each design in order to ensure accessibility by elderly and handicapped persons into these stations.

The seven conceptual subway station designs considered herein are presented in Report No. UMTA-MA-06-0025-77-6 entitled, "Study of Subway Station Design and Construction," prepared by DeLeuw, Cather & Company and Skidmore, Owings & Merrill. This report is dated March 1977.

Approach

The seven subway station designs considered herein are not "designs"; rather, architectural schematics depicting different configurations for mezzanines, trainrooms, escalators and other features, the locations of which are dictated by geotechnical, economic, and right-of-way restrictions. Because these station designs are conceptual and not final designs, an in-depth analysis cannot be performed. Instead, a concept evaluation of each station type will be made which will seek to improve upon the relative locations of the handicapped facilities shown in the existing station concept as well as to implement new features which are not provided in the existing concept.

All modifications to station concepts will be made assuming each station to be a "key station" as defined in the final rule implementing Section 504 of the Rehabilitation Act of 1973, and published by the Department of Transportation in the Federal Register on May 31, 1979. The rule provides that UMTA grant recipients must treat as key stations those stations which meet any one of several criteria, which are as follows: "A station must be made accessible if it is (1) a transfer point on a rail line (e.g., where two subway lines cross), (2) a major interchange point with other modes (e.g., a rapid rail station serving an airport; a subway station adjacent to a stop serving three bus lines (this criterion does not make every rail station adjacent to a bus stop a key station, however)), (3) a station serving at the end of a line (unless the station is close to another accessible station), (4) a station serving major activity centers (employment or government centers, institutions of higher learning, or hospitals or health care facilities), (5) a station that is a special trip generator for sizeable numbers of handicapped persons (e.g., a station serving a cluster of high rise, high density apartment buildings with a large handicapped population), or (6) in the case of rapid rail, a station where passenger boardings exceed average station boardings by 15 percent."

Each station concept is analyzed independently in this report. Modifications to each concept are made solely on the basis of improving accessibility to and from the station and facilitating the handicapped person in maneuvering and transporting

himself within the station. The impact of the proposed new modifications on station costs will be cited. A cost estimate reflecting the relative cost for implementation will also be provided for each concept modification.

The modifications prescribed herein address themselves to two main categories of handicapped persons as outlined in the study by DeLeuw, Cather and Co., and Ralph M. Parsons Co. (Ref. 2), namely, semi-ambulatory persons and wheelchair users. The report does not comment on improvements to aid visually-impaired and hearing-impaired persons, since the degree to which these subway stations have been developed does not lend itself to such an analysis.

Chapter 2

STATION TYPE I

Description

Station Type I exemplifies a cut-and-cover box structure whose mezzanines are not contained within the trainroom, but located at street level. The station platforms are located on the sides of the trainroom. Station Type I is shown in cross section in Figure 1.

This type of station has been developed to illustrate the potential and limitations of a shallow cut-and-cover station with mezzanines or fare collection facilities located at street level. Both features of the design reduce the volume and cost of excavation, but also present problems involving utility relocation, passenger circulation, and economy of operation.

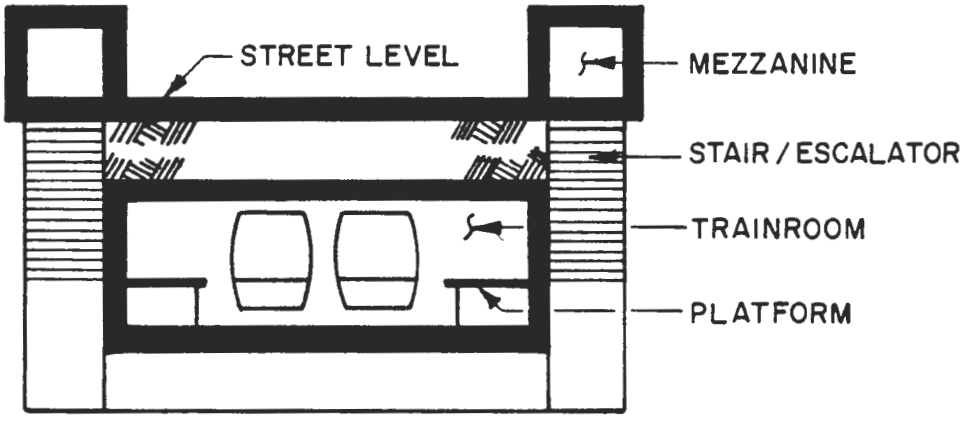
The station has two primary entrances and two elevator entrances, one serving each platform. The primary entrances provide direct access to two mezzanines, each 40 x 60 feet, and contain an attendant's booth, ten turnstiles, and related ancillary space. Their street level location reduces excavation requirements, and thus station construction cost.

Each platform is center-loaded; that is, people arrive and leave the platform from a central point. A major problem with center-loading is that people are concentrated near the station center while the ends of the platforms are underutilized. User walking distances at the platform level are also longer. To ensure a free flow of traffic at the station center, the platform must be widened, and a generous amount of standing room must be provided at the foot of the stair/escalator unit to the mezzanine.

Two vertical circulation elements connect the mezzanine with the platforms. They each have one stair, an up escalator and a down escalator. The capacity of each element is 220 people per minute. Ancillary space is located directly behind the platform.

The platforms are connected by a crossunder which has two vertical circulation elements. Each element has a capacity of 200 people per minute. The crossunder circulation pattern is U-shaped.

Station capacity, the maximum one-way flow of people to a center or side platform, is determined by the lowest capacity corridor or vertical circulation element in a station. In this station, the passenger handling capacity is 420 people per minute. The mezzanine-to-platform vertical circulation element carries 220 people per minute and the crossunder from the opposite platform has a capacity of 200 people per minute.



- CUT-AND-COVER BOX STRUCTURE
- MEZZANINE SEPARATE FROM TRAINROOM AND AT STREET LEVEL
- SIDE PLATFORM

STATION TYPE I - CROSS SECTION
FIGURE 1

Provisions for Handicapped - Existing Concept

Figure 1A shows plan views of the street/mezzanine, platform and crossunder levels respectively. The street/mezzanine and platform level plans indicate that a provision for two vertical elevators has been made to accomodate those handicapped people confined to wheelchairs.

These elevators provide service from the street level entrance to the platform on each side of the street. Entry to and exit from the elevators at street level is accomplished by providing a separate street entrance structure which houses the elevator. The elevator stops at the platform level, adjacent to the ancillary rooms.

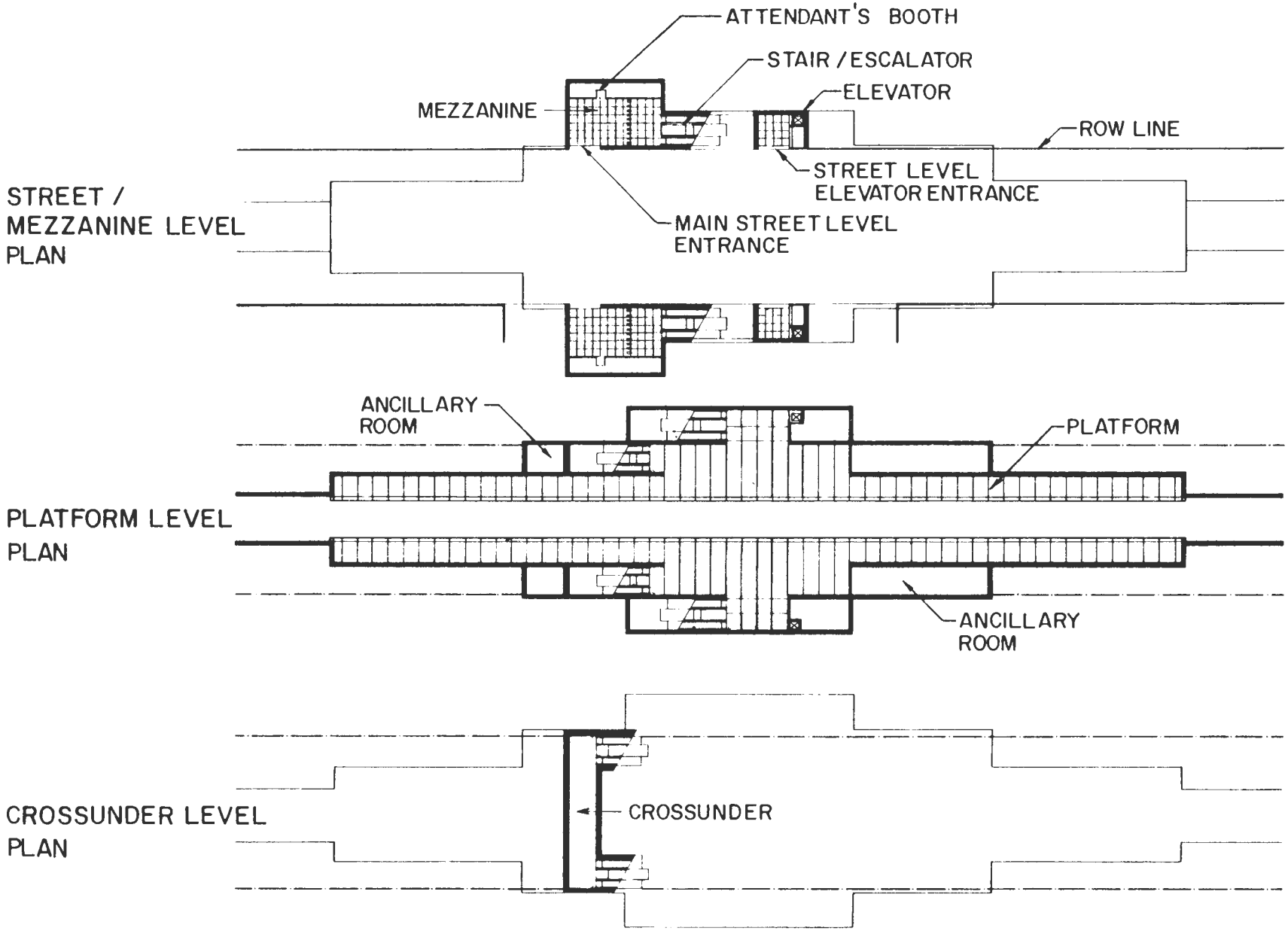
Station Type I allows patrons to transfer from the inbound platform to the outbound platform without having to exit the station by means of a crossunder. Although stair/escalator units are provided from each platform to the crossunder to allow for this transferral of patrons between the platform and crossunder, no elevator is provided from the platform level to the crossunder. Consequently, all transfers from inbound to outbound platforms performed by wheelchair-confined persons must be effected by exiting the station at the street level, crossing the street, and entering the other street level elevator entrance. The requirement for crossunders to be accessible to handicapped persons is not mandated by any code, and under normal conditions, such provisions would have a very low cost/benefit ratio. However, if with a minor modification, entry to crossovers for handicapped individuals could be provided, it might be deemed cost-effective especially in light of the fact that the additional expenditures required to implement such an access were negated in part by the reduction in cost which would result from modifying the existing concept.

Provisions for Handicapped - Modified Concept

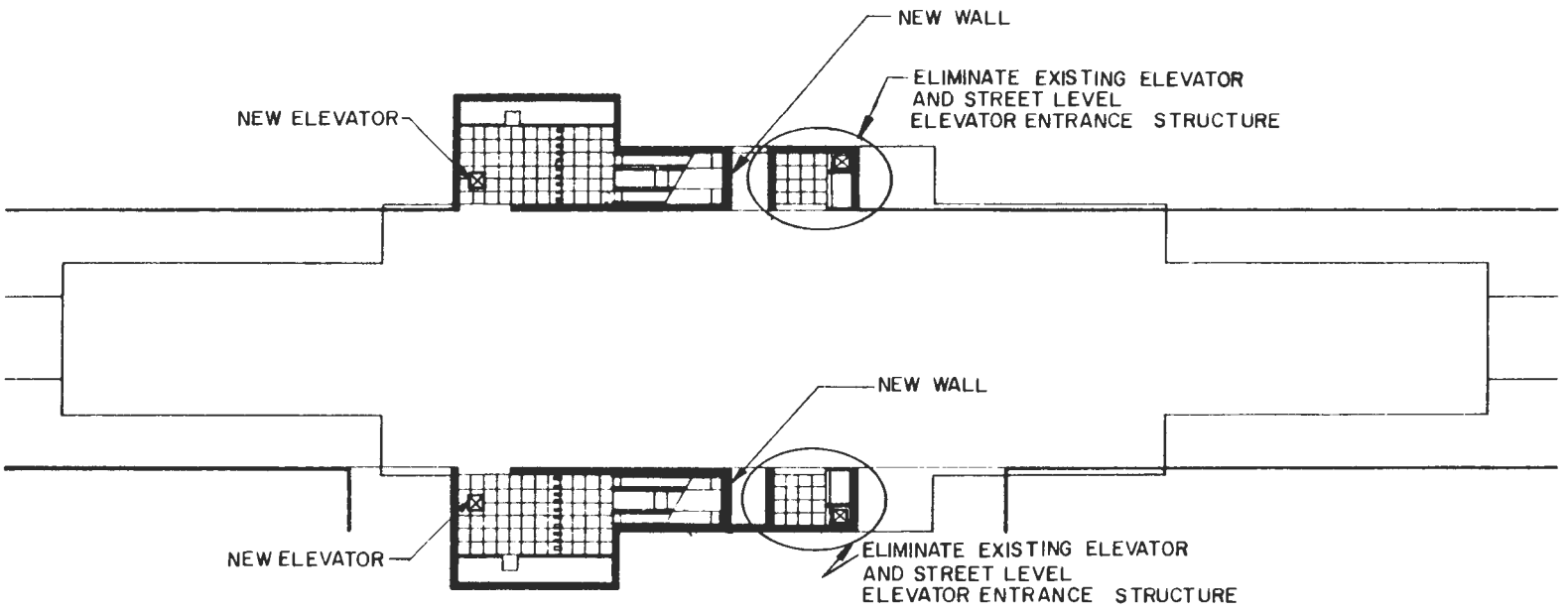
The proposed scheme for modifying this station type is illustrated in Figures 1B, 1C, and 1D, which are plans of the street/mezzanine, platform and crossunder levels, respectively. Essentially the modification entails the following:

- Elimination of the street level elevator entrance on each side of the street.
- Relocation of elevator from the street level elevator entrance to the mezzanine on each side of the street.
- Widening each platform to extend to the new location of the elevator.
- Lengthening the crossunder (longitudinally) at both ends to accommodate the space required for the relocated elevator.

In this station modification, the street level entrance structure would be eliminated, since the elevator will be relocated into the mezzanine. Elimination of the street level elevator entrance structure will result in a considerable reduction not only in construction costs but also right-of-way acquisition costs.

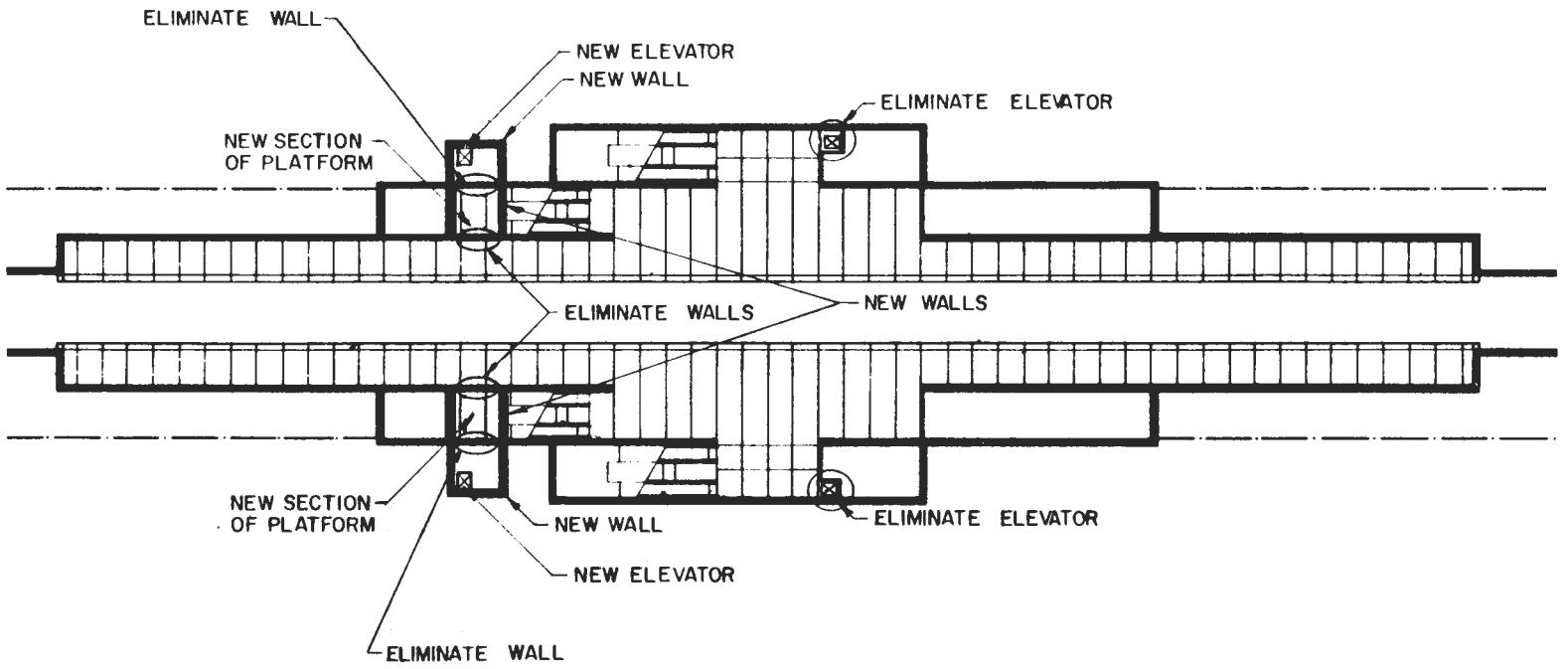


STATION TYPE I - EXISTING CONCEPT
FIGURE 1A



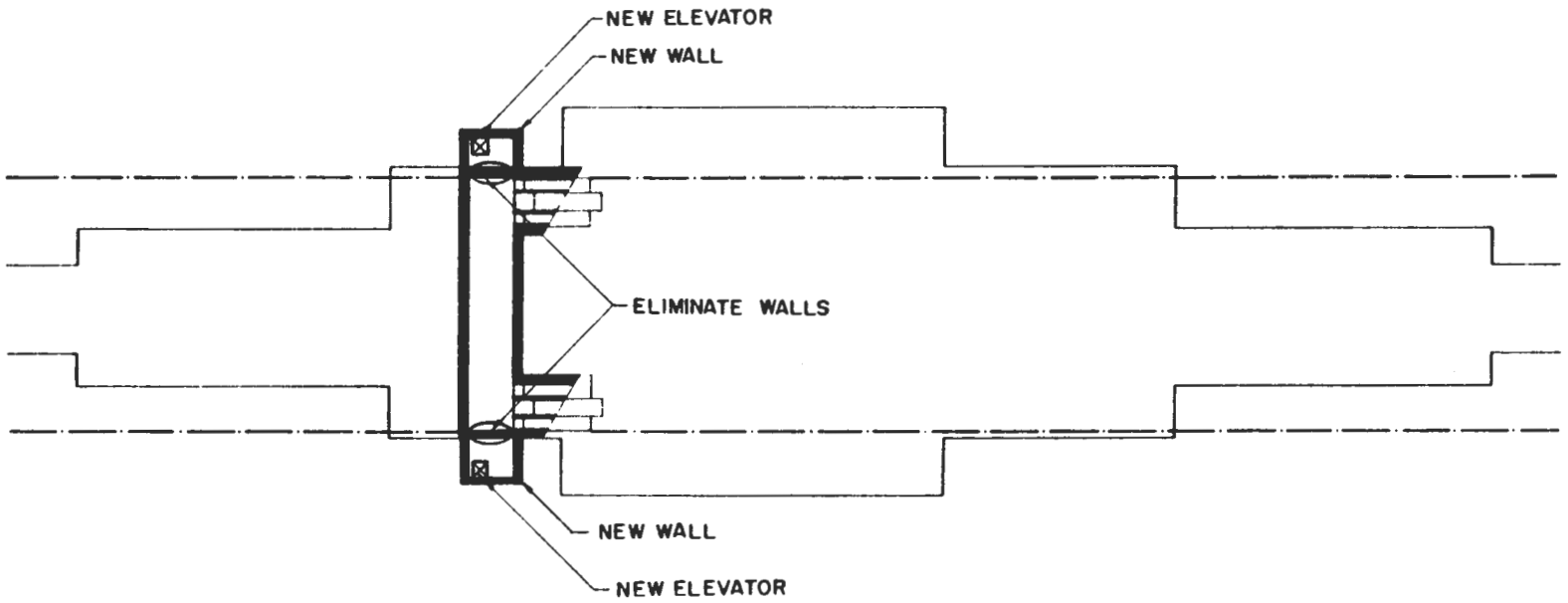
STREET / MEZZANINE LEVEL PLAN

STATION TYPE I - MODIFIED CONCEPT
FIGURE 1 B



PLATFORM LEVEL PLAN

STATION TYPE I - MODIFIED CONCEPT
FIGURE IC



CROSSUNDER LEVEL PLAN

STATION TYPE I - MODIFIED CONCEPT
FIGURE 1D

Relocation of the elevator into the mezzanine area requires that the crossunder be extended and will require additional excavation to enable the elevator to descend to the crossunder level. At the mezzanine level, an additional area at the platform must be constructed between the end of the platform (as shown in the modified station concept) and the new location of the elevator. Also, a new wall should be constructed between this new segment of platform and stair/escalator unit which connects the mezzanine to the crossunder. Since at street level the street level elevator entrance will be eliminated, a new wall must be constructed to enclose the open side of the mezzanine structure.

Table 1 summarizes the costs for the modification. It can be seen that the total additional cost for this modification is relatively low when compared to the total construction cost of the station. The cost/benefit ratio of implementing this concept modification becomes lower in stations where there exist both a high density of handicapped persons and heavy traffic. In such cases the handicapped individual may enter the station at the closest point to his residence and, by means of the elevator servicing the platform and crossunder, arrive at either the inbound or outbound platform.

TABLE 1

STATION TYPE I - MODIFIED CONCEPT

COST ESTIMATE

EXPENDITURES:	
New Elevators (2) - 2500 lb capacity include rails, cab, pit, doors, hydraulic, 3-stops, ±30 ft vertical length, installed	$ 61,200
Electrical service, panels, conduits, wires, switches, etc.	19,000
Excavation for New Elevator Shaft	700
New Section of Platform	4,500
New Extension of Crossunder	7,800
New Segment of 4 ft High Wall	900
New Segment of Mezzanine Wall	1,300
New Elevator Stop	5,000
Subsurface Easements	3,000
	$103,400
SAVINGS:	
Elimination of Main Street Level Elevators	$ 80,200
Elimination of Main Street Level Elevator Entrances	11,000
Elimination of Ancillary Room Walls	3,400
Elimination of Right-of-Way Acquisition	1,400
	$ 96,000
TOTAL ADDITIONAL COST FOR CONCEPT MODIFICATION	$ 7,400

Chapter 3

STATION TYPE II

Description

Station Type II is similar to the first station. The major difference is the location of the mezzanine which is at platform level in this station. This station has been developed to illustrate the advantages and disadvantages which a platform level mezzanine brings to a shallow cut-and-cover station. This type of station still poses utility relocation, passenger circulation, and movement problems, but it also tends to minimize excavation requirements and some operational problems.

As illustrated in Figure 2, the station's relationship to the surrounding area is similar to that of Station Type I. By locating the mezzanine at platform level, however, the station plan is enlarged. This enlargement makes construction of the station at greater depths or in a narrower right-of-way even more costly than Station Type I.

This station has the same type of entrances as Station Type I but, at 20 feet by 20 feet, requires much less level space than the first station. Where street level space is expensive, as in densely developed urban areas, the reduction in size can result in property acquisition cost savings.

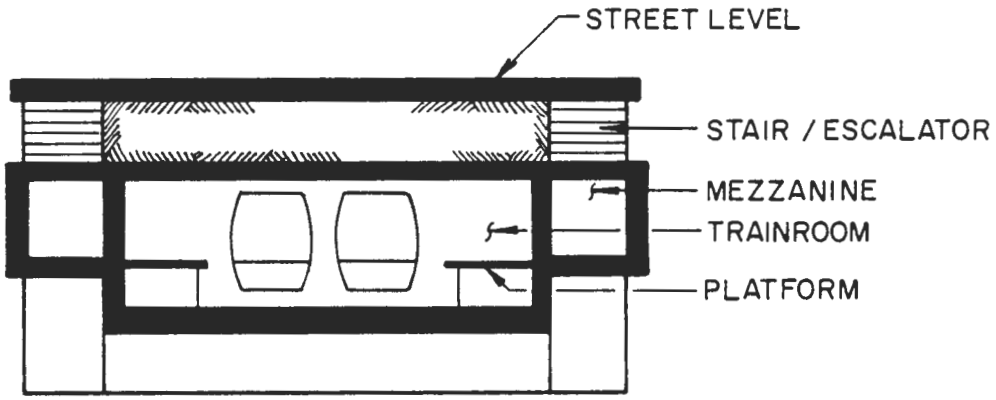
The mezzanines and the station train room are located one level below the entrances. The mezzanines contain the same facilities and have the same passenger handling capacity as Station Type I, but are slightly smaller.

This station's platform area and circulation elements are the same as the first station, but the center of the station is extended an additional 40 feet on each side of the station's center axis. This extension provides standing room in front of the mezzanine, but, of course, increases the volume and cost of excavation compared to the first station.

The passenger handling capacity of this station is the same as the first station--420 people per minute.

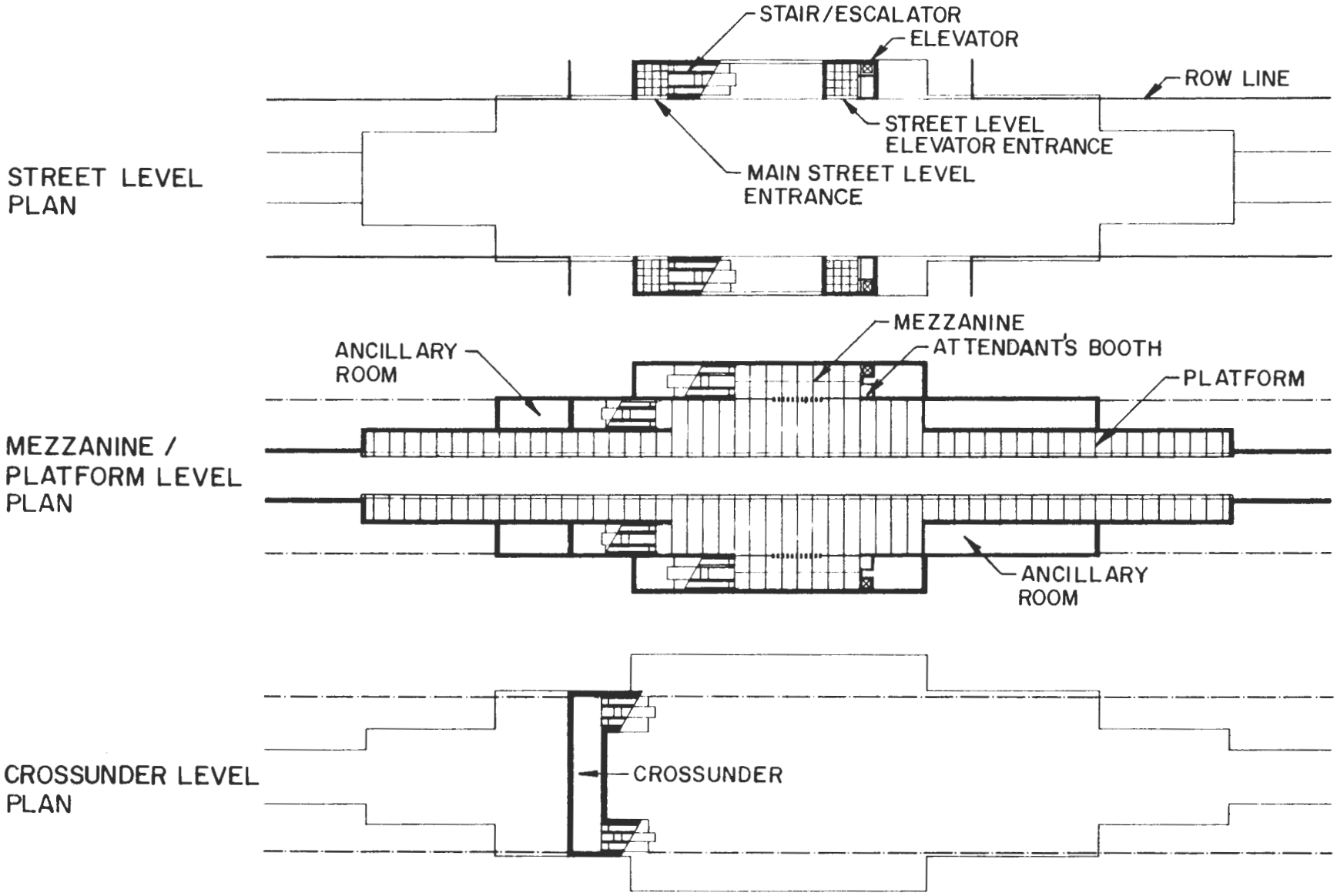
Provisions for the Handicapped - Existing Concept

The provisions for handicapped facilities, which are shown in Figure 2A, for this station type are essentially the same as those provided in Station Type I. Two street level entrances are provided, each of which houses a vertical elevator which provides service from the street level down to the mezzanines. The station design concept provides for a crossunder below platform level, but like the first station type, provides no elevator service from the platform to the crossunder. In order to gain access to the stair/escalator unit which connects the platform to the



- CUT-AND-COVER BOX STRUCTURE
- MEZZANINE SEPARATE FROM TRAINROOM AND AT PLATFORM LEVEL
- SIDE PLATFORMS

STATION TYPE II - CROSS SECTION
FIGURE 2



STATION TYPE II - EXISTING CONCEPT
FIGURE 2A

mezzanine, the handicapped individual must pass through the fare gates once he has arrived at the mezzanine level. He, therefore, experiences an additional level of inconvenience in having to pass through fare gates to enter the platform. This level of inconvenience, compiled with his inability to change from the inbound platform to the outbound platform, serve as the bases for modification to this station.

Provisions for the Handicapped - Modified Concept

The modifications to the Station Type II Concept are essentially the same as those implemented in the first station with the addition of an enlargement of the street level entrance. Graphically illustrated in Figures 2B, 2C, and 2D the modification essentially proposes the following:

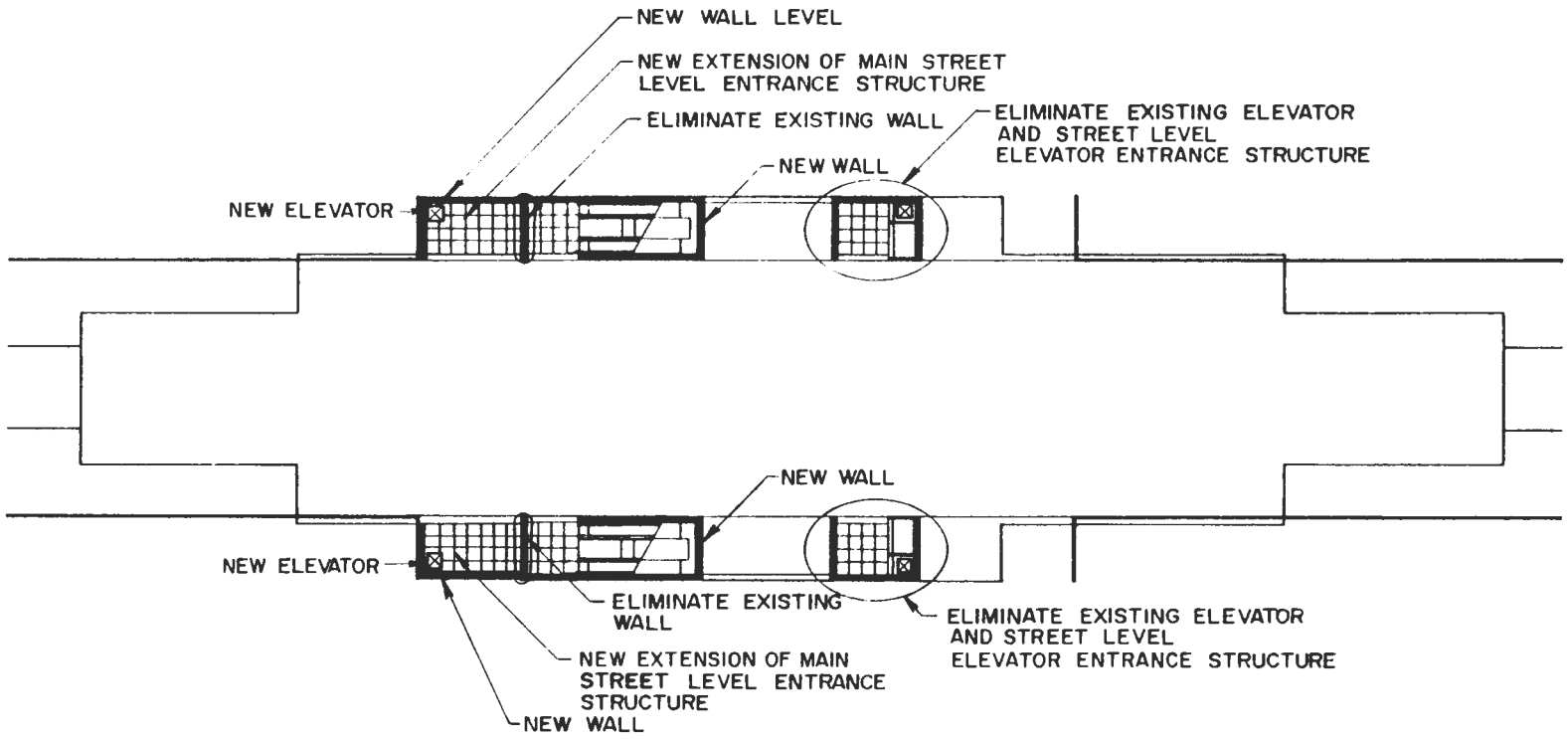
- Elimination of the street level elevator entrance structure on each side of the street.
- Relocation of the elevator from the street level elevator entrance to the main street level entrance on each side of the street.
- Enlarging a portion of both platforms to extend to the new location of the elevator.
- Lengthening the crossunder (longitudinally) at both ends to accommodate the space required for the relocated elevator.
- Enlarging the main street level entrance to accommodate the new location of the elevator.

The location of the crossunder is the same as that shown in the existing (unmodified) concept. Like the previous station, the location of the crossunder is basically a function of the difference in elevations between the platform and the crossunder, assuming the slope of the stair/escalator unit is fixed. The crossunder should be extended longitudinally on both sides far enough to house the new elevator whose location at street level is dictated by the limits of the property acquisition necessary to construct the existing (unmodified) station concept.

The concept modification at street level requires that the main street level entrance structure be extended in a direction parallel to the tracks a sufficient distance to enclose the relocated elevator.

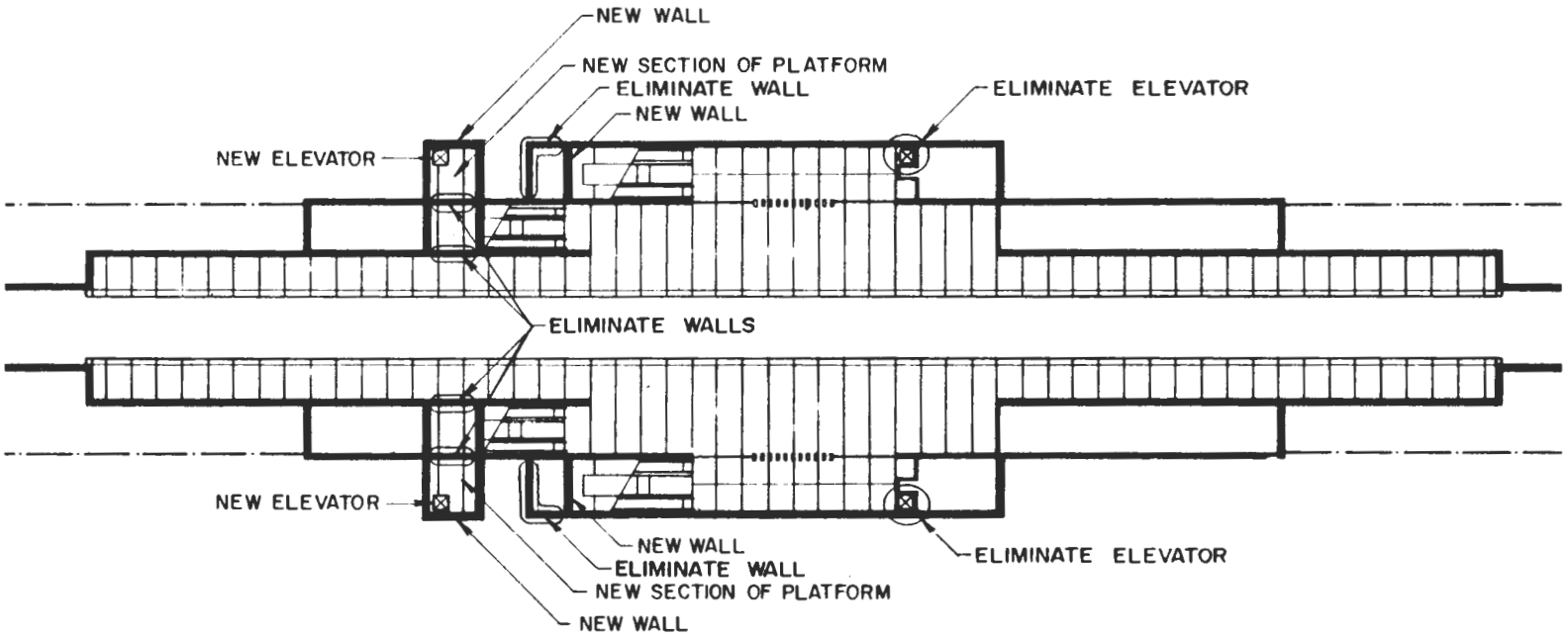
The additional cost of the enlargement of the main street level entrance structure is somewhat offset by the elimination of the street level elevator entrance, but is not nearly as much as compared to the first station modification. With the mezzanine located at platform level, the area required for the main street level entrance is much less than that required in Station Type I where the mezzanine is located at street level.

At the platform level, this concept modification is identical to that of the first concept modification. A new segment of platform is required to fill the gap between the outer edge of the platform (that farthest from the train) and the new location of the elevator. Similar to the first concept modification, construction of



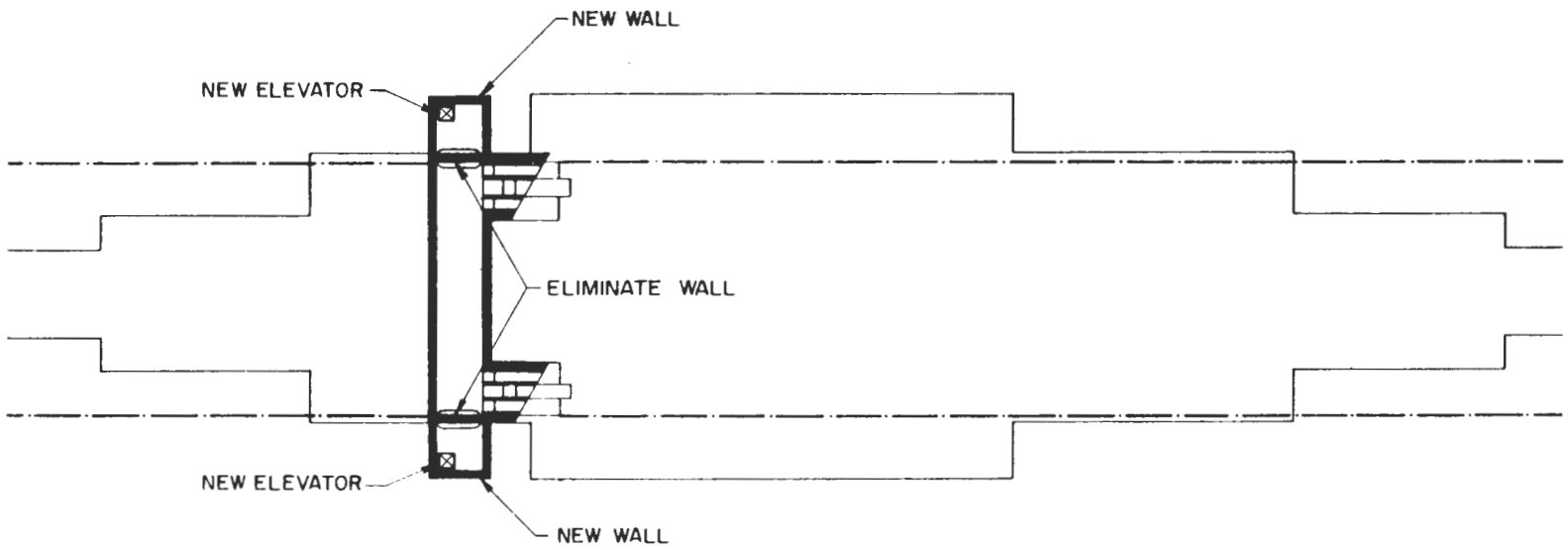
STREET LEVEL PLAN

STATION TYPE II - MODIFIED CONCEPT
FIGURE 2B



MEZZANINE / PLATFORM LEVEL PLAN

STATION TYPE II - MODIFIED CONCEPT
FIGURE 2C



CROSSUNDER LEVEL PLAN

STATION TYPE II - MODIFIED CONCEPT
FIGURE 2D

this additional section of platform warrants a barrier wall between the platform and the stair/escalator unit which connects the crossunder to the platform level.

Table 2 tabulates the additional expenditures and savings attributable to this concept modification. The basic rationale for implementation of this concept modification is exactly that which was brought out in the modified concept for Station Type I. Even though the cost of this modification exceeds that of the first station, the reduction in inconvenience to be experienced by handicapped and elderly persons resulting from its implementation would far exceed the incurred extra costs.

TABLE 2

STATION TYPE II - MODIFIED CONCEPT

COST ESTIMATE

EXPENDITURES:	
New Elevators (2) - 2500 lb capacity includes rails, cab, pit, doors, hydraulic, 3-stops, ±30 ft vertical length, installed	$ 61,200
Electrical service, panels, conduits, wires, switches, etc.	19,000
Excavation for New Elevator Shaft	700
New Section of Platform	4,500
New Extension of Crossunder	7,800
New Segment of 4 ft High Wall	900
New Section of Street Level Entrance Slab	
New Extension to Street Level Entrance	18,600
New Right-of-Way Acquisition	2,700
	$115,400
SAVINGS:	
Elimination of Main Street Level Elevators	$ 80,200
Elimination of Street Level Elevator Entrances	11,000
Elimination of Ancillary Room Walls	3,400
Elimination of Right-of-Way Acquisition	1,400
	$ 96,000
TOTAL ADDITIONAL COST FOR MODIFICATION	$ 19,400

Chapter 4

STATION TYPE III

Description

This station type can be best described as a cut-and-cover box structure whose mezzanine is separate from the trainroom and above the platform level. It differs from the first two stations in the depth of excavation and location of the mezzanine. The station illustrates the assets and liabilities of a single mezzanine, separate from the trainroom and constructed at a depth which minimizes interference with existing street utilities. It also shows the potential and problems of achieving uniform passenger distribution at the platform in a single platform station.

The greater station depth reduces utility relocation problems and provides room for a separate mezzanine level below the street. It also increases excavation, support of excavation, and underpinning costs.

The distinguishing feature of this station, which is illustrated in Figure 3, is the mezzanine. It is a single story space of more than six times the area of the mezzanines of either of the first two stations. The large vicinage is determined by the area of the trainroom below it and by the location of the stair/escalator units that serve the platform.

The platform level has the same basic dimensions as the first two stations with one major exception. The station is 24 feet wider to accommodate twelve-foot stair/escalator units at the side walls of each platform. The stair escalator arrangement clearly has an impact on the cost of excavation, but contributes to the simplicity of the shape of the structural shell.

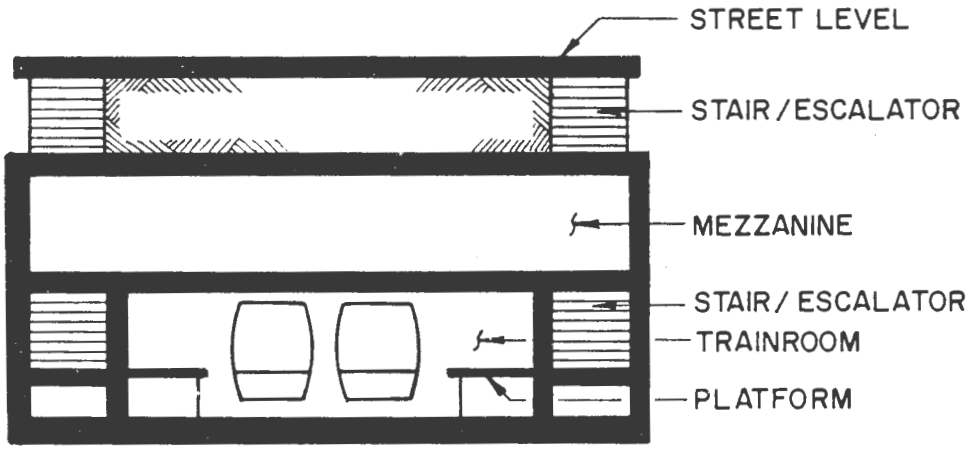
The stair/escalator units between the entrance and the mezzanine are like those of the first two stations except that the run (the horizontal length of the units) is longer in this station. The longer run is the result of greater station depth and increases both capital and operating costs of the stair/escalator units.

The capacity of the station is governed by the capacity of the two entrances to the mezzanine vertical circulation elements which have a capacity of 220 people per minute each, totalling 440 people per minute per station.

Provisions for the Handicapped - Existing Concept

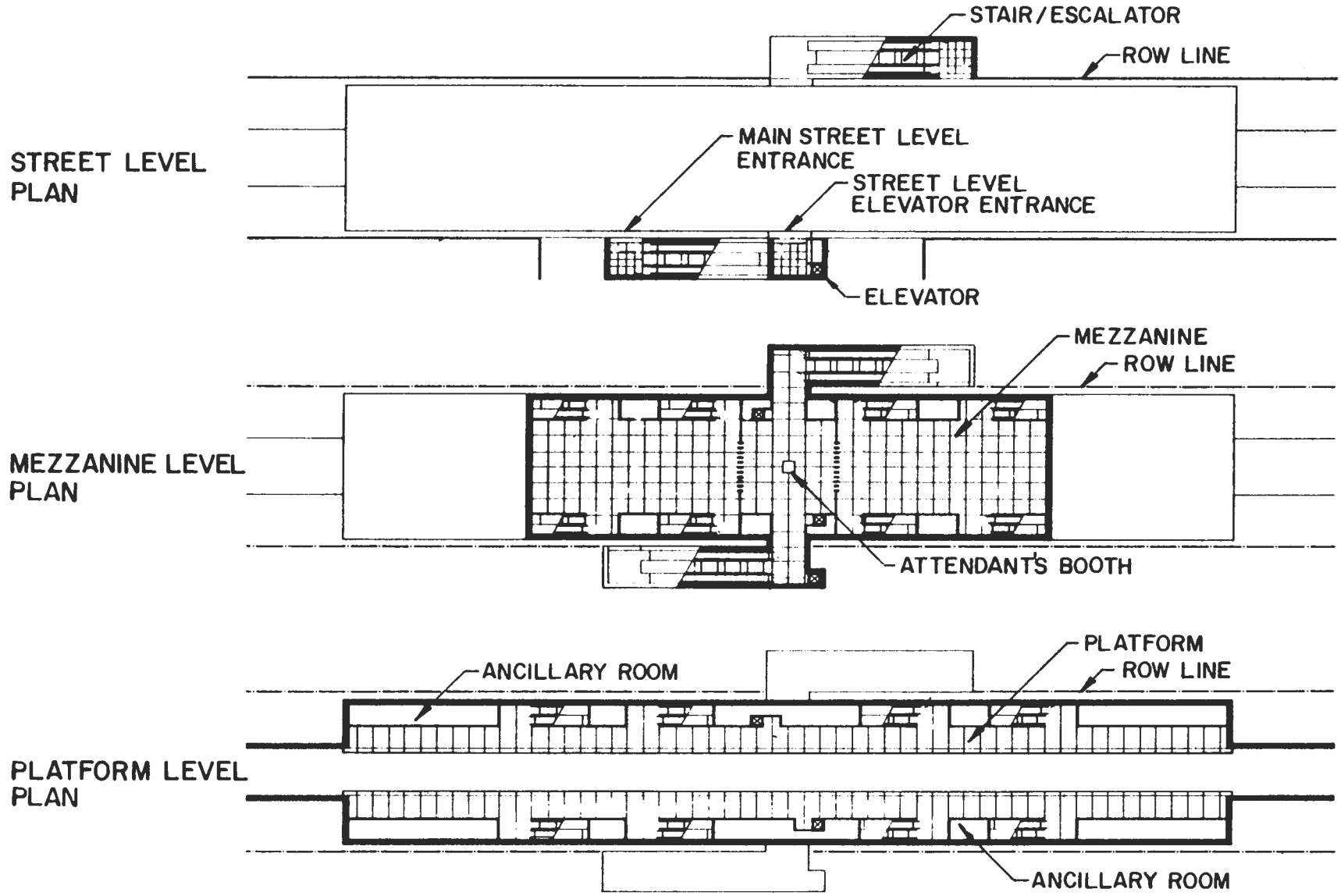
The existing conceptual design for Station Type III is depicted in Figure 3A which shows the street, mezzanine, and platform levels, respectively.

It can be seen by comparison of the street level plan with the mezzanine plan that the elevator by which the handicapped person enters (or exits) at the street level is not the same elevator which transfers him from the mezzanine level



- CUT - AND - COVER BOX STRUCTURE
- MEZZANINE SEPARATE FROM TRAINROOM AND ABOVE PLATFORM LEVEL
- SIDE PLATFORM

STATION TYPE III - CROSS SECTION
FIGURE 3



STATION TYPE III - EXISTING CONCEPT
FIGURE 3A

to the platform level. In other words, the handicapped person must enter the elevator at street level, exit at the mezzanine level, cross the mezzanine and enter one of two new elevators. One of these transports him from the mezzanine level to the inbound platform, and the other from the mezzanine level to the outbound platform.

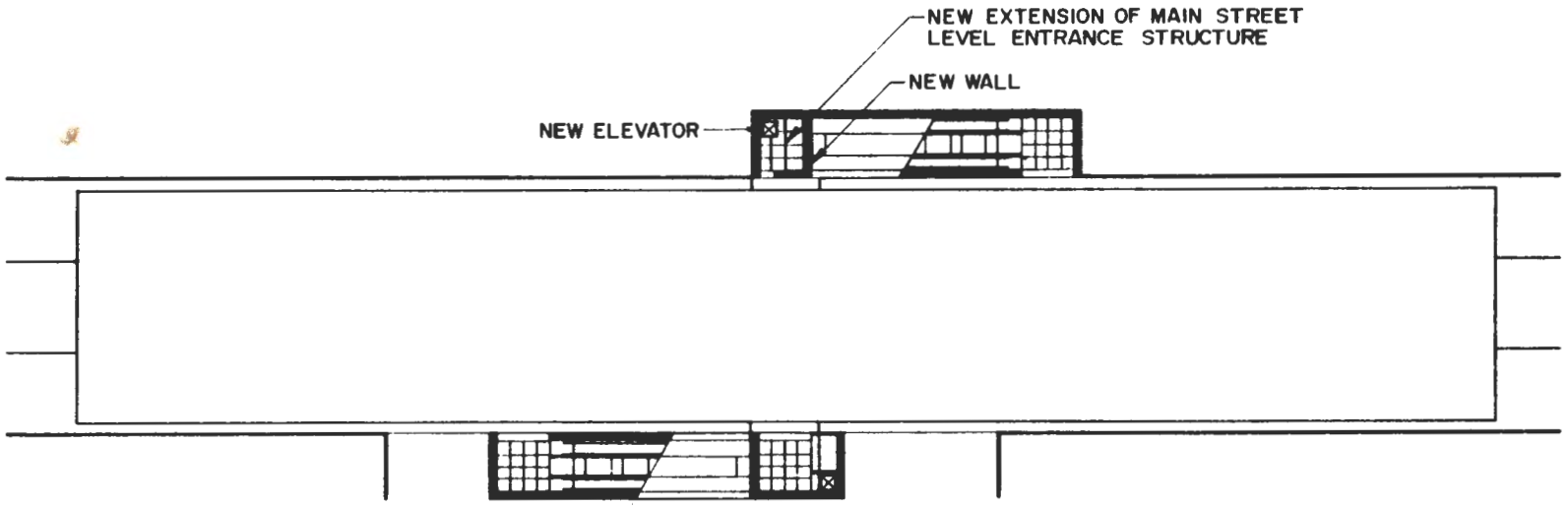
This conceptual design affords one benefit to the handicapped which neither of the previous two existing concepts provide -- provision for transferring from the inbound platform to the outbound platform without having to exit the station, cross the streets, and enter the entrance on the other side of the street. This conceptual design, however, provides elevator access on only one side of the street, which necessitates his having to cross the street to enter into the station if the direction of his travel so warrants.

Provisions for the Handicapped - Modified Concept

The recommended modification to this station design requires that a new elevator be provided between the street level and the mezzanine level at the main street level entrance, and also an extension of the main street level entrance to accommodate the new elevator. This new elevator will be located in the main street level elevator entrance where the existing station concept failed to provide such a facility.

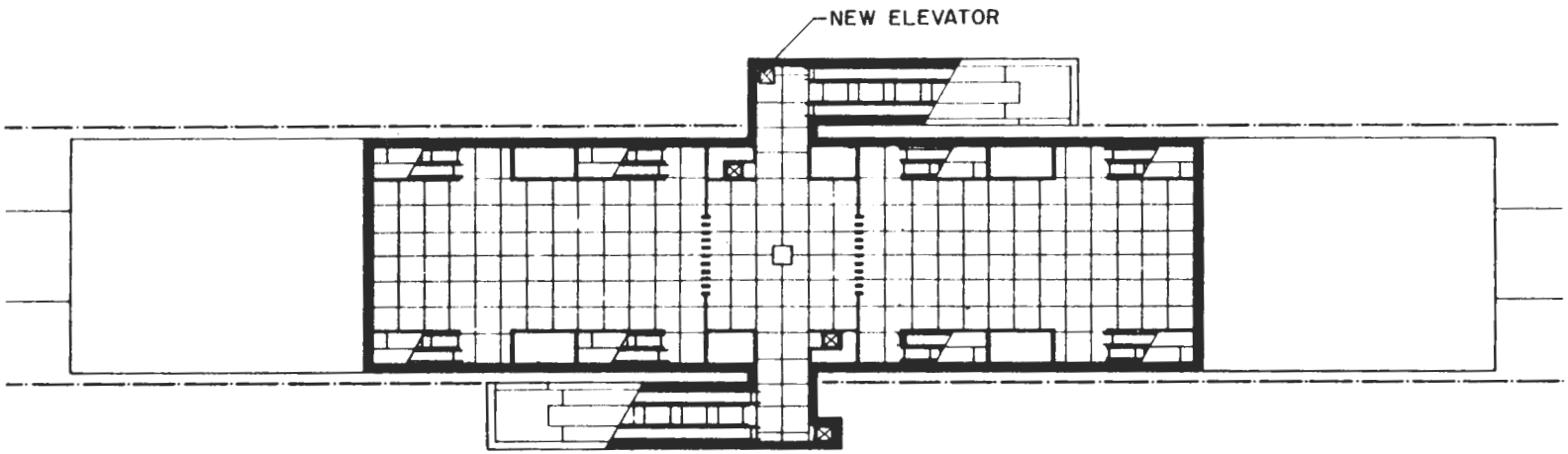
The Street Level Plan, which is illustrated in Figure 3B, shows the location of the new elevator and the extended main street level entrance structure. A new wall should be provided between the new elevator and the existing stair/escalator which services the street and mezzanine levels. The new elevator will terminate at the mezzanine and require the handicapped patron to exit at this level and enter one of the two existing elevators which provide service from the mezzanine level to the platform levels. The location of the new elevator at the mezzanine level is shown in the plan in Figure 3C.

The costs attributable to this station modification are listed in Table 3.



STREET LEVEL PLAN

STATION TYPE III - MODIFIED CONCEPT
FIGURE 3B



MEZZANINE LEVEL PLAN

STATION TYPE III - MODIFIED CONCEPT
FIGURE 3C

TABLE 3

STATION TYPE III - MODIFIED CONCEPT

COST ESTIMATE

EXPENDITURES:

New Elevator (1) - 2500 lb capacity includes rails, cab, pit, doors, hydraulic, 2-stops, ±20 ft vertical length, installed	$26,600
Electrical service, panels, conduits, wires, switches, etc.	8,600
New Section of Street Level Entrance Wall	2,600
New Extension to Street Level Entrance	12,400
New Right-of-Way Acquisition	2,100
	$52,300

TOTAL ADDITIONAL COST FOR MODIFICATION $52,300

Chapter 5

STATION TYPE IV

Description

Station Type IV has been developed to illustrate the problems and potential of constructing a station in a narrow right-of-way, which is often found in many older cities. In addition, this type of station is found where very high capacities are needed, or where a junction occurs for a branch line.

To achieve a narrow station width, the platforms are stacked, thus creating two trainrooms. Stacking also creates a deep station, with correspondingly high excavation costs, and possibly more groundwater and excavation support problems.

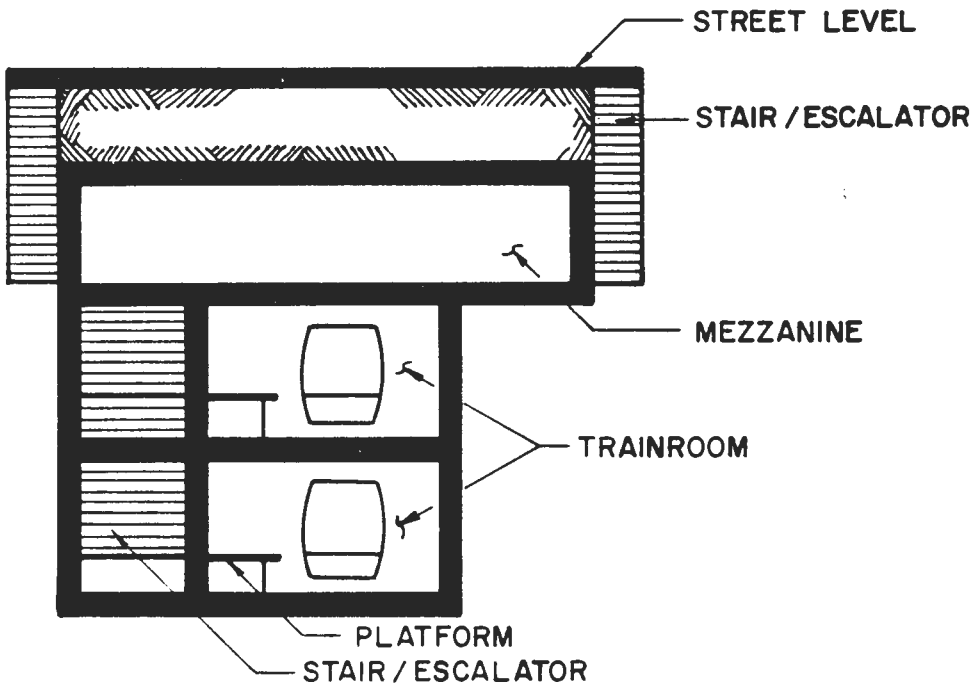
The major difference in this station's relationship to the surrounding area is a narrower, 60 foot right-of-way. Since the station has three rather than two levels below grade, this amount of cover results in a deep and generally more expensive cut-and-cover station. However, the station can be constructed at shallower depths with a likely substantial saving in construction cost.

The station entrances are identical to those in Station Type III. The mezzanine is about two-thirds the area of the Station Type III mezzanine, but the area still exceeds that required for minimum efficient passenger circulation. This is because the mezzanine must extend to the farthest vertical circulation element that provides access to the platform near the station ends. Unlike the previous station, the mezzanine size cannot be reduced due to the number of stair/escalator units that must be located along one side of the station. Eight stair/escalator units alternate between the platforms. Thus, a fairly even distribution of people to the platforms is created, resulting in an efficient use of the area between the units as ancillary space, but requiring lengthy, mezzanine level access corridors to reach the units.

Figure 4 illustrates this station type in cross section. From this figure it can be seen that the distinguishing feature of this station is the vertically stacked, rather that horizontally adjacent, alignment of the trackways. This feature not only creates a narrow station, but also, under the same alignment conditions, creates the need for complicated and costly transitions in the tunnel outside the station. The distribution of people on the platform and circulation at the platform is not substantially altered by the stacked platform from that of Station Type III.

The mezzanine is visually separated from the platform as are the platforms from each other. Movement between the platforms involves longer travel distances than in Station Type III.

Vertical circulation between the mezzanine and platforms is the same in terms of the number and capacity of stair/escalator units as in Station Type III. However, four of the vertical circulation elements have longer runs to the lower platform which will increase capital and operating costs slightly.



- CUT-AND-COVER BOX STRUCTURE
- MEZZANINE SEPARATE FROM TRAINROOM AND ABOVE PLATFORM LEVEL
- STACKED PLATFORMS

STATION TYPE IV - CROSS SECTION
FIGURE 4

The station capacity is the same as that of Station Type III--440 people per minute.

Provisions for the Handicapped - Existing Concept

Station Type IV provides essentially the same facilities for the handicapped as those of the last station type--one elevator at the street level which provides service from the street to the platform level. Because the platform levels are stacked, only one elevator is required to provide service between the lower platform, upper platform and mezzanine levels. The existing station concept is illustrated in Figure 4A.

As in Station Type III, handicapped persons confined to wheelchairs are able to enter the station on only one side of the street. Upon reaching the platform level, they must exit the elevator and enter a second station elevator which allows them to have access to both the lower platform and the upper platform. The ability to transfer from the inbound platform to the outbound platform is effected by use of the second elevator which runs vertically between the upper and lower platform levels. In the previous three station concepts, this crossover was effected by either utilizing a crossunder passageway below the tracks or using one elevator at each platform to provide service between the platform and the mezzanine where patrons may transfer from one elevator to the other at the mezzanine level.

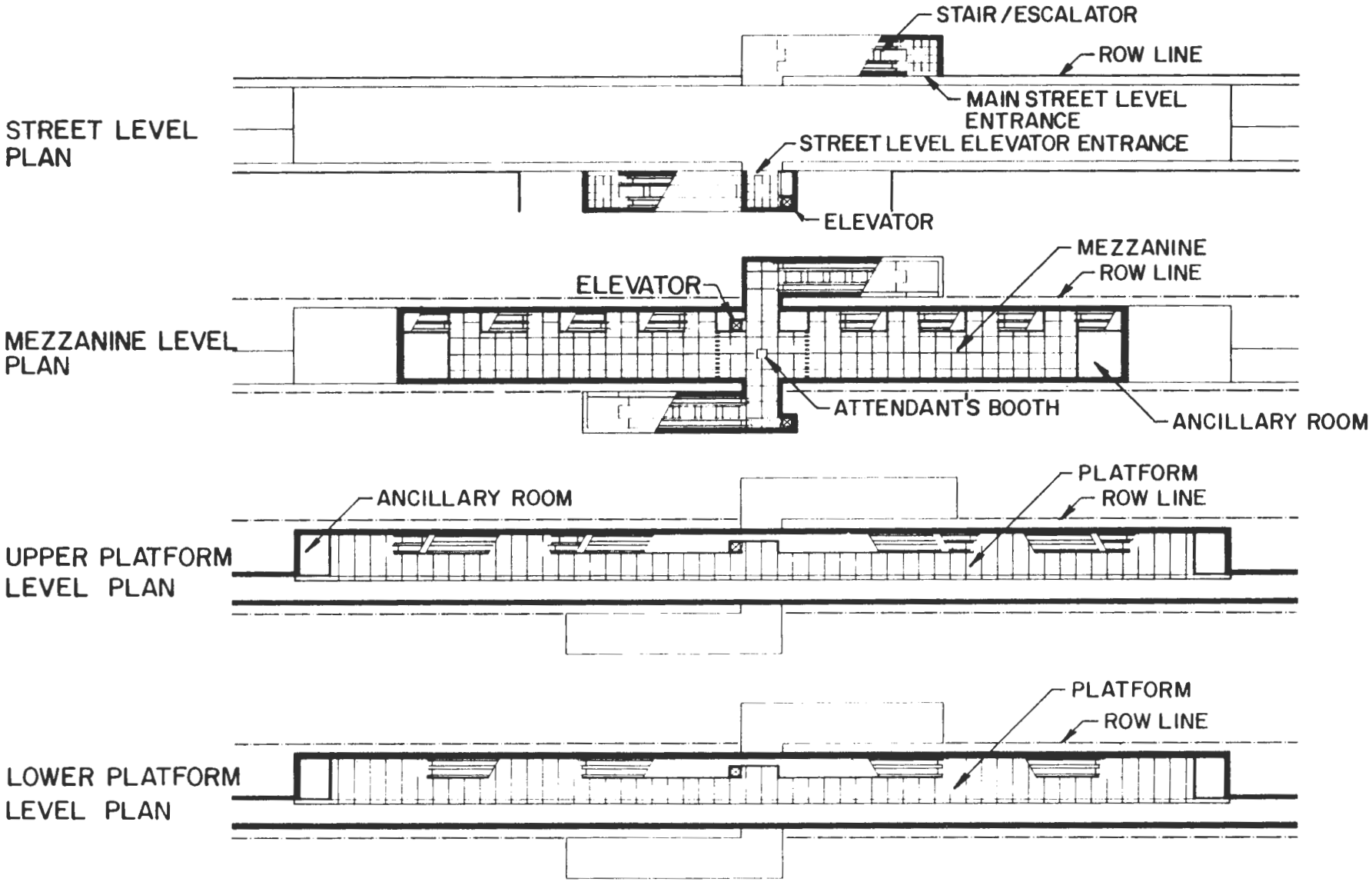
Provisions for the Handicapped - Modified Concept

The modification recommended for this type of station is the same as that of the previous station - providing a new elevator at the main street level entrance at which no elevator is provided by the existing station concept. The proposed modifications for this station type are shown in Figures 4B and 4C, which are plan views of the street and mezzanine levels respectively.

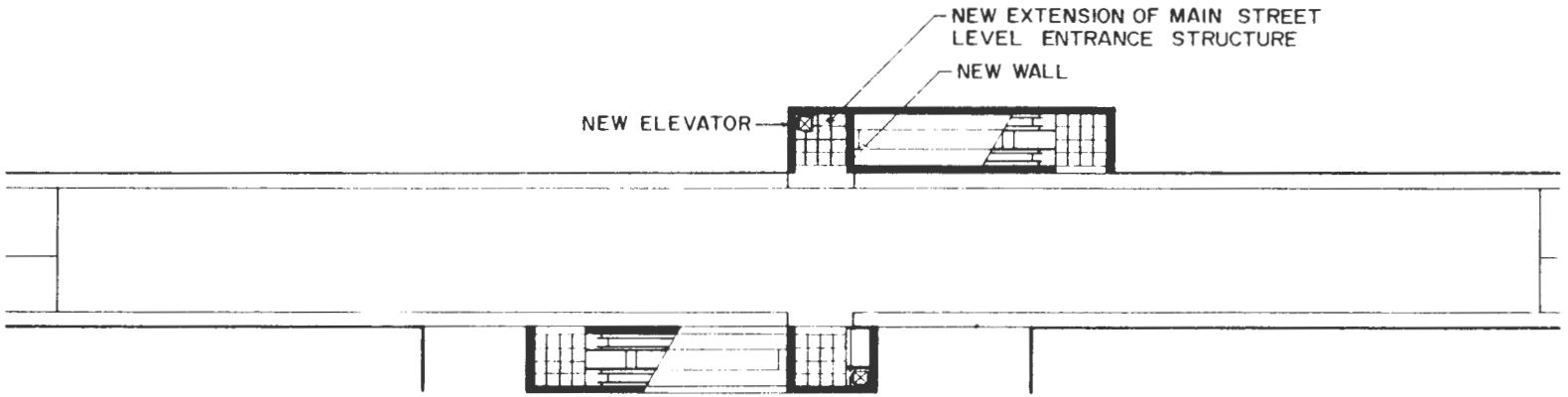
The provision for a new elevator at the main street level entrance warrants an extension of the entrance as well as a new wall which will separate the new elevator from the opening required for the stair/escalator unit servicing the street and mezzanine.

The total additional cost of implementing the modifications are basically the same as that attributable to the modification of Station Type III. The increased cost of the new elevator for this station modification results from the fact that in most circumstances, the difference in elevation between the street level and the mezzanine level for this station type will be greater than that of the previous concept, and consequently, the vertical run will be longer.

The additional cost of modifying this station concept to facilitate the handicapped is tabulated in Table 4.

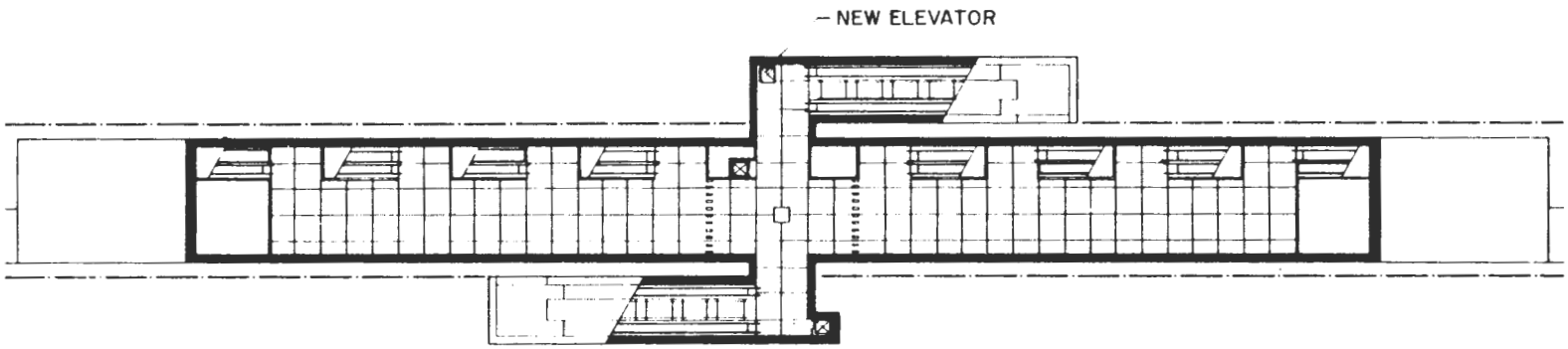


STATION TYPE IV - EXISTING CONCEPT
FIGURE 4A



STREET LEVEL PLAN

STATION TYPE IV - MODIFIED CONCEPT
FIGURE 48



MEZZANINE LEVEL PLAN

STATION TYPE IV – MODIFIED CONCEPT
FIGURE 4C

TABLE 4

STATION TYPE IV - MODIFIED CONCEPT

COST ESTIMATE

EXPENDITURES:

New Elevator (1) - 2500 lb capacity includes rails, cab, pit, doors, hydraulic, 2-stops, ±20 ft vertical length, installed	$26,600
Electrical service, panels, conduits, wires, switches, etc.	8,600
New Section of Street Level Entrance Wall	2,600
New Extension to Street Level Entrance	12,400
New Right-of-Way Acquisition	2,100
	$52,300

TOTAL ADDITIONAL COST FOR MODIFICATION $52,300

Chapter 6

STATION TYPE V

Description

Station Type V incorporates several cost reducing features developed from other cut-and-cover stations. It can best be described as a cut-and-cover box structure whose mezzanine is located above the platform level, forming the top of the trainroom. The platforms are located centrally between the inbound and outbound tracks. It has a two-story trainroom which does not increase the volume of total excavation when compared with Station Types III and IV, but does reduce the volume of backfill one-half million cubic feet compared to Station Type III. The potential of the center platform halves the number of vertical circulation elements while providing excellent one-way capacity and optimum overall circulation and operational characteristics.

The station is located within the same right-of-way, at the same depth of cover, and with the same entrance as that of Station Type III.

As illustrated in Figure 5, the distinguishing characteristics of this station are the location of the mezzanine above the platform within the trainroom, and the center platform layout. Locating the mezzanine in the trainroom has both economic and functional advantages. Excavation requirements do not exceed those of Station Types III and IV, and backfill requirements are less than those of Station Type III. Roof structure costs also are reduced as the backfill load diminishes.

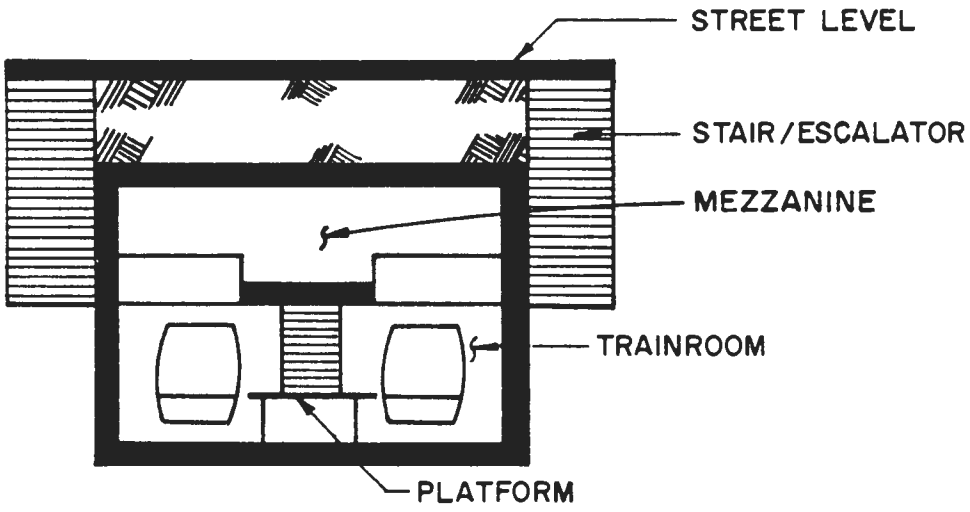
The center platform consolidates vertical circulation between the mezzanine and the platform with a substantial savings in capital and operating costs. One-way capacity is the same as the other stations. The center platform also simplifies cross-platform movements and facilitates movement of patrons from the mezzanine because a directional decision is not required until the patron reaches the platform.

Ancillary space is located beyond the ends of the platform on two levels. The effect of this arrangement is to enlarge the volume of excavation and increase costs. One method of reducing these costs is to locate the ancillary space a level above, at the ends of the platform within the trainroom space. This location would reduce excavation costs without impairing the platform circulation of users.

The capacity of this station is the same as the last two stations--440 people per minute.

Provisions for the Handicapped - Existing Concept

This station concept provides essentially the same handicapped facilities as the previous station--one elevator from the main street level entrance to the mezzanine and one elevator from the mezzanine to the platform.



- CUT - AND - COVER BOX STRUCTURE
- MEZZANINE WITHIN TRAINROOM AND ABOVE PLATFORM LEVEL
- CENTER PLATFORM

STATION TYPE Ⅴ - CROSS SECTION
FIGURE 5

Upon entry into the elevator at street level the handicapped patron is required to exit the first elevator at the mezzanine and enter into the second elevator which provides service from the mezzanine to the centrally located platform.

This station concept, like the previous two station concepts, provides only one elevator at the street level, therefore, the handicapped patron must transfer elevators at the platform level. The existing station concept is shown in Figure 5A.

Provisions for the Handicapped - Modified Concept

The suggested modification for this station concept is the same as that for Station Type III--the addition of one elevator at the main street level entrance wherein no elevator has been provided by the existing station concept. Addition of the new elevator requires that the main street level entrance be extended in order to provide adequate space for its installation. The addition of the elevator, and the extension of the main street level entrance are illustrated in Figures 5B and 5C.

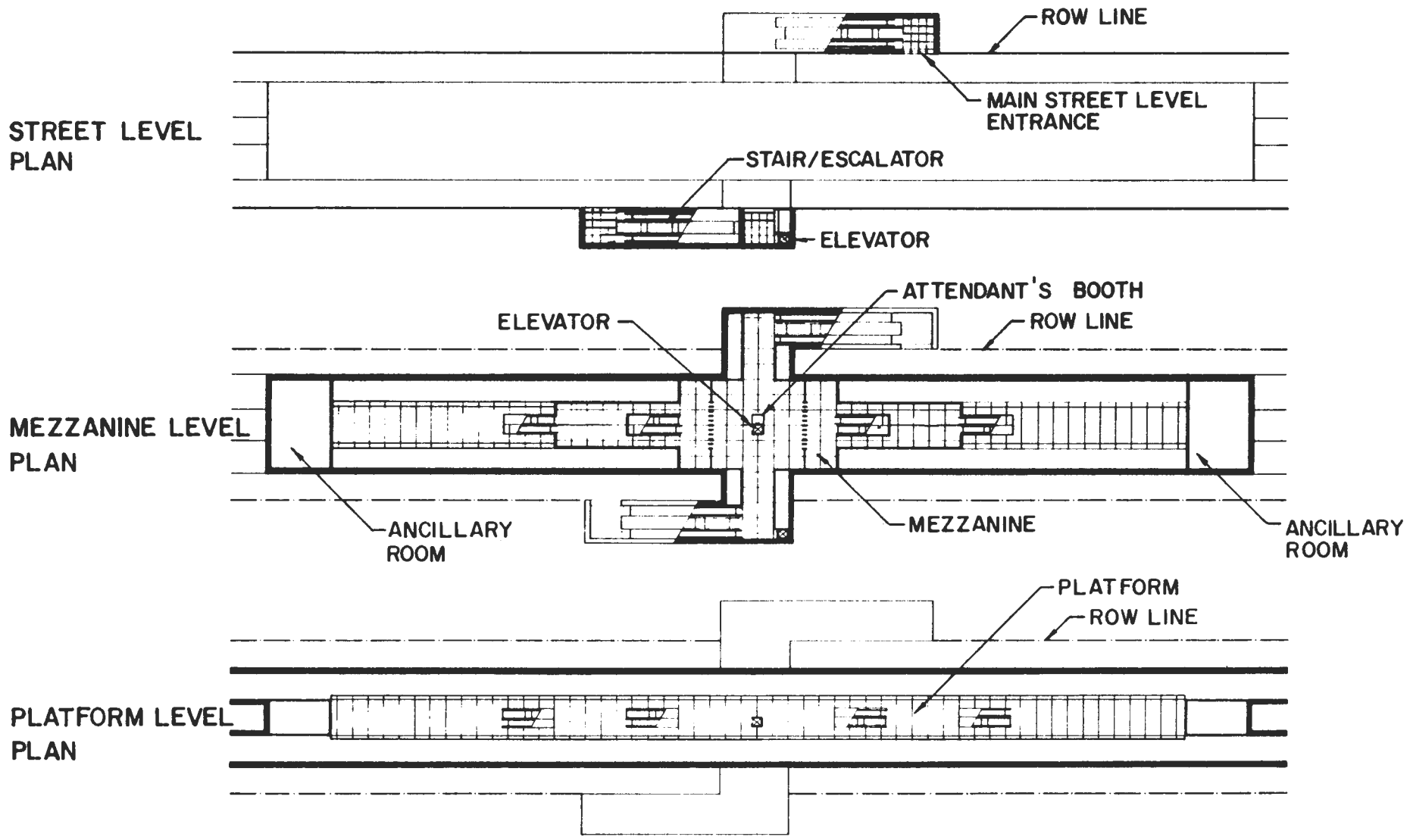
The incurred costs resulting from the implementation of this modification are tabulated in Table 5.

TABLE 5

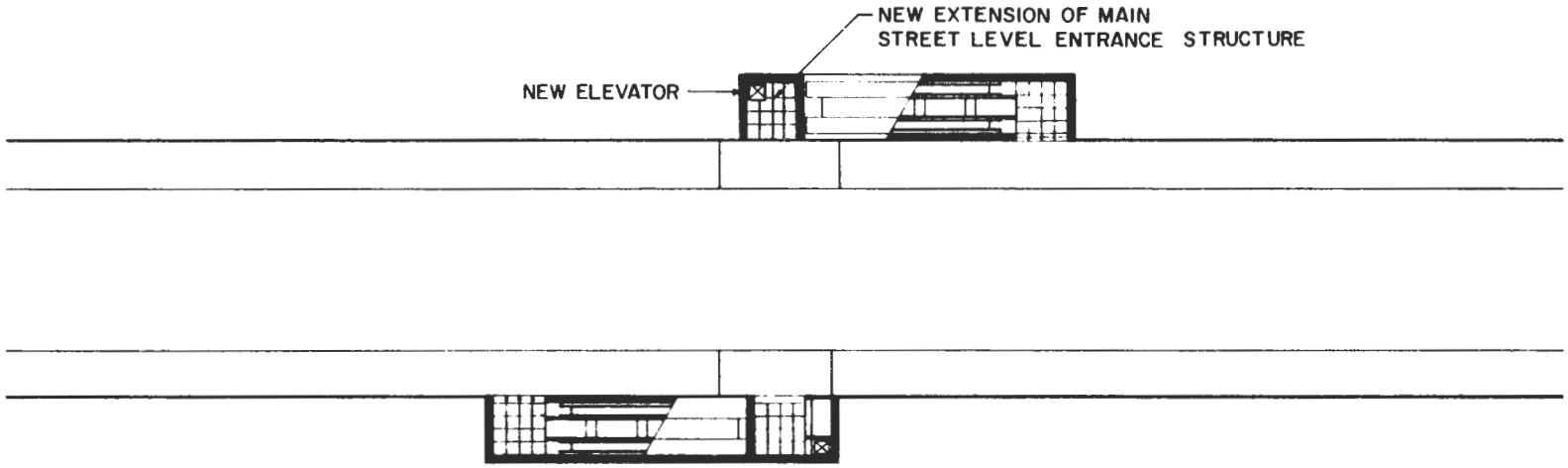
STATION TYPE V - MODIFIED CONCEPT

COST ESTIMATE

EXPENDITURES:	
New Elevator (1) - 2500 lb capacity includes rails, cab, pit, doors, hydraulic, 2-stops, 20 ft vertical length, installed	$26,600
Electrical service, panels, conduits, wires, switches, etc.	8,600
New Section of Street Level Entrance Wall	2,600
New Extension to Street Level Entrance	12,400
New Right-of-Way Acquisition	2,100
	$52,300
TOTAL ADDITIONAL COST FOR MODIFICATION	$52,300

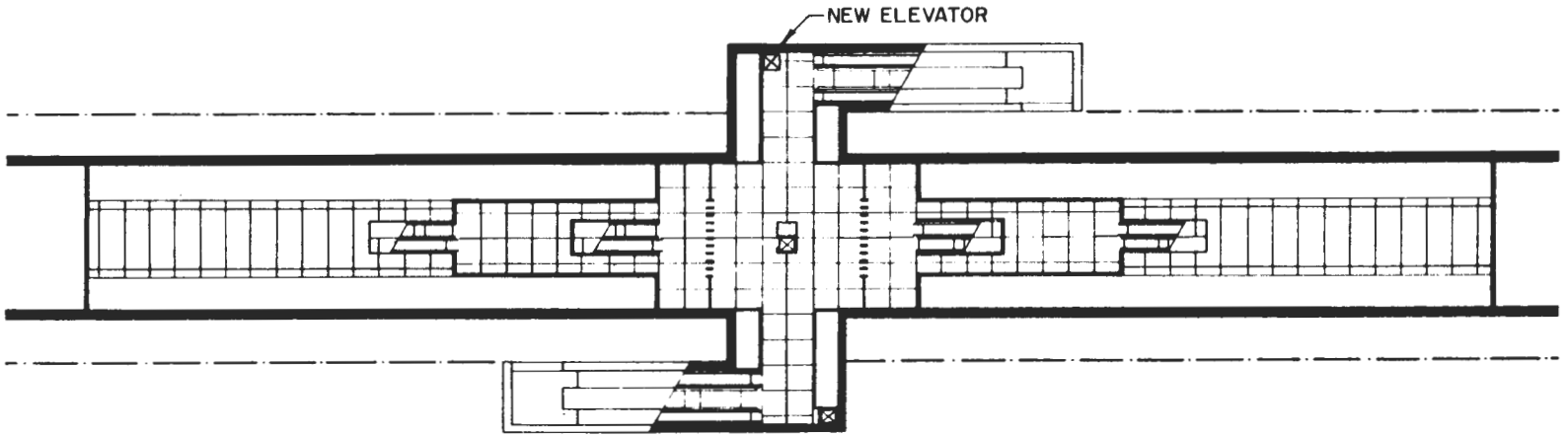


STATION TYPE V – EXISTING CONCEPT
FIGURE 5A



STREET LEVEL PLAN

STATION TYPE V - MODIFIED CONCEPT
FIGURE 5B



MEZZANINE LEVEL PLAN

STATION TYPE V – MODIFIED CONCEPT
FIGURE 5C

Chapter 7

STATION TYPE VI

Description

Station Type VI is basically a mined single arch in which the mezzanine is located within the trainroom and above the platform level. The platforms are located in the center.

This station type is usually constructed at a greater depth than the other stations. The controlling influences are normally track geometry requirements, geotechnical conditions, and local policy. Mining costs usually do not vary substantially with changes in depth.

Figure 6 shows the station depicted within a street right-of-way, but a mined station would not necessarily have to be located within the existing street system.

A major benefit of the mined station is the avoidance of utility relocation problems. This station normally will cause less disruption of the surface than the cut-and-cover station types. However, such conditions as a high water table or unstable ground conditions can make mined excavation prohibitively expensive.

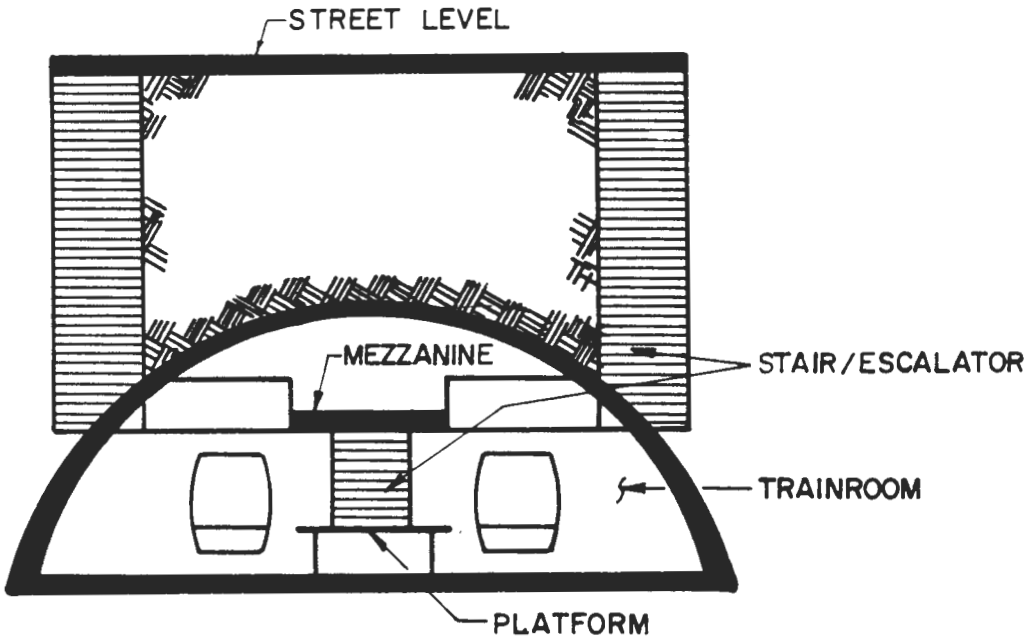
The major difference between Station Types V and VI is the vertical circulation runs between the street and mezzanine levels. Since the station is much deeper, each vertical circulation element requires three escalators--two in the peak direction and one in the off-peak direction. This increases the capital as well as operating costs of these vertical circulation elements. In addition, user convenience diminishes as the travel distance from the entrance to the platform increases.

The three escalator vertical circulation elements between the street and mezzanine level govern the capacity of this station type. They each have a one-way peak total section capacity of 400 people per minute.

Provisions for the Handicapped - Existing Concept

The provisions made for handicapped facilities in the existing station concept for this station are very similar to those of Station Type V. The basic difference is that Station Type V is constructed as a cut-and-cover box structure whereas this station type is a mined single arch.

Both these station types provide one elevator from the street level to the mezzanine level, and another elevator located in the center of the mezzanine which provides service from the mezzanine to the platform level. Because the platform is centrally located, two elevators are required to provide service from the platform to street level.



- MINED SINGLE ARCH
- MEZZANINE WITHIN TRAINROOM AND ABOVE PLATFORM LEVEL
- CENTER PLATFORM

STATION TYPE VI- CROSS SECTION
FIGURE 6

Just as in Station Type V, this station concept provides only one elevator from the main street level entrance to the mezzanine, thus requiring the handicapped patrons to enter the station on only one side of the street.

Figure 6A illustrates the street, mezzanine and platform levels of the existing station concept.

Provisions for the Handicapped - Modified Concept

The modification to the station concept provides for a new elevator and a new street level elevator entrance structure to be located adjacent to the main street level entrance. The new elevator should be a vertical elevator which will provide service from the street level to the mezzanine. The proposed modifications to the street and mezzanine levels of this station are illustrated in Figures 6B and 6C.

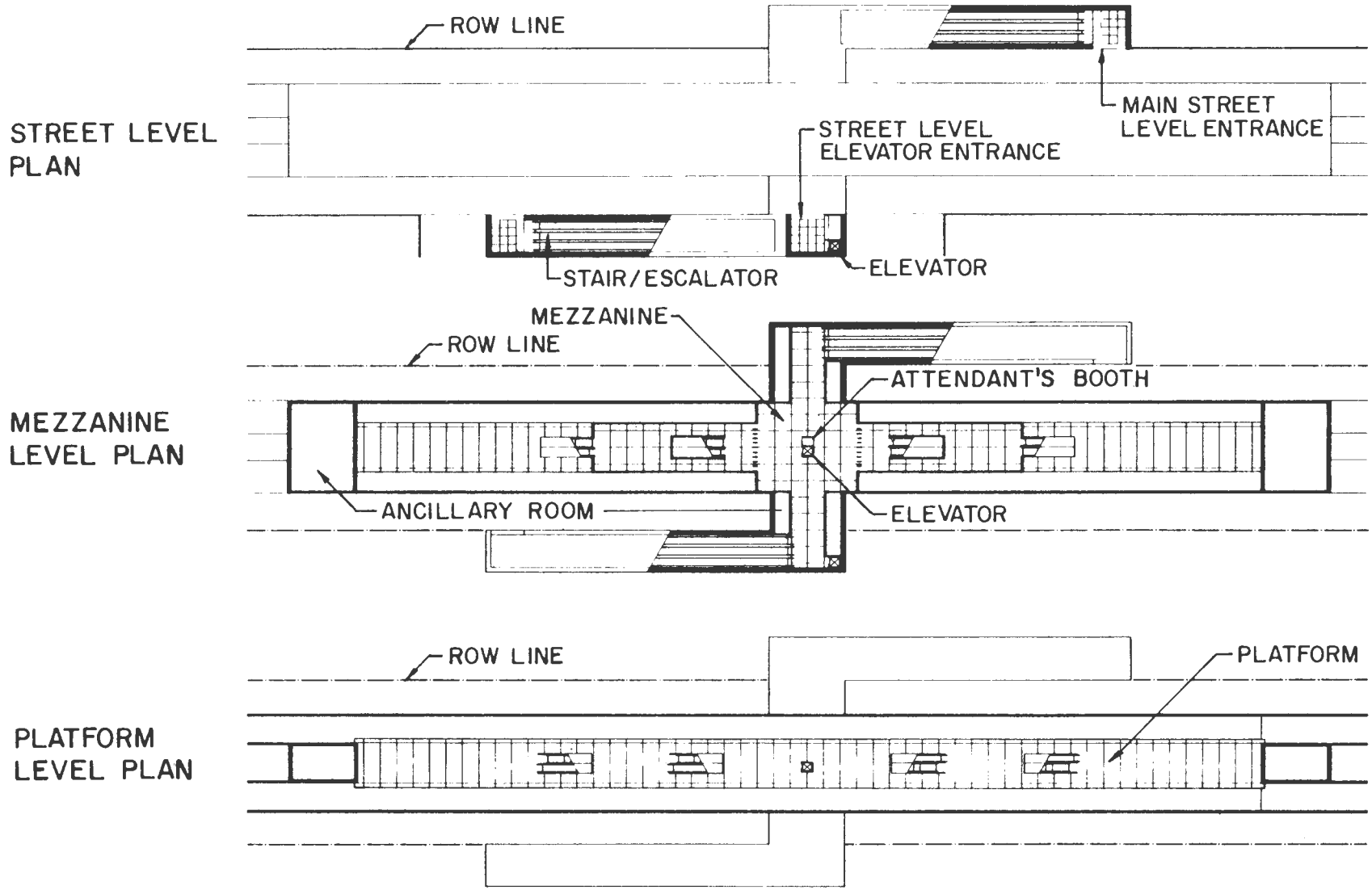
The use of the inclined elevator was considered as a modification to this station concept, but was not employed for two basic reasons:

1) The cost of the inclined elevator and associated hardware is double that of the vertical elevator for lengths running from 30 ft to 130 ft.

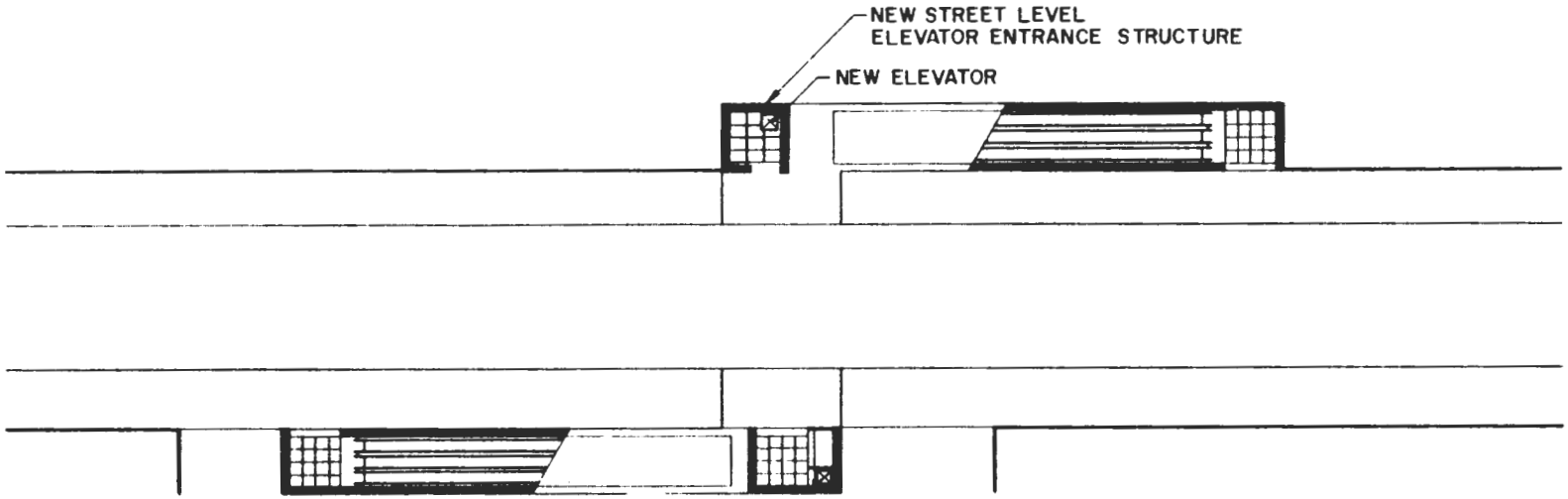
2) No additional excavation for the vertical elevator will be required because, in order to construct the stair/escalator and ancillary room structures at the mezzanine level, excavation will have had to be performed in the area which encompasses the location of the new vertical elevator.

Implementation of the prescribed modifications for this station concept affords the handicapped patron entry at the main street level entrance, and elevator service from the street level to the mezzanine. Because the platforms are centrally located, they must exit these elevators and enter the existing elevator located in the center of the mezzanine. This elevator provides service from the mezzanine to the platform level.

The additional costs attributable to this station modification are shown in Table 6.

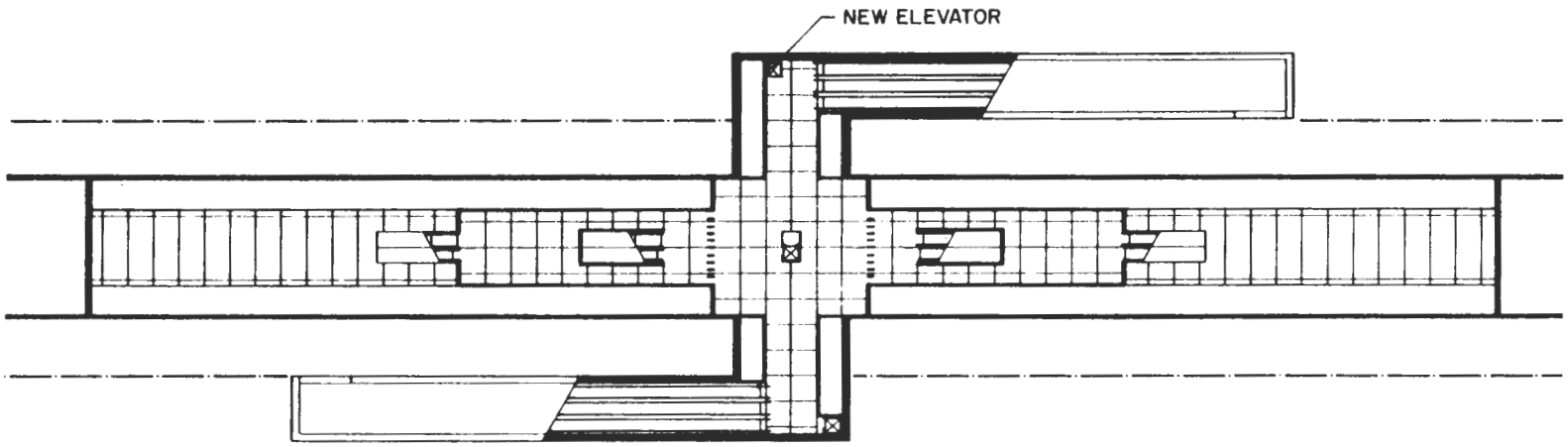


STATION TYPE VI - EXISTING CONCEPT
FIGURE 6A



STREET LEVEL PLAN

STATION TYPE VI-MODIFIED CONCEPT
FIGURE 6B



MEZZANINE LEVEL PLAN

STATION TYPE VI - MODIFIED CONCEPT
FIGURE 6C

TABLE 6

STATION TYPE VI - MODIFIED CONCEPT

COST ESTIMATE

EXPENDITURES:

New Elevator (1) - 2500 lb capacity includes rails, cab, pit, doors, hydraulic, 2-stops, ±35 ft vertical length, installed	$29,500
Electrical service, panels, conduits, wires, switches, etc.	10,000
New Street Level Elevator Entrance	18,000
New Right-of-Way Acquisition	3,200
	$60,700

TOTAL ADDITIONAL COST FOR MODIFICATION $60,700

Chapter 8

STATION TYPE VII

Description

The last of the station types, Station Type VII, is a mined twin-tube construction in which the mezzanine is separate from the trainroom and above platform level. Its central platforms, which are illustrated in Figure 7, are accessible through a concourse located near platform level. It illustrates the potential economies of small, separate trainrooms which reduce the volume of mined excavation and of a separate mezzanine that is excavated using less expensive cut-and-cover methods.

The station mezzanines act as a transition between the street and station alignment. They are about half the size of the other mined station mezzanines and are excavated using cut-and-cover methods. This lowers expenses by reducing the volume and unit cost of excavation.

This station has two mezzanines, and thus requires double manning and increases operational costs. This adverse characteristic is balanced somewhat by the greater service area provided by the two mezzanines.

The platform level consists of two trainroom tubes and a central concourse area or tube. The station platforms are twelve feet wide. Passengers are distributed to the concourse from the mezzanine. Access between the concourse and platforms is provided at the quarter points of the platforms, thus providing even distribution to the platform and improved circulation on the platform.

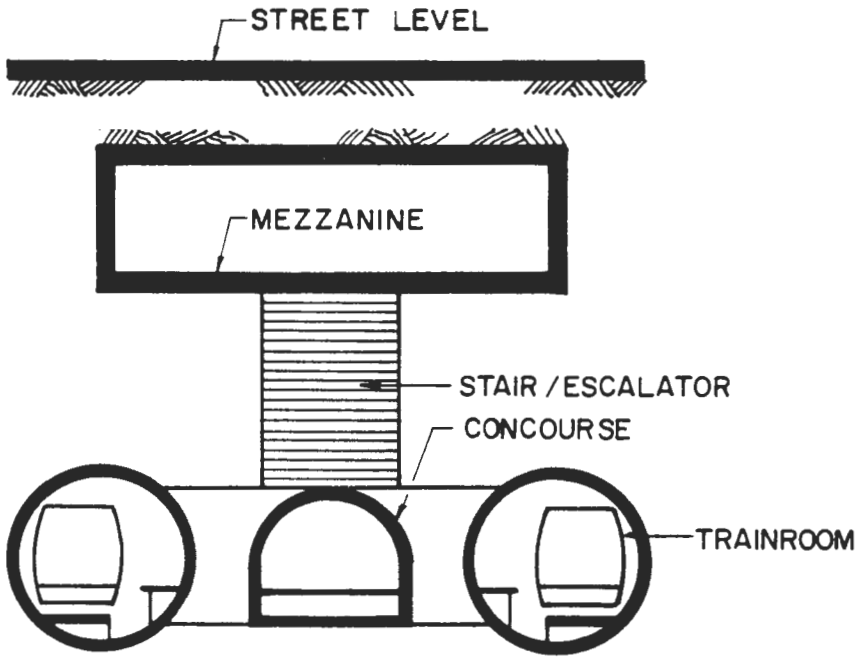
The platform level ancillary space is located at the ends of the station under the stair/escalator units. Excavation beyond the ends of the platform is not required to provide sufficient ancillary space.

Vertical circulation is similar to that of Station Type VI. The major circulation elements connect the mezzanine and the concourse, and each consists of three escalators and an inclined elevator. These elements far exceed the cut-and-cover stair/escalator units in length and have correspondingly higher capital and operating costs.

The station capacity, governed by the vertical circulation element capacity between the mezzanine and the concourse, is 400 people per minute.

Provisions for the Handicapped - Existing Concept

The existing concept for this station type provides two elevators at each street level entrance. The first elevator is a vertical elevator which provides service from the street level entrance to the mezzanine level. Upon entry at the mezzanine level, the handicapped patron exits the first elevator, passes through a



- MINED TWIN TUBES
- MEZZANINE SEPARATE FROM TRAINROOM AND ABOVE PLATFORM LEVEL
- CENTER PLATFORM AND CONCOURSE

STATION TYPE VII - CROSS SECTION

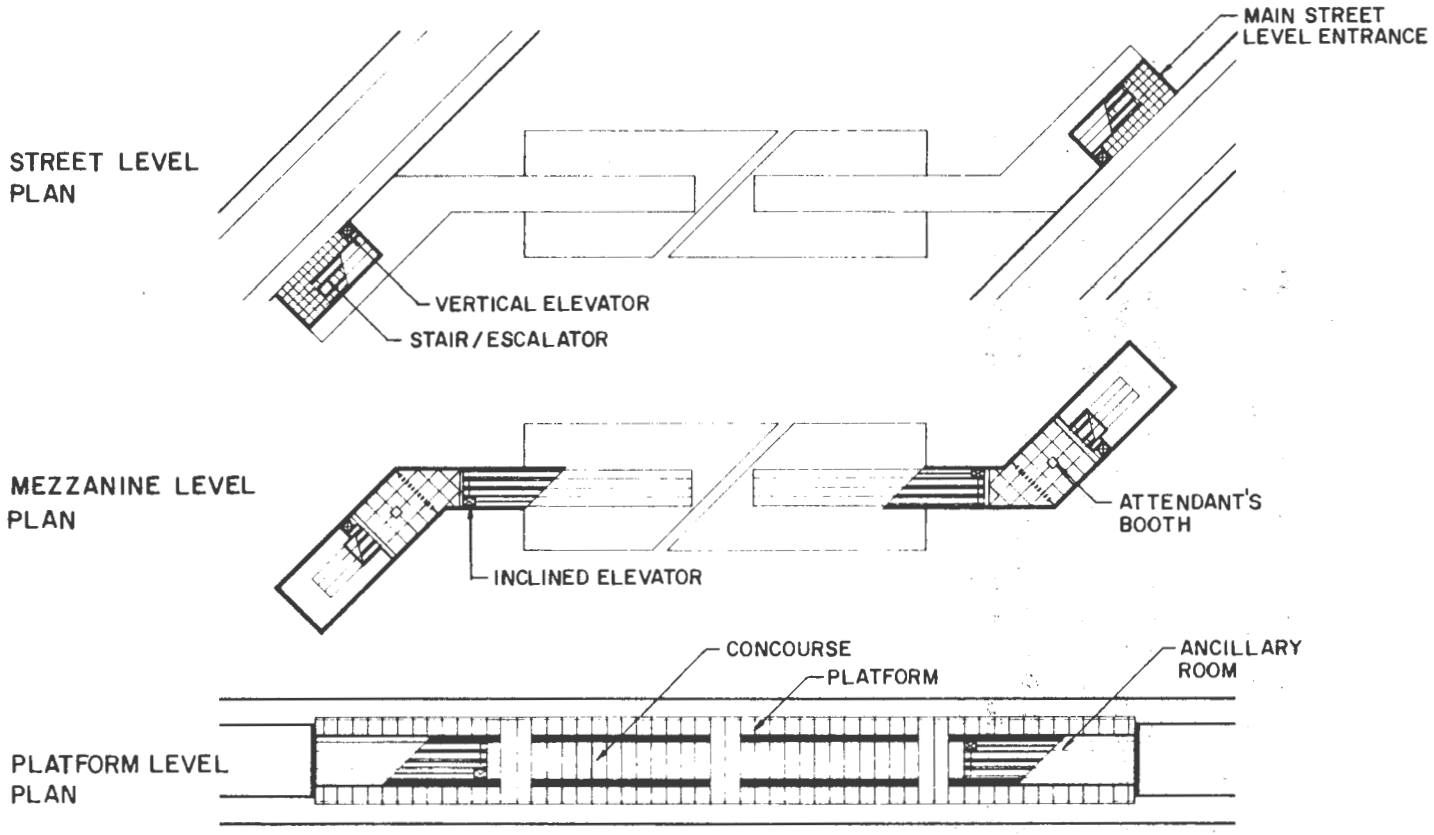
FIGURE 7

gate at the turnstiles, and enters a second, inclined elevator. This inclined elevator transports him from the mezzanine level to the platform level. Figure 7A illustrates this type of station at the street, mezzanine, and platform levels.

The use of the inclined elevator eliminates costly passageway mining which would have been required had a vertical elevator been provided.

Justification for the use of the inclined elevator is based on the assumption that codes and standards will have been developed by the time this station type reaches the design phase.

This is the only station of the seven types for which no modification is prescribed.



STATION TYPE VII. - EXISTING CONCEPT

FIGURE 7A

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