History of Median Development in Illinois

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Designs for medians of divided highways have gone through an extended period of development involving the trial installation of many different median widths and cross-sections. Myriad design variations have been created on the basis of administrative decisions supported by individual engineering judgment and the qualitative analysis of gradually accumulating needed data on the traffic safety and service benefits from medians. Some knowledge of these activities and the thoughts accompanying them is essential to a proper understanding of current median design philosophy. This history is a summary of such thought and activity, from 1930 to the present, in Illinois. Although the discussion is primarily concerned with reasons for the adoption or elimination of specific median design features in Illinois, other states have probably had much the same history.

After years of experimenting with different widths of medians for rural highways it was decided that a 40-ft width was the desirable minimum. Where possible, medians wider than this minimum are now used because of the decrease in headlight glare, reduction in cross-median accidents, and frequent economical improvement in roadway alignment. It is often desirable from the traffic and cost standpoints to construct such wide medians even in built-up city areas. However, in most cases of constructing a highway with full control of access in urban areas, it is considered necessary to use a narrower median and consider the installation of a suitable median barrier.

For routes with no control of access in cities, the cost of right-of-way normally limits the design to the narrow median types or, in some cases, to no median at all. It is currently believed that an easily mounted or flush-type narrow median (less than 6 ft wide) should not be used where there is need for numerous left-turn movements. Such movements should be limited to intersections or provided for by the construction of adequate left-turn lanes in the median.

[Editor's Note: The original manuscript of this paper was accompanied by an illustrated inventory of 422 medians constructed in Illinois and a detailed inventory, in tabular form, of dimensions, surfacing, location, design, construction dates, etc. Space limitations and cost of publication prohibit their inclusion herein; however, the Board will provide this material at cost of reproduction upon request—Supplement XS-6 (Highway Research Record 105).]

Paper sponsored by Committee on Operational Effects of Geometrics.

•THE history of median development in Illinois was compiled as part of a study aimed at the determination of desirable widths and cross-sections for medians of divided highways. Aside from whatever purely historical value it may have, this report is intended to provide a summary of the thoughts involved in the development of what are currently believed to be acceptable median designs for the various sets of conditions that have been encountered throughout the state. It presents some indication of the extent to which various types of medians are believed to have provided the intended traffic safety and service benefits, but deals primarily with the reasons behind the adoption or elimination of specific median design features.

An inventory of median dimensions, surfacing, location, design and construction dates, and other pertinent data was completed. It was prepared in tabular form to serve as a reference guide to designers and researchers in analyzing apparently successful designs to determine what harmonious combinations of factors are responsible for success in providing the desired traffic safety and service benefits. It was felt that use of such an inventory would decrease any tendency toward unnecessary repetition of the process of evolution of these designs at different times in other areas as a result of the subsequent development of the same design conditions. The work toward improvement of currently accepted median designs could thus be directed more in the light of past efforts than along the path of past efforts. [This detailed inventory is not included herein.]

The inventory contains information pertaining to 422 medians. The information was verified by the ten district offices of the Illinois Division of Highways to insure accuracy of the basic data. Although the combined experience of engineers throughout Illinois is reflected in the discussion of these medians, a majority of the information regarding median development stems from the 45 years of experience accumulated by Hugo E. Surman, retired Engineer of Design and former member of the American Association of State Highway Officials Committee on Planning and Design Policies.

All medians have been classified according to design intent as nondeterring, deterring or nontraversable. The criteria for such classifications are somewhat arbitrary because they are based on current opinions of designers concerning the effects of the various median cross-sections on the propensity of drivers to make intentional turns across the median. Having been derived from personal observation and judgment, these criteria can serve only as a general guide in median design.

Nontraversable—A median designed to prevent intentional crossing.

a. Slopes steeper than or equal to 1 vertical in 1 horizontal with a 3-ft minimum vertical dimension.
b. Continuous barrier (cables, guardrail, etc.).
c. Double ditch with slopes steeper than or equal to 1 vertical in 5 horizontal (5:1) and depths greater than or equal to 3 ft.
d. Medians with continuous heavy planting.
e. Curbs:
   (1) Straight-faced, vertical curbs with heights greater than or equal to 6 in.
   (2) Rolled curbs with heights greater than 9 in.
   (3) Rolled curbs with heights greater than or equal to 6 in. for median widths less than or equal to 5 ft.

Deterring—A median designed to discourage intentional crossing.

a. Width greater than or equal to 50 ft.
b. Crown greater than or equal to 1 ft in 30 ft of median width; greater than or equal to 6 in. in 3 ft of median width.
c. Slopes steeper than or equal to 1 vertical in 5 horizontal (5:1).

d. Curbs:
   (1) Straight-faced, vertical curbs with heights greater than 4 in. and less than 6 in.
   (2) Rolled curbs with heights greater than 4 in. and less than or equal to 9 in. for median widths greater than 5 ft.
   (3) Rolled curbs with heights greater than 4 in. and less than 6 in. for median widths less than or equal to 5 ft.

e. Turf surface.

Nondeterring—A median intended to be easily crossed. It is nondeterring if it fails to meet all of the above criteria.

Photographs and typical cross-sections representing 24 different groups of medians having the same general characteristics are included in an Appendix to provide the reader with a clear impression of the design features of the 422 medians contained in the inventory. These illustrations are cross-referenced to the original inventory.

HISTORY OF MEDIAN DEVELOPMENT IN ILLINOIS

The state's two bond issue systems of highways[1] were constructed during the 1920's and early 1930's. The amount of traffic and the number of registered cars and trucks during that period were only a fraction of present-day figures. Legal traffic speeds were very much lower; first 30, then 45 mph. There was little necessity for either the channelization of intersections or the design and construction of medians except in the Chicago metropolitan area. Such designs often could not be effectively used even in Chicago because of inadequate widths of right-of-way. Several hundred miles of 40-ft pavements were squeezed into existing right-of-way. This was the result of a State policy to require only a 60-ft width of right-of-way and its willingness to accept existing right-of-way widths whenever it was possible to construct the pavement within the limits. In most cases this meant accepting substandard features such as narrow shoulders and bridges, very shallow ditches, entrance culverts too close to the pavement, and, in some cases, only a 16-ft pavement. The construction of the second bond issue system of highways was well along before the State changed its policy to require wider right-of-way. The first bond issue act did not permit the construction of highways within cities of more than 2,500 population except in Cook County where the limit was 20,000 population. All of the pavements built under the two bond issue acts were of 2 lanes with the exception of the 40-ft pavements built in the Chicago metropolitan area and a very limited mileage of 9-ft, 1-lane pavements specified in the Second State Bond Issue Act. The construction of 1-lane pavements was prompted by the thought that it would be better to have half a road all the way than a whole road half the way.

By the early 1930's all of the $160 million provided by the two bond issue acts had been invested in highways and the two systems were practically completed. This was with the help of Federal-aid funds. The State then operated on a pay-as-you-go plan which provided an annual construction program, varying from $20 to 30 million of state and Federal-aid funds for the construction of additional roads not included in the bond issue acts.

It was against this historical background that the Illinois Division of Highways started to give consideration to the design and construction of medians in highways. The earliest designs were planned in the 1930's and these were greatly influenced by inadequate widths of right-of-way. Because of limited funds available for the construction of highways, the officials of the Division of Highways did not feel justified in expending large amounts of money for additional right-of-way. It is not the intention to be critical of that policy, but it is unfortunate that it was the cause of limiting many median

[1] Routes 1 through 46 were provided for in the Durable Hard Roads Act, June 22, 1917 ($60,000,000); Routes 47 through 185, plus unfinished segments of Routes 1 through 46, were provided for in the Second State Bond Issue Act, June 29, 1923 ($100,000,000). See Illinois Revised Statutes, Chap. 121, Sec. 266-281.

designs of a later date when right-of-way costs had skyrocketed because of adjacent property developments. There were exceptions such as US 66 where sufficient right-of-way was secured in the early 1940's to permit a 40-ft median width to be used on many miles of this route. However, this policy did apply to other sections of US 66 where narrower medians were used with the knowledge that they were not considered desirable. The lack of sufficient legal tools in acquiring right-of-way was a major influence in many of the median designs. This situation was not improved until the State Supreme Court upheld the legality of the Freeway Act in 1953 and the Quick-Taking Act in 1957.

When the Illinois Division of Highways first gave consideration to the design of highway medians, there was practically no information on this subject. It was, therefore, necessary for the State to start on its own. The ten different districts were given a free hand to develop designs with only nominal supervision from the main office. Most of the early designs were limited to the narrow median types because they were constructed on improved streets and highways under the restrictions imposed by the policy regarding right-of-way.

Many of the principles employed in these early designs were sound. Others were changed considerably as the gradually increasing mileage of highways and streets with medians offered an opportunity to observe the traffic operation benefits and maintenance requirements of medians. Experience indicates that the chief advantages of medians are to separate opposing traffic lanes, to provide an intervening area to give cars that inadvertently get onto the median a chance to recover, to reduce headlight glare, to discourage U-turns except at designated locations, and to provide space for median lanes, temporary parking of disabled vehicles, storage of snow, and location of signs and other necessary highway facilities.

The following comments in regard to individual median designs in Illinois are limited primarily to those designed or approved by the Illinois Division of Highways during the time that Mr. Surman was connected with the Bureau of Design in that Division, from 1921 to 1955. The typical designs will be referred to by cross-section number (Appendix) and the design number from Table 1 of the original inventory is also given. In many instances, reference design numbers are given in tabulated notes to the typical cross-sections.

Cross-section 13 (number 2 in Table 1 of the inventory) is the famous reversible lane design prepared by the city of Chicago. It has several 8-in. steel median curbs that can be raised or lowered to provide extra one-way traffic lanes during rush-hour traffic. In general, the design has been successful, but there has been some difficulty during brief periods when snow and ice conditions have caused malfunctioning of the device for raising and lowering the steel curbs.

Cross-section 9 (number 3) is in a densely built-up area of East St. Louis where additional right-of-way for a wider median would have been expensive. Number 4 is at a relocation site with deep cuts and fills. The 2-ft median width was used because of the lack of side entrances requiring left-turn lanes in the median.

Cross-section 7 (number 17) was an experimental design consisting of bituminous ribs placed 12.5 ft apart across a 4-ft median to warn traffic of being in an off-limit area. This type was discontinued in favor of corrugated portland cement concrete designs that proved to be more durable.

Cross-section 6 (number 18) is on a bypass which is partly in the city of Barrington where right-of-way is restricted. Traffic can cross the median for the purpose of entering the property on the opposite side. This was not too serious when the median was designed in the early 1950's, but since that time traffic volumes have increased to the point where random turns across the median are often quite hazardous even though traffic speeds are limited.

Cross-section 2 (numbers 21 and 22) are medians at the outer limits of the city of Chicago on built-up streets. The corrugated 4-ft concrete median has the same purpose as indicated for cross-section 6 (number 18). This type of median is becoming popular for city streets where right-of-way is limited and where traffic is permitted to cross the median at any point between intersections. Narrow raised medians (such as cross-section 2, numbers 38-40 in the inventory) are also easily fitted into existing right-of-way, but the corrugated medians give a better warning to encroaching traffic.

Numbers 51, 82 and 95 from Table 1 of the inventory (see cross-sections 2 and 6) are corrugated 4-ft medians on built-up streets with restricted right-of-way. Although varying in detail they give an excellent warning to encroaching traffic.

Flush and slightly raised medians less than 6 ft in width have been used extensively on built-up city streets in commercial areas with low traffic speeds. However, with traffic increases far above the expected volumes, the need to prevent random crossing of these narrow medians in midblock areas has become increasingly apparent. The advantage of having access to commercial establishments across the median is greatly diminished when the traffic volume exceeds about 900 veh/hr on 4-lane facilities. Turns across the median become extremely hazardous, if not impossible, and traffic flow is greatly impeded by slow-moving or stopped vehicles preparing to turn from the left traffic lane.

The design date of cross-section 1 was 1941 (1, pp. 7-19 and 7-20; 2, pp. 334-336). The rounded cross-section was intended to lessen the shock to encroaching vehicles and to reduce the chances of overturning. This precast version of the rounded narrow median was not built elsewhere in Illinois but the basic principle is reflected in more recent designs (see cross-section 2, references to numbers 96 and 145). The rounded cross-section also allows rain to help remove the sand and cinders that accumulate on narrow corrugated medians when abrasives are used for snow and ice control.

Cross-section 9 (number 101) and cross-section 11 (number 208) were designed to eliminate U-turn and crossing maneuvers except at intersections. Experience seems to indicate that both designs are effective in deterring such maneuvers, although only cross-section 11 (number 101) has the combination of width and curb height deemed necessary to prevent intentional crossing. Advances in the design of vehicles for greater stability have reduced the clearance between the road surface and the lowest extremity of the frame or body for most modern passenger cars[2]. As a result, many vehicles on the road today would become trapped in straddling a narrow median with a vertical dimension greater than or equal to 6 in. (cross-section 9, number 101). Further progress in lowering the center of gravity of passenger cars may soon reduce the average road clearance to about 4 in., thereby reducing the minimum height of curb required to discourage or prevent intentional U-turn and crossing maneuvers.

Number 110 of cross-section 9 is the same basic design as number 101. It was considered to be the best type of median for this location because there is little need for turning movements and the right-of-way width is restricted by a railroad on the east side and a bluff on the west side.

Cross-section 7 (number 98), cross-section 9 (number 105) and cross-section 10 (number 122) are also nontraversable-type medians. Numbers 98 and 122 are on built-up streets with restricted right-of-way and number 105 is near a signalized major intersection with a built-up service area where indiscriminate turns across the fast-moving opposing traffic streams would be extremely hazardous.

The variable median width for number 133 (see cross-section 9) was dictated partly by the right-of-way restrictions imposed by the location of the road between a railroad and the Illinois River bluff and partly by the conditions existing on the portion of this route which serves as a built-up street in the town of Peoria Heights.

Number 143 (cross-section 7) is on Lake Shore Drive in Chicago. The 6-ft width was used to permit more protection for traffic signals and to afford greater safety for pedestrians who find it necessary to stop at the median in crossing the wide street. Such a design also provides some space for emergency and maintenance activities.

The high curbs and crown on number 152 (cross-section 10) were intended to discourage intentional turns across the median. This median is on a street with a railroad abutting on the south side and thus has only a few side entrances.

Some examples of medians that are the widest that could be used within the right-of-way width secured several years in advance are numbers 153 and 154 (see cross-section 11); 158 and 159 (cross-section 5); and 171, 172, 183, 184, 195-198 and 201 (cross-section 11). Pavement resurfacing has practically covered the curbs at some of these locations (see number 183, left-hand photograph, cross-section 11).

[2]For example, road clearance is 6 in. for 1963 Oldsmobile F85 and Buick Special, 5-3/4 in. for 1963 Chevy II and 4 in. for 1963 Corvair.

The lack of visibility of curbs under certain conditions is one of the objections to placing them adjacent to the pavement edge. If the curb on the median cannot be readily seen during low-visibility conditions, it is a hazard to traffic. Delineation of the left extremity of the authorized path of vehicle travel is one of the primary functions of medians in achieving proper separation of opposing traffic streams (3, p. 1). Some field experiments (carried out on only channelization medians at intersections) with reflective paints have seemed to indicate that a solid yellow line on the top or face of rolled curbs is not as effective as a yellow dashed line (8-ft yellow dashes, 16 ft apart). There have also been some attempts at providing better visibility by use of construction materials of contrasting colors. This appears to provide somewhat better delineation of the curbed median except in cases where a median of approximately the width of a traffic lane is surfaced with the same material as that used on the adjacent traffic lanes, making it appear to some drivers as an additional lane (see numbers 174 and 175, right-hand photograph, cross-section 11).

Number 154 (cross-section 11), north of Chicago on US 41, was the first median constructed in District 1. This raised, curbed median has subsequently been replaced with a depressed median to eliminate the hazard created by melted snow that would run onto the pavement from the raised median and freeze.

The 36- to 52-ft widths of median for numbers 202-204, 206 and 207 (cross-section 7) were chosen by the Chicago Park District with the thought that the median could be narrowed in the future, if necessary, for the purpose of providing additional traffic lanes.

Number 217 (see cross-section 11) is mostly in cut. The variable width median with curbs seemed to be the most practical and economical to provide reasonable safety. There are no side entrances.

The nondeterring 4-ft concrete median on Ill. 23 north of DeKalb (cross-section 6, number 14) was used to permit traffic to cross at the numerous roadside entrances. The 4-lane pavement at this location replaced 1 mi of 9-ft concrete pavement built in the early years of this century. This 1-lane pavement was the first concrete pavement built on a country road in Illinois.

Number 227 (cross-section 14) is a 4-ft flush median surfaced with bituminous concrete. It divides the 2-lane pavement of US 66 on the east side of the city of Springfield and was intended to be temporary. Two more lanes were to be added, at which time the asphalt was to be removed and a raised median constructed. This has not been done. However, a new bypass, I-55, is being built for US 66 traffic at Springfield.

Numbers 221 to 225 (cross-section 14) are 4-ft flush concrete medians that were used because of the large number of turning movements on the built-up streets involved. In the meantime, traffic volumes have increased to the point where attempted turns across the median cause unwarranted congestion during rush hours.

The Chicago mesh-type median (cross-section 7, number 1) was one of the more recent experiments with low-cost traversable type medians for use in urban areas on built-up streets. However, due to the extremely thin concrete sections, mesh-type medians were lacking in durability. The remaining sections of this type of median are scheduled for removal in the near future.

Number 228 (cross-section 14) is a 6-ft flush median on a road located along the bottom of a high bluff adjacent to the Mississippi River. It was considered temporary until the balance of the road is constructed into Grafton, at which time it is to be changed to a nontraversable type because of the few locations where cross-median turning movements are demanded.

The slightly raised 20-ft medians (cross-section 6, numbers 186-188) were some of the earliest to be considered flush-type designs. One thing in their favor was low construction cost. Because of the increased traffic at these locations, safety considerations could lead to depressing and paving the median areas and/or adding continuous median barriers at some time in the future.

The concrete V-gutter adjacent to the edge of the pavement on Calumet Expressway (cross-section 15, number 265) reduces maintenance costs because it prevents erosion of the earth shoulders and side slopes. The use of gutters for this purpose on the inside edge of superelevated pavement on horizontal curves is also common practice in rural areas (see photographs, cross-section 22). Paved or stabilized shoulders greatly reduce the need for such gutters in rural areas where erosion control vegetation can be readily established. However, the heavy applications (about 2.6 lb of deicing chemicals per square foot of expressway surface area during an average winter) of deicing salts for winter maintenance in the Chicago area prevent luxurious growth of erosion control vegetation on the side slopes of medians. Gutters at the outside edge of a stabilized median shoulder would be less of a hazard to traffic and would carry away much of the salt-laden surface runoff from Chicago expressways, although the cost of providing the gutters and mowing the grass in the center of the median may be, in the case of medians less than 30-ft wide, greater than the cost of paving or stabilizing the entire median area. The median on Edens Expressway has recently been paved as shown in Figure 1.

Number 231 (cross-section 16) was a design for a roadway relocation where the abutting property was improved and the cost of a wider median would have been excessive. Traffic speeds are restricted in this area. Numbers 232 and 233 (cross-section 15) could have been wider medians without excessive cost.

The 30-ft median (numbers 237-239, 249 and 261; see cross-sections 15, 16 and 18) was built on an appreciable mileage of highways in Illinois during the process of gradual recognition of the traffic safety and service benefits of wider medians. It is somewhat narrow for a 3-ft depth of ditch. However, it offers a deterrent to illegal U-turns and, except for obstacles such as culvert headwalls and steep side slopes on crossover embankments, it provides some chance for recovery of vehicles getting onto the median. The increased width of shoulder (10 ft) on some mileage with this type of median (see cross-section 15, number 253) is a very desirable feature.

Numbers 265-353 (see cross-sections 15, 16, 22 and 24) are all 40-ft wide with minor variations in type and width of shoulders and depth and shape of ditch. Although some of the designs were completed after 1955, the width of median for most of these projects was decided years earlier when right-of-way was being secured. After years of experimenting with different widths of medians for rural highways, it was decided that a 40-ft width was the desirable minimum to achieve the majority of benefits obtainable.

The 44-ft width was chosen for numbers 360 and 361 (see cross-section 15) because of the wider inside shoulders (10 ft) used on this portion of US 66. The shallow ditch was used for number 266 (cross-section 15) because rock was encountered at the base of the pavement.

Numbers 366-368 (see cross-section 16) represent the beginning of the use of medians wider than the desirable minimum to lessen headlight glare and to help decrease the chance of cars getting into opposing traffic lanes. The use of a 50-ft median

Figure 1. Edens Expressway at Dundee Road.

also allowed economical improvement of the alignment on portions of numbers 382 and 383 (cross-section 16).

The 64-ft medians (numbers 385-388 of cross-section 23) and 80-ft medians (numbers 405-421 of cross-section 23) with a double ditch were used in an attempt to keep cars out of opposing traffic lanes when the drivers inadvertently run into the median area. They have proven to be effective in this regard. Interim results from a current investigation of all inadvertent vehicle encroachments on more than 20 mi of I-57 (numbers 405-421) show that less than 2 percent of the encroaching vehicles crossed the median, whereas slightly more than 15 percent were found to have crossed the 40-ft medians on US 66 and I-74 (4, p. 46). In the case of number 385, the soil from the ridge between the two median ditches was later used as the subgrade for additional through traffic lanes constructed in the median, thus eliminating the need to bring in borrow soil across the existing pavements.

Some of the principal factors governing current thinking in median design are type of highway or street (i.e., whether there is full, partial, or no control of access), amount of traffic and its permissible speed, built-up street or open country, cost, and available funds.

If the highway has full control of access, such as on the Interstate System, the tendency is toward wider medians for rural highways. Here the thoughts concerning details of median design more often include a stabilized shoulder not less than 10-ft wide, 4 to 1 or flatter side slopes, and no obstructions such as culvert headwalls, drainage inlets, steep side slopes on crossover embankments and ditch checks, etc. It is, of course, deemed necessary to permit certain signs for the guidance of traffic to be placed within the side slope areas and, in the case of median widths greater than about 75 ft, trees are permitted among the shrubs and ground cover plantings that are often employed in narrower medians. Grade separation structure supports are also placed in the median area and are protected from collision by the construction of a suitable guard fence. Even where such highways traverse built-up city areas it is often deemed feasible from the traffic and cost standpoints to construct a wide median. In some cases, such as in the Chicago Congress Street project (Dwight D. Eisenhower Expressway), it was desirable to design a wide enough median to permit the construction of a rapid-transit railroad between the dual pavements. However, in cases of constructing a highway with full control of access within the built-up areas of cities, it is considered necessary from the cost standpoint to use a narrow median except in those cases where total acquisition between two existing streets is to be accomplished. Here median widths can be determined on the basis of the then existing right-of-way. A narrow median, if necessary, is probably not too objectionable when traffic speeds are restricted and left-turns across the median are prevented. The installation of a suitable median barrier should be considered in such cases and any curbs or gutters should be placed at the outside edges of the shoulders (5, p. 27).

In cases where dual pavements are built with only partial control of access, additional design features, such as median lanes and traffic signs and signals are introduced within the median area. The details of current designs for median lanes are in accordance with those outlined by the Committee on Planning and Design Policies of the American Association of State Highway Officials. Grade separations are provided for the more heavily traveled intersecting highways. Other rural intersections and intermediate crossovers are often reduced in number by the construction of frontage roads. Those that remain are treated on the basis of their traffic importance and in accordance with AASHO design policies regarding median lanes and at-grade intersections.

For routes with partial control of access in cities, the cost of acquiring additional right-of-way normally limits the design to the narrow median types. Medians are usually of the nontraversable type with the minor intersections limited to right-turn movements only. Those intersections having heavy cross traffic are generally provided with median lanes for left-turn traffic and controlled by 3-cycle traffic signals. It is considered desirable that such medians have a minimum width of 6-ft to protect pedestrians as well as traffic signs and signals. Another type of median used for city streets where right-of-way is restricted is the narrow corrugated type. It is usually employed where there is a minimum volume of left-turn movements. Adjacent to intersecting streets the median is more often of the deterring or nontraversable type not less than 6-ft wide. It is currently believed that an easily mounted or flush-type narrow median (less than 6-ft wide) should not be used where there is need for numerous left-turn movements. Such movements should be limited to intersections or provided for by the construction of adequate left-turn lanes in the median.

Accident records and traffic capacity analyses clearly indicate that 4-lane pavements should not be built on rural highways without some control of access, and that all should be designed with opposing lanes separated by a median area (6, p. 135; 2, p. 90). Complete control of access gives maximum benefit to traffic, and no control gives the most benefit to commercial developers and the least to traffic.

During the past several years many cities have adopted one-way streets. These generally do not require medians; however, in many cases traffic is channelized at intersections by placing narrow medians or some other type of divider to mark the lanes for turning movements.

The inclusion of medians as a part of both rural and urban multilane pavements has undoubtedly saved many lives even though no design has yet been devised which will prevent a driver from inadvertently getting into a median area. Current studies of vehicle encroachments on the medians of urban expressways and rural freeways in Illinois indicate that the numbers of vehicles inadvertently getting into the median are from 4 to 14 per year per mile of divided highway (4). This definitely places a limitation on those designs conceived with the thought that medians need not serve as a safe vehicle stopping or recovery area. It is true that alertness and attention to road conditions, as well as to other drivers, every minute of the time, is the best way to avoid accidents, but maximum consideration of "what drivers will do" instead of "what drivers ought to do" is the best way to design medians.

ACKNOWLEDGMENTS

This study was conducted as a part of the Illinois Cooperative Highway Research Program, Project IHR-59, "Widths and Cross Sections for Medians of Divided Highways," by the staff of the Department of Civil Engineering, in the Engineering Experiment Station, University of Illinois, under the joint sponsorship of the Illinois Division of Highways and the U.S. Bureau of Public Roads.

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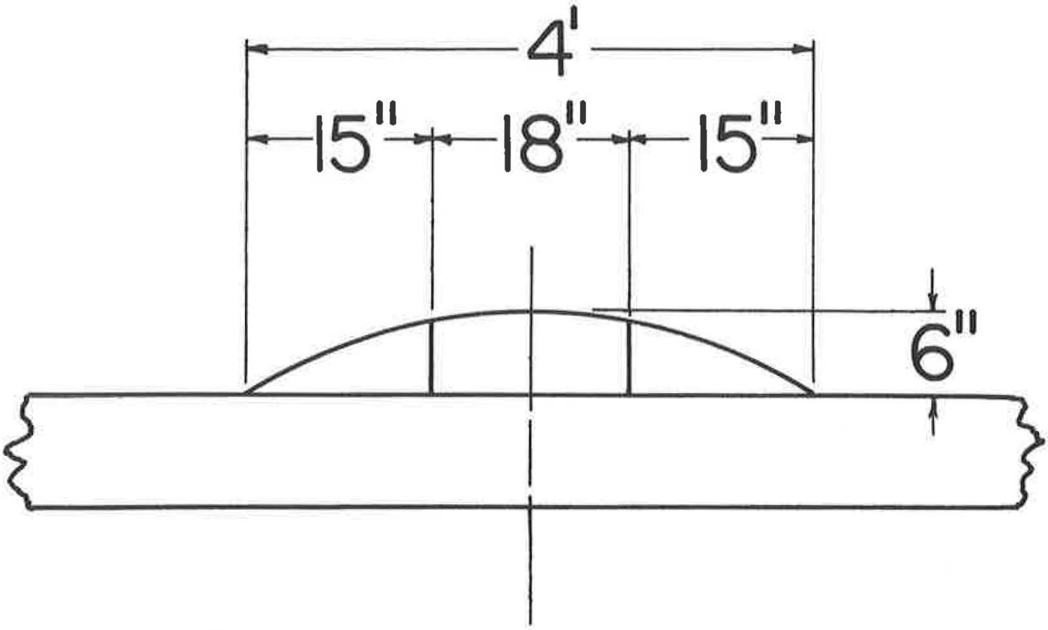
Appendix



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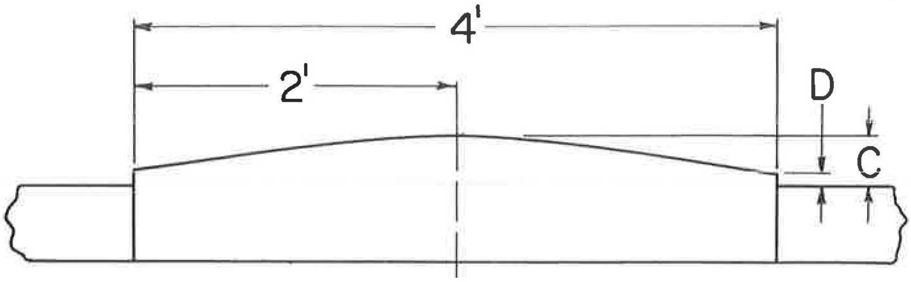

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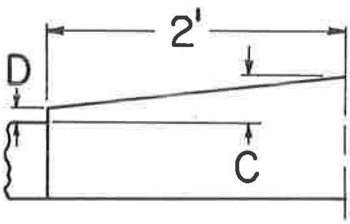

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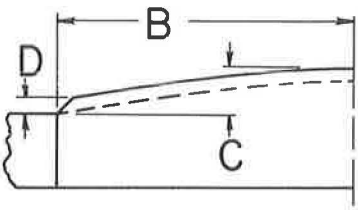

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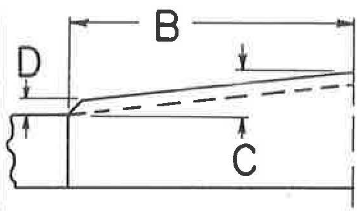


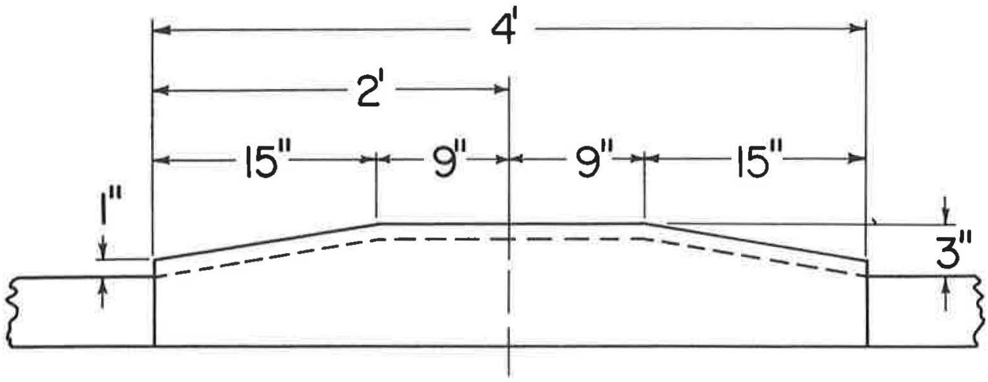
(VAR. D)

VAR. A

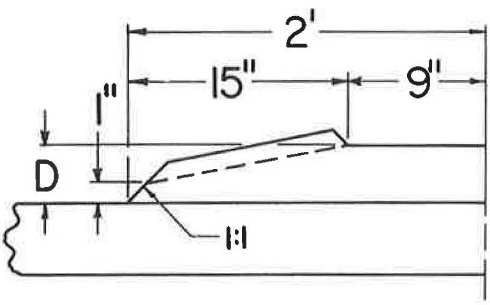
VAR. B

VAR. C

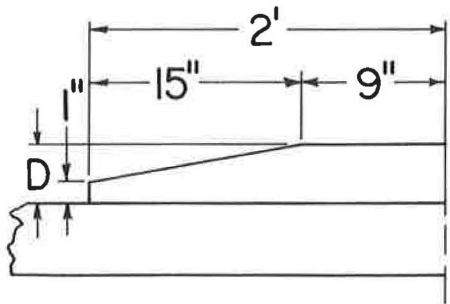
VAR.	B	C	D	MISC.	Ref. No.
Aa		1-3/4"	3/4"	Circular Arc	24
Ab		2"	3/4"	Circular Arc	51
Ba		2"	1"	Straight Crown	38-40
Bb		2¼"	1¼"	Straight Crown	82
Ca	2'	1-3/4"	3/4"	Circular Arc Corrugated	25,26
Cb	2'	2"	1"	Circular Arc Corrugated	41
Cc	2'	2"	1¼"	Circular Arc Corrugated	43-45
Cd	2'	2¼"	1¼"	Circular Arc Corrugated	52-78
Ce	2'	2-3/4"	1-3/4"	Circular Arc Corrugated	83,84
Cf	2'	3"	2"	Circular Arc Corrugated	94
Cg	3' &Var.	6"	6"	Circular Arc Corrugated	145
Da	2'	1½"	½"	Straight Crown	19-23
Db	2'	2"	1"	Straight Crown	42
Dc	2'	2¼"	1¼"	Straight Crown	79-81
Dd	2'	4"	1"	Straight Crown	96
De	2' &Var.	2¼"	1¼"	Straight Crown	131



CROSS-SECTION 3 (VAR. A)



(VAR. B)



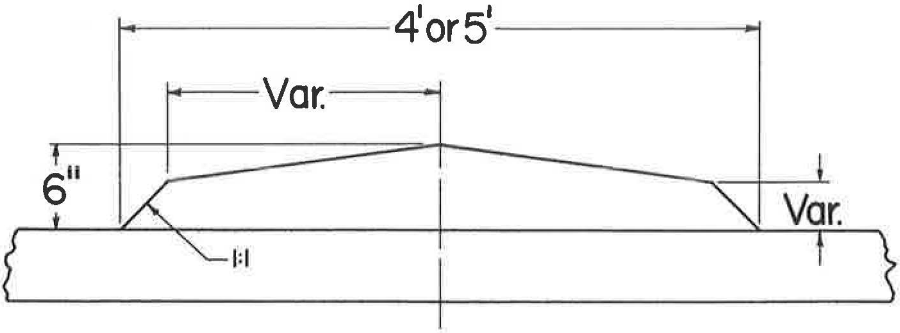
(VAR. C)

VAR. A

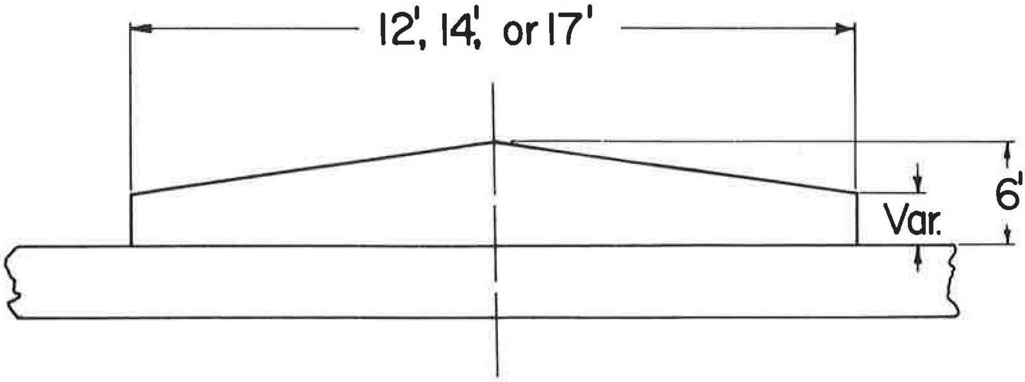
VAR. B

VAR. C

VAR.	MISC.	REFERENCE TABLE I
A	Corrugated (depressed)	87,89-92
B	Corrugated (raised)	93
C	Corrugated (raised)	88

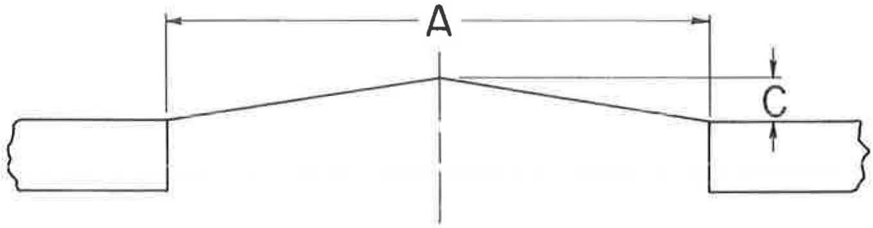


CROSS SECTION 4
(Reference Nos. 124, 125, 141)

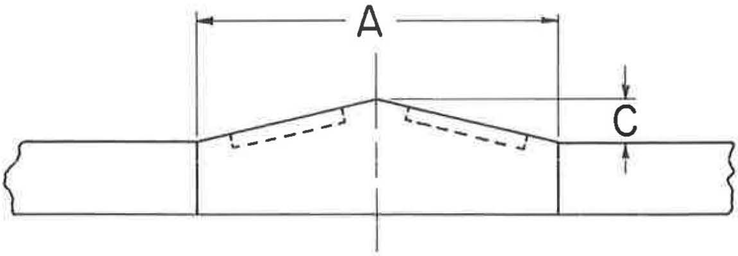


CROSS-SECTION 5

(Reference Nos. 158-160, 168, 181)

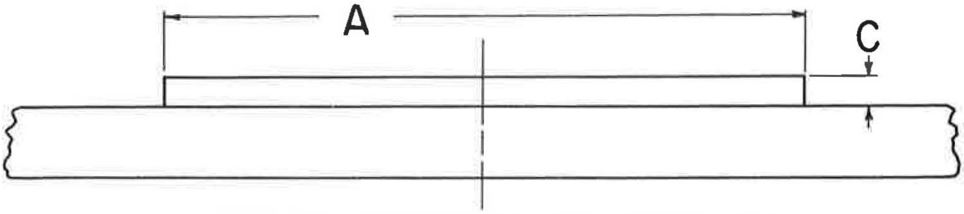


CROSS-SECTION 6 (VAR. A)

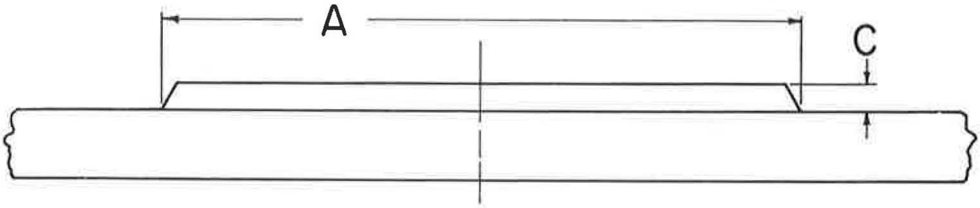


(VAR. B)

VAR.	A	C	MISC.	Ref. No.
Aa	3'	2"	P.C.C.Surface	13
Ab	4'	¼"	P.C.C.Surface	14
Ac	4'	1"	P.C.C.Surface	15
Ad	4'	1½"	P.C.C.Surface	18
Ae	4'	2"	P.C.C.Surface	27-37
Af	6'	2"	P.C.C.Surface	142
Ag	8'	2"	P.C.C.Surface	151
Ah	20'	3"	Turf	186-188
B	4'	4"	Depressed Side Ribs	95



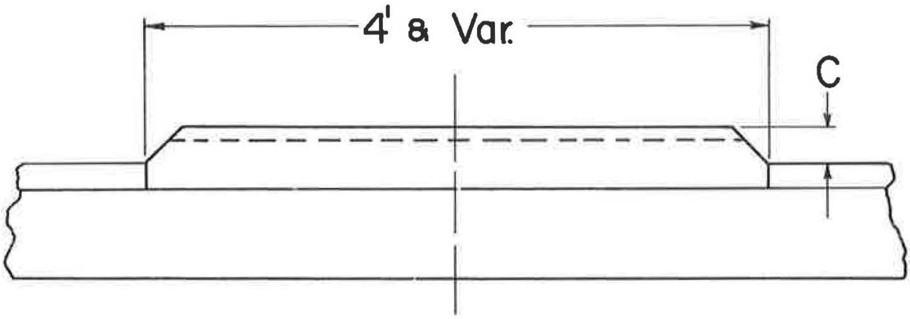
CROSS-SECTION 7 (VAR. A)



(VAR. B)

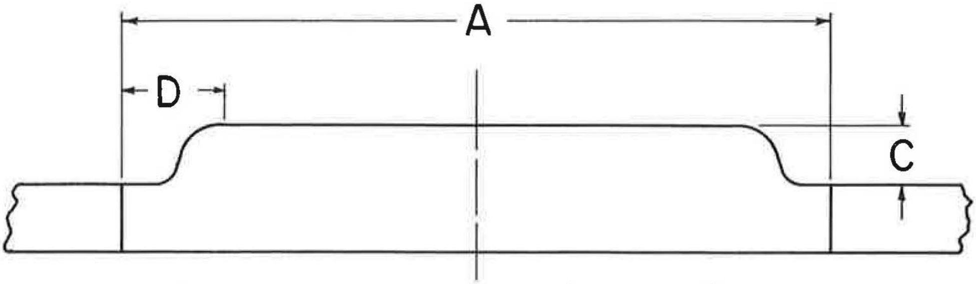
VAR. A VAR. B

VAR.	A	C	MISC.	Ref. No.
Aa	1'	1"	Chicago Mesh Type	1
Ab	2'	6"	Chicago "Barrier"	5
Ac	3'	1"		7-12
Ad	4'	6"	Chicago "Barrier"	98
Ae	6'	6"	Chicago "Barrier"	143
Af	12'	6"	Chicago "Barrier"	156
Ag	36'	6"	Chicago "Barrier"	202
Ah	38'	6"	Chicago "Barrier"	203
Aj	40'	6"	Chicago "Barrier"	204
Ak	45'	6"	Chicago "Barrier"	206
Al	52'	6"	Chicago "Barrier"	207
Ba	4'	1"		16
Bb	4'	1"	Corrugated	17
Bc	4'	2"		46

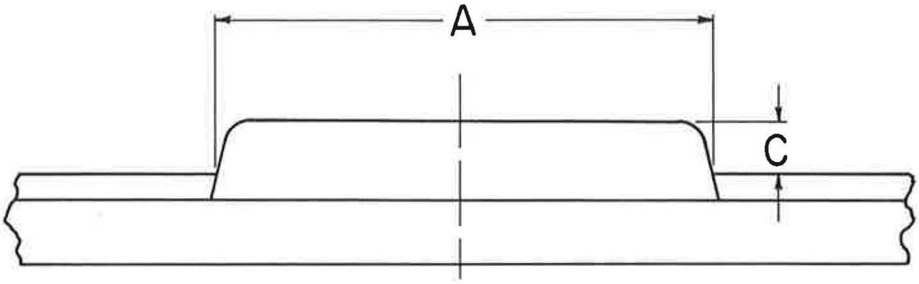


CROSS-SECTION 8

VAR.	C	MISC.	Ref. No.
Aa	2"	Not Corrugated	47,48
Ab	2"	Corrugated	49,50
Ac	2-3/4"	Not Corrugated	85
Ad	3"	Not Corrugated	86



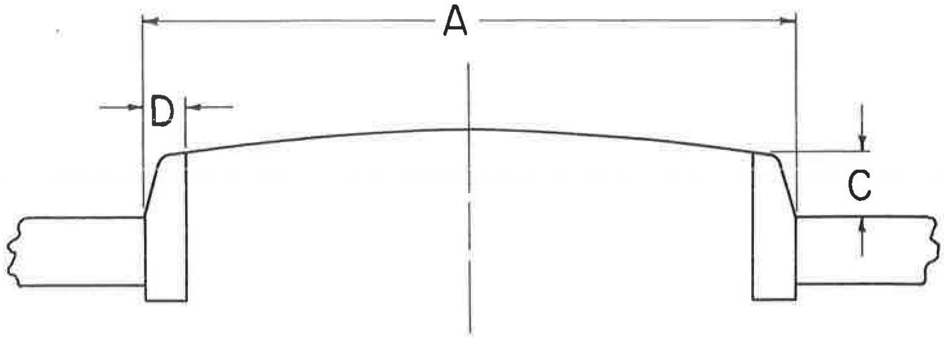
CROSS-SECTION 9 (VAR. A)



(VAR. B)

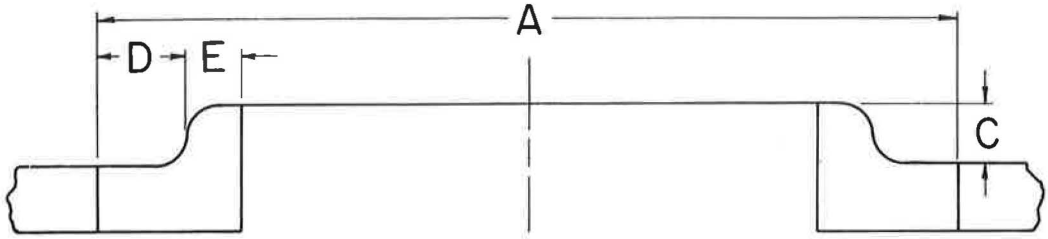
VAR. A **VAR. B**

VAR.	A	C	D	MISC.	Ref. No.
Aa	2'	4"	4½"	Before 1940	3,4
Ab	4'	6"	4"		99
Ac	4'	6"	9"	After 1940	100-119
Ad	4'	9"	6½"		126
Ae	4' &Var.	6"	9"		132-134
Af	6' &Var.	6"	9"		146,147
Ba	2-2/3' & Var.	6"	-		6
Bb	4'	6"	-		120
Bc	4' &Var.	6"	-		135

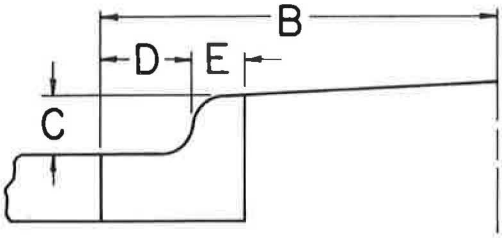


CROSS-SECTION 10

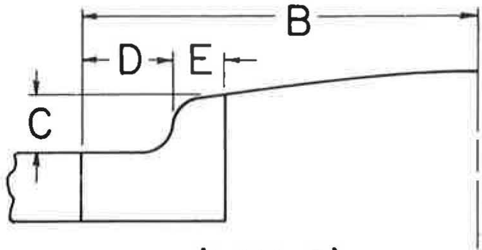
VAR.	A	C	D	MISC.	Ref. No.
Aa	4'	6"	7"	Straight Crown 0.25"/ft.	121,122
Ab	4'-12'	6"	7"	Rounded Top 1" Crown	128,129
Ac	4'-16'	6"	7"	Straight Crown	130
Ad	4' &Var.	6"	7"	Flat Top	137-139
Ac	5'	4"	7"	Flat Top	140
Af	6'	4"	7"	Flat Top	144
Ag	6' &Var.	6"	7"	Flat Top	148-150
Ah	10'	6"	7"	Rounded Top 3" Crown	152
Aj	12'	Var.	7"	Straight Crown 0.75"/ft.	155
Ak	12'	6"	10"	Flat Top	157
Al	12'	6"	7"	Rounded Top 1" Crown	161
Am	20'	6" &Var.	7"	Flat Top	189
An	24'	6" &Var.	7"	Rounded Top	193
Ao	40'	Var.	7"	Flat Top	205
Ap	Var.	6"	7"	Flat Top	211



CROSS-SECTION II (VAR. A)



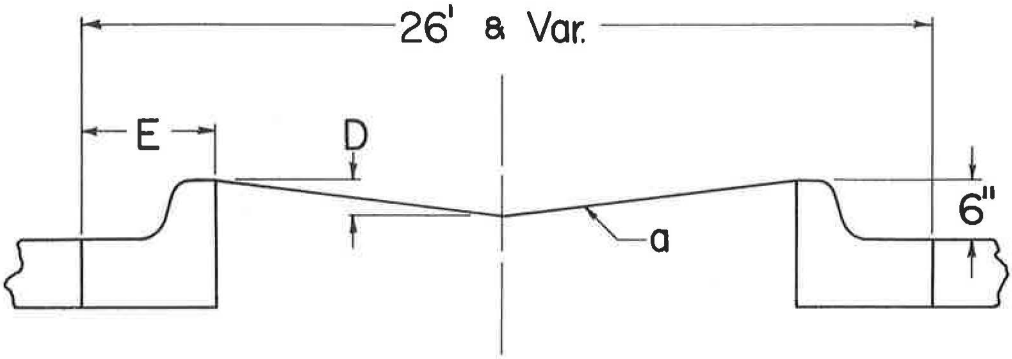
(VAR. B)



(VAR. C)

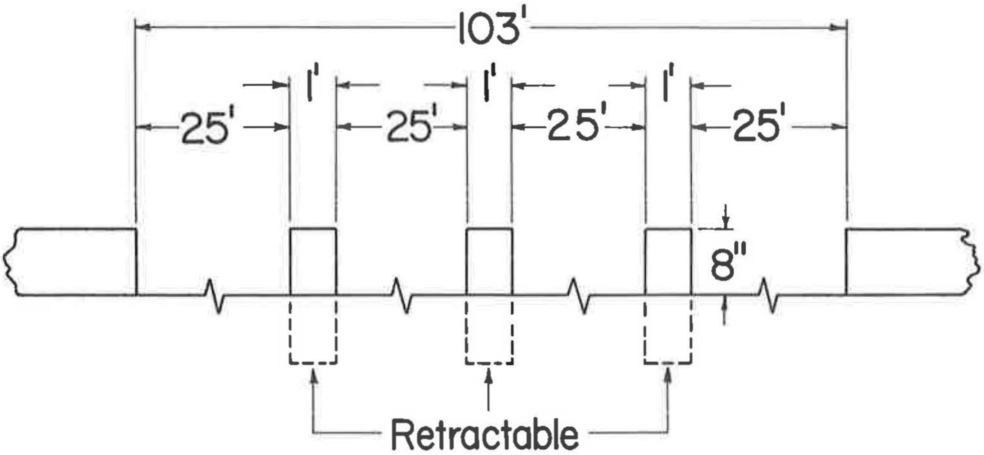
VAR.	A	B	C	D	E	MISC.	Ref. No.
Aa	4'	2'	6"	6"	7"	Flat Top	123
Ab	4'	2'	9"	6"	7"	Flat Top	127
Ac	12'	6'	9"	12"	7"	Flat Top	162
Ad	12' & Var.	6' &Var.	6"	6"	7"	Flat Top	163-165
Ae	14'	7'	4"	6"	7"	Flat Top	166
Af	14'	7'	6"	-	-	Flat Top	167
Ag	15'	7½'	7"	12"	7"	Flat Top	169
Ah	16'	8'	6"	6"	7"	Flat Top	174, 175
Aj	16' & Var.	8' &Var.	6"	24"	7"	Flat Top	176
Ak	17'	8.5'	6"	12"	7"	Flat Top	179, 180

VAR.	A	B	C	D	E	MISC.	Ref. No.
Al	17' & Var.	8.5' & Var.	6"	12"	7"	Flat Top	182
Am	20' & Var.	10'&Var.	8"	Var.	7"	Flat Top	192
An	Var.	Var.	6"	6"	7"	Flat Top	212
Ao	Var.	Var.	6"	-	-	Flat Top	213
Ba	15'	7.5'	6"	12"	7"	0.25"/ft. Straight Crown	170
Bb	15' & Var.	7.5' & Var.	6"	12"	7"	0.25"/ft. Straight Crown	173
Bc	16' & Var.	8' &Var.	6"	7"	6"	0.75"/ft. Straight Crown	178
Bd	18'	9'	4"	4-3/8"	7-5/8"	0.75"/ft. Straight Crown	183,184
Be	Var.	Var.	4"	4-3/8"	7-5/8"	0.5"/ft. Straight Crown	208
Bf	Var.	Var.	6"	6"	7"	0.75"/ft. Straight Crown	215
Bg	Var.	Var.	6"	-	-	0.75"/ft. Straight Crown	216
Bh	Var.	Var.	6"	-	-	0.5"/ft. Straight Crown	217
Ca	10' & Var.	5' &Var.	4"	4-3/8"	7-5/8"	Round Top 196' Radius	153
Cb	10' & Var.	5' &Var.	8"	12"	7"	Round Top 196' Radius	154
Cc	15' & Var.	7.5' & Var.	4" &Var.	4-3/8"	7-5/8"	Round Top 196' Radius	171
Cd	15' & Var.	7.5' & Var.	6"	12"	7"	Round Top Var. Crown	172
Ce	16' & Var.	8' &Var.	6"	7"	6"	Round Top	177
Cf	19'	9.5'	4"	4-3/8"	7-5/8"	Round Top 4" Crown	185
Cg	20'	10'	4"	4-3/8"	7-5/8"	Round Top 4" Crown	190,191
Ch	28'	14'	4"	4-3/8"	7-5/8"	Round Top	195
CJ	30'	15'	4"	4-3/8"	7-5/8"	Round Top 6" Crown	196-198
Ck	30' & Var.	15'&Var.	4"	4-3/8"	7-5/8"	Round Top 6" & Var. Crown	199,200
Cl	30' & Var.	15'&Var.	6"	4-3/8"	7-5/8"	Round Top 6" & Var. Crown	201
Cm	Var.	Var.	4"	4-3/8"	7-5/8"	Var. Crown	209,210



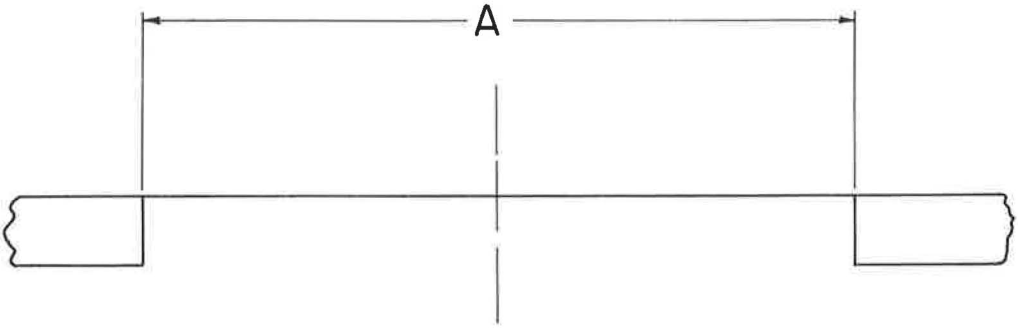
CROSS-SECTION 12

VAR.	D	E	a	MISC.	Ref. No.
Aa	6"	13"	26:1 & Var.	Curbed (depressed)	194
Ab	Var.	19"	1"/ft.	Curbed (depressed)	214



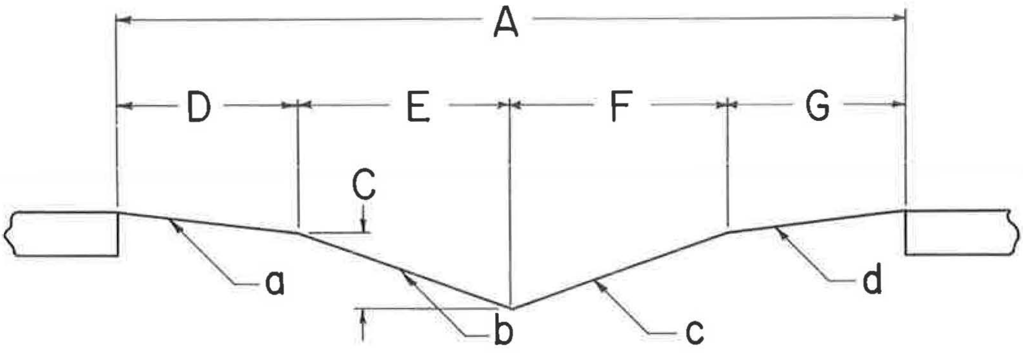
CROSS-SECTION 13

(Reference, No. 2)



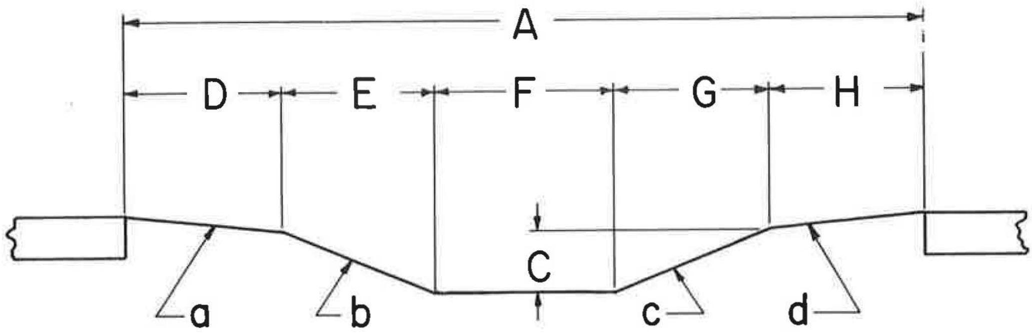
CROSS-SECTION 14

VAR.	A	MISC.	Ref. No.
Aa	4'	P.C.C.Surface	218-225
Ab	4'	Bituminous Concrete Surface	226,227
Ac	6'	Crushed Stone Surface	228
Ad	24'	Turf	229



CROSS-SECTION 15

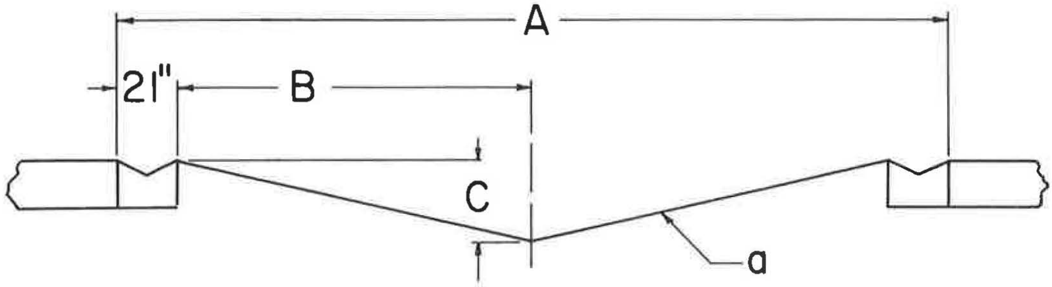
VAR.	A	C	D	E	F	G	a	b	c	d	MISC.	Ref. No.
Aa	20'	2'	6'	4'	4'	6'	0.75"/ ft.	2:1	2:1	0.75"/ ft.		232
Ab	21'	2'	7'	4'	4'	6'	0.75"/ ft.	2:1	2:1	0.75"/ ft.		233
Ac	30'	1½' & Var.	10'	5'	5'	10'	0.75"/ ft.	3:1 & Var.	3:1 & Var.	0.75"/ ft.		238
Ad	30'	3'	6'	9'	9'	6'	0.75"/ ft.	3:1	3:1	0.75"/ ft.		244-249
Ae	30'	3'	6'	9'	9'	6'	0.5"/ ft.	3:1	3:1	0.5"/ ft.		250-252
Af	30'	3' &Var.	6'	9'	9'	6'	0.75"/ ft.	3:1 & Var.	3:1 & Var.	0.75"/ ft.		253
Ag	30'	3' &Var.	6'	9'	9'	6'	0.5"/ ft.	3:1 & Var.	3:1 & Var.	0.5"/ ft.		254-261
Ah	30'	3' &Var.	6'	9'	9'	6'	0.75"/ ft.	3:1 & Var.	3:1 & Var.	0.75"/ ft.		262
Aj	40'	2' &Var.	11'	9'	9'	11'	0.75"/ ft.	3.6:1 & Var.	3.6:1 & Var.	0.75"/ ft.		265
Ak	40'	2' &Var.	10'	10'	10'	10'	0.75"/ ft.	4.5:1 & Var.	4.5:1 & Var.	0.75"/ ft.		266
Al	40'	3'	6'	12'	14'	8'	0.75"/ ft.	4:1	Var.	0.75"/ ft.		268,269
Am	40'	Var.	10'	10'	10'	10'	0.75"/ ft.	Var.	Var.	0.75"/ ft.		351
An	40' & Var.	2' &Var.	10'	10'	10'	10'	0.75"/ ft.	4.5:1	4.5:1	0.75"/ ft.	Rounded Ditch 9' Radius	354
Ao	40' & Var.	Var.	10'	Var.	Var.	10'	0.75"/ ft.	Var.	Var.	0.75"/ ft.		358
Ap	44'	3'	6'	12'	12'	10'	Var.	4:1	4:1	Var.		360,361



CROSS-SECTION 16

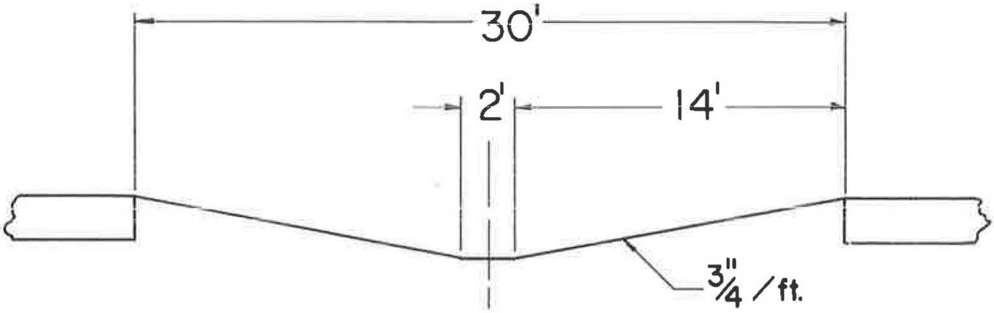
VAR.	A	C	D	E	F	G	H	a	b	c	d	Ref. No.
Aa	20'	1'	6'	3'	2'	3'	6'	0.75"/ ft.	3:1	3:1	0.75"/ ft.	231
Ab	26'	2' &Var.	6'	6'	2'	6'	6'	0.5"/ ft.	3:1 & Var.	3:1 & Var.	0.5"/	235,236
Ac	30'	2'	6'	8'	2'	8'	6'	0.75"/ ft.	4:1	4:1	0.75"/ ft.	239
Ad	30'	2' &Var.	6'	8'	2'	8'	6'	0.5"/ ft.	4:1 & Var.	4:1 & Var.	0.5"/ ft.	240
Ae	30'	2.5' & Var.	7.66'	6.33'	2'	6.33'	7.66'	0.48"/ ft.	4:1	4:1	0.48"/ ft.	241-243
Af	37' & Var.	2.875' & Var.	6'	11.5' & Var.	2'	11.5' & Var.	6'	0.5"/ ft.	4:1	4:1	0.5"/ ft.	263
Ag	39' & Var.	2' &Var.	6'	8'	2'	8'	6'	0.5"/ ft.	4:1 & Var.	4:1 & Var.	0.5"/ ft.	264
Ah	40'	2.875'	8'	11'	2'	11'	8'	0.5"/ ft.	3.82:1	3.82:1	0.5"/ ft.	267
Aj	40'	3'	6'	12'	2'	14'	6'	0.75"/ ft.	4:1	4-2/3: 1	0.75"/ ft.	270
Ak	40'	3'	6'	13'	2'	13'	6'	0.5"/ ft.	4-1/3: 1	4-1/3: 1	0.5"/ ft.	271-293
Al	40'	3'	6'	13'	2'	13'	6'	0.75"/ ft.	4-1/3: 1	4-1/3: 1	0.75"/ ft.	294-304
Am	40'	3'	8'	11'	2'	11'	8'	0.5"/ ft.	3-2/3: 1	3-2/3: 1	0.5"/ ft.	305-326
An	40'	3'	10'	9'	2'	9'	10'	0.75"/ ft.	3:1	3:1	0.75"/ ft.	327

VAR.	A	C	D	E	F	G	H	a	b	c	d	Ref. No.
Ao	40'	3' &Var.	6'	13'	2'	13'	6'	0.5"/ ft.	4-1/3: 1 & Var.	4-1/3: 1 &Var.	0.5"/ ft.	330
Ap	40'	3' &Var.	6'	13'	2'	13'	6'	0.75"/ ft.	4-1/3: 1 & Var.	4-1/3: 1 &Var.	0.75"/ ft.	331-335
Aq	40'	3' &Var.	6' &Var.	13'&Var.	2' &Var.	13'&Var.	6' &Var.	0.5"/ ft.	4-1/3: 1 & Var.	4-1/3: 1 &Var.	0.5"/ ft.	336-338
Ar	40'	3' &Var.	8'	11'	2'	11'	8'	0.5"/ ft.	3-2/3: 1 & Var.	3-2/3: 1 &Var.	0.5"/ ft.	339-346
As	40'	3' &Var.	6'	11'-5"	2'	14'-7"	6'	0.5"/ ft.	3-3/4: 1 & Var.	3-3/4: 1 &Var.	0.5"/ ft.	350
At	40'	Var.	6'	13'	2'	13'	6'	0.5"/ ft.	4:1 & Var.	4:1 & Var.	0.5"/ ft.	352
Au	40'	Var.	6'	13'	2'	13'	6'	0.5"/ ft.	Var.	Var.	0.5"/ ft.	353
Av	40' & Var.	3'	8'	11' & Var.	2'	11' & Var.	8'	0.5"/ ft.	3-2/3: 1 & Var.	3-2/3: 1 &Var.	0.5"/ ft.	355
Aw	40' & Var.	3' &Var.	6' &Var.	13'&Var.	2' &Var.	13'&Var.	6' &Var.	0.5"/ ft.	4-1/3: 1 & Var.	4-1/3: 1 &Var.	0.5"/ ft.	356
Ax	42'	3'	6'	13'	2'	13'	8'	0.75"/ ft.	4:1	4:1	0.5"/ ft.	359
Ay	48'	3'	8'or 10'	15' or 13'	2'	15' or 13'	8'or 10'	0.25"/ ft.	5:1 or 4-2/3:1	5:1 or 4-2/3:1	0.25"/ ft.	362
Az	48'	3'	8'	15'	2'	15'	8'	0.75"/ ft.	5:1	5:1	0.75"/ ft.	363
Aaa	50'	2.5'	14.66'	9.33'	2'	9.33'	14.66'	0.48" to 0.72"/ft.	4:1	4:1	0.48" to 0.72"/ft.	364,365
Abb	50'	3'	6'	12'	10'	14'	8'	0.75"/ ft.	4:1	4-2/3: 1	0.75"/ ft.	366-368
Acc	50'	3'	6'	18'	2'	18'	6'	0.5"/ ft.	6:1	6:1	0.5"/ ft.	369
Add	50'	3' &Var.	8'	16'	2'	16'	8'	0.5"/ ft.	4:1 & Var.	4:1 & Var.	0.5"/ ft.	370,371
Aee	50'	3' &Var.	10'	12.5'	5'	12.5'	10'	0.5"/ ft.	4:1 & Var.	4:1 & Var.	0.5"/ ft.	372-374
Aff	50'	Var.	8'	16'	2'	16'	8'	Var.	Var.	Var.	Var.	375
Agg	50' & Var.	3'	8'	12'&Var.	10'&Var.	12'&Var.	8'	0.5"/ ft.	4:1	4:1	0.5"/ ft.	376
Ahh	50' & Var.	3' to 4'	8'	16'&Var.	2'	16'&Var.	8'	0.5"/ ft.	4:1 & Var.	4:1 & Var.	0.5"/ ft.	377,378
Ajj	50' & Var.	3' &Var.	10'&Var.	12'&Var.	6' &Var.	12'&Var.	10'&Var.	0.5"/ ft.	4:1	4:1	0.5"/ ft.	379
Akk	54'	3' &Var.	12'	14'	2'	14'	12'	0.48"/ ft.	4-2/3:1 & Var.	4-2/3:1 & Var.	0.48"/ ft.	380-384
All	64'	3' &Var.	8'	23'	2'	23'	8'	0.5"/ ft.	7-2/3:1 & Var.	7-2/3:1 & Var.	0.5"/ ft.	389-396
Amm	Var.	3'	10'	Var.	2'	Var.	10'	0.5"/ ft.	Var.	Var.	0.5"/ ft.	422



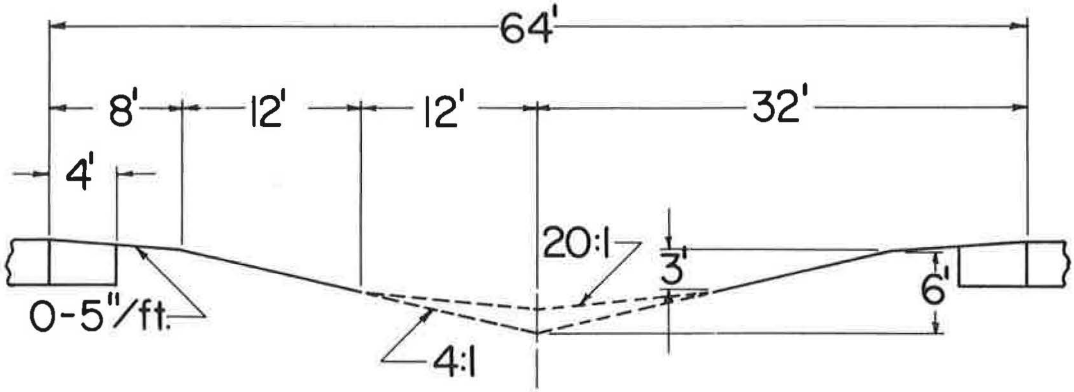
CROSS-SECTION 17

VAR.	A	B	C	a	MISC.	Ref. No.
Aa	18'-50'	Var.	Var.	0.875"/ ft.	Type B Gutter	230
Ab	25'	10.75'	7"	0.66"/ ft.	Type B Gutter	234



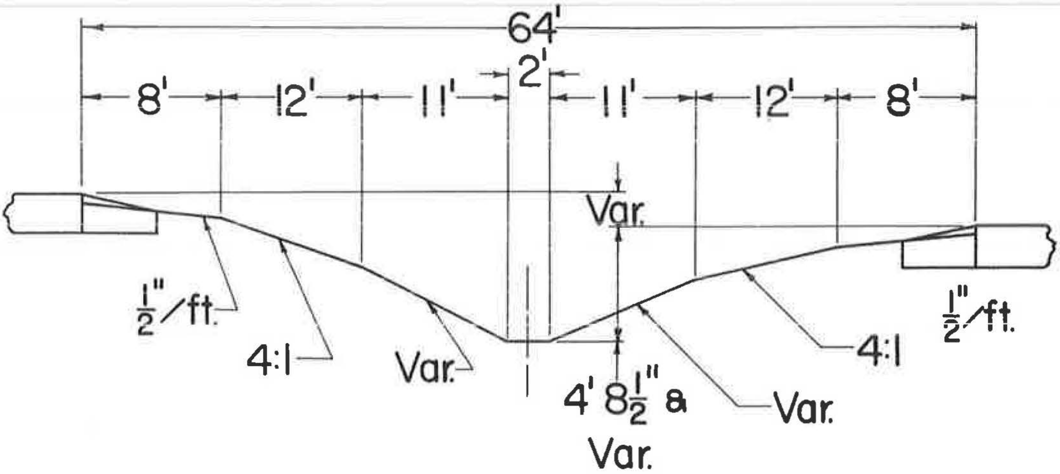
CROSS-SECTION 18

Reference No. 237

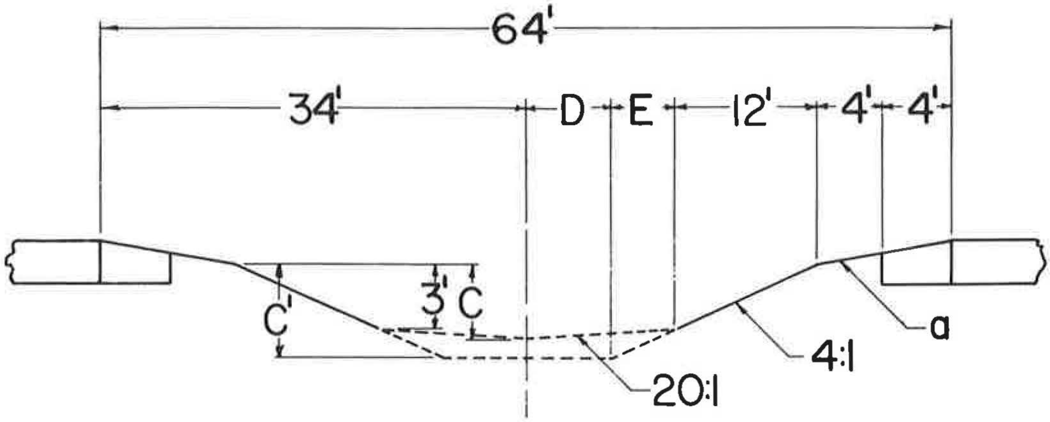


CROSS-SECTION 19

(Reference Nos. 399-401)

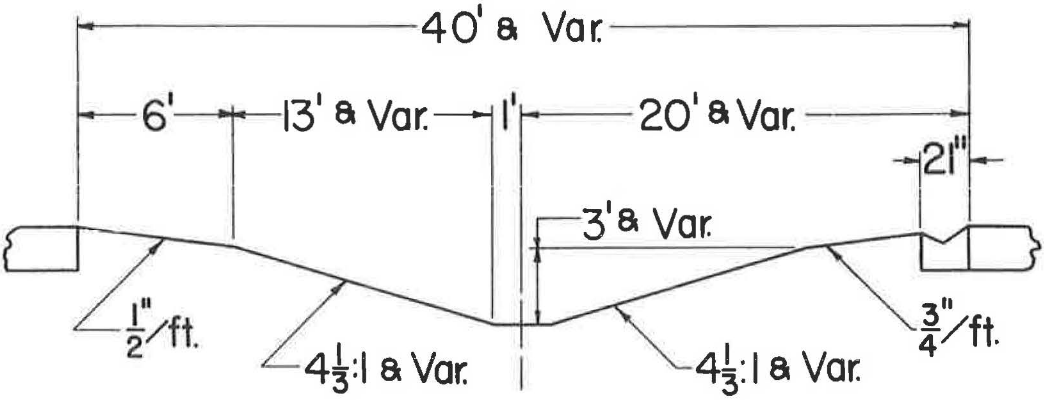


CROSS-SECTION 20
(Reference Nos. 402–404)

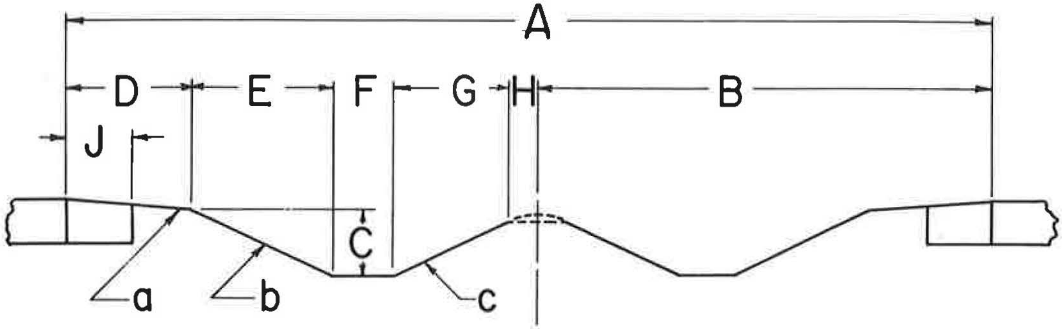


CROSS-SECTION 21

VAR.	C	C'	D	E	a	Ref. No.
Aa	3'-6-5/8"	5'-9"	1'	11'	0.75"/ft.	397
Ab	3'-7-1/5"	5'-3-3/4"	3'	9'	0.5"/ft.	398

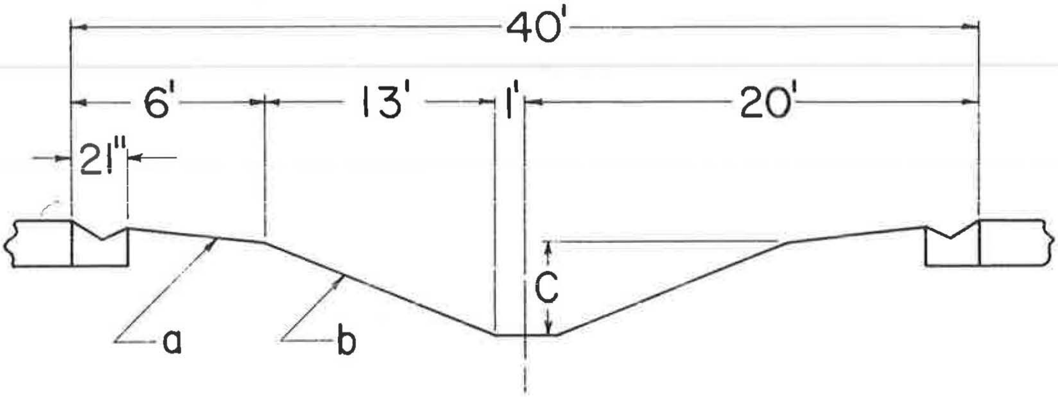


CROSS-SECTION 22
(Reference No. 328)



CROSS-SECTION 23

VAR.	A	B	C	D	E	F	G	H	J	a	b	c	Ref. No.
Aa	64'	32'	3'	6'	12'	2'	7'	5'	3'	0.5"/ ft.	4:1	2:1	385
Ab	64'	32'	3'	6'	12.5'	2'	6'	5.5'	3'	0.5"/ ft.	4:1	2:1	386
Ac	64'	32'	3' &Var.	8'	10.5'	2' &Var.	6'	5.5'	4'	0.5"/ ft.	3-1/3: 1	2:1	387,388
Ad	80'	40'	3'	8'	12'	2'	12'	6'	3'	1"/ft.	4:1	4:1	405-410
Ae	80'	40'	3'	8'	12'	2'	12'	6'	3'	0.5"/ ft.	4:1	4:1	411-416
Af	80'	40'	3'	8'	12'	2'	12'	6'	4'	0.5"/ ft.	4:1	4:1	417-419
Ag	80'	40'	3' &Var.	8'	12' & Var.	2'	12' & Var.	Var.	4'	0.5"/ ft.	4:1	4:1	420
Ah	80' & Var.	40' & Var.	3'	8'	12'	2'	12'	6'	3'	0.5"/ ft.	4:1	4:1	421



CROSS-SECTION 24

VAR.	C	a	b	Ref. No.
Aa	3'	0.75"/ ft.	4-1/3:1	329
Ab	3'-5-5/8" & Var.	0.75"/ ft.	3.78:1	347
Ac	3'-6½" & Var.	0.75"/ ft.	Var.	348
Ad	3'-6½" & Var.	0.75"/ ft.	3.78:1	349