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Development of the NARROW MEDIAN CONCRETE BARRIER in New Jersey

by

Edgar J. Hellriegel

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DEVELOPMENT OF THE NARROW MEDIAN CONCRETE BARRIER IN NEW JERSEY

New Jersey, being one of the most urbanized states in the nation, has had many years of experience with narrow medians. Early designs consisted of islands with a sloping concrete curb and a grass median, the ends being rounded at intersections and at other median openings, such as factory or commercial sites, U-turns, etc. The majority of these islands had widths of 16-22 feet with some as narrow as 9 feet.

With the increase in highway traffic, many of the openings posed a hazardous condition, and in the interest of safety the state adopted a policy of island closing. At the same time, it adopted the system of jug handle turns spaced at 1/2 mile to 3000 feet so that there would be not more than a one mile turn-around. This spacing also aided traffic flow on highways in the 50-55 mile per hour class, where progressive timing traffic signals had been installed.

As traffic volume increased over the planned capacity, both the highway and the narrow grassed median became obsolete. Removal of the islands in conjunction with the installation of concrete median barriers served a twofold purpose; it not only aided in preventing median cross-over, but in many cases allowed for the placement of additional traffic lanes without the acquisition of additional right-of-way. In other cases, such as on undivided highways, use of the rigid concrete barrier has virtually eliminated the danger of head-on collision. As a matter of fact, it was one such spectacular collision on Jugtown Mountain that expedited construction of the first concrete median barrier at this location. This original barrier built in 1949 was 16" high, having parabolic curved surfaces which swept from a 9" top to a 30" base. The radial curvature was 18". The barrier was constructed of class B grey concrete with a 2" minimum thickness of class B white concrete on the exposed curved surfaces and a 2" 1:1-3/4 white mortar mix on the top surface. Where the barrier was placed on existing concrete pavement, one inch round deformed dowels 12" in length were imbedded halfway into the pavement at an angle of approximately 60°, 8 inches in from the outer surfaces. The dowels were spaced 4' on centers with the inclination of the dowels alternately reversed. This barrier functioned so well that it became pretty much the standard for the next few years.

In 1955, short sections of various experimental barriers such as wire cables, concrete beams, steel beams, 12" vertical concrete curbing and the parabolic concrete barrier were field tested along a hazardous section of highway. Within a short period of time, the superiority of the parabolic concrete barrier as a positive median was easily ascertained.

During the decade from 1949-1959, the concrete median barrier had performed so successfully that it was hailed by many organizations and individuals. However, because of transgression by a few vehicles, the barrier was raised to a height of 20 inches. The modified barrier maintained the same parabolic contour, and the additional height came from an extension of a vertical surface from the tangency of the 18" radial curve. At the same time the dowels were reduced to 8" in length and set perpendicular to the pavement. The white mortar mix previously specified for the top was dropped and construction consisted of the composite grey concrete core and white concrete facing. This 20" barrier served as an interim standard for approximately a two-year period while other designs were being considered.

(1) (Slide 1 please) This shows some of the designs that were under consideration. Scheme one was quickly discounted, since experience had proven that an outlying curb caused vehicles to strike center barriers in an unfavorable manner. In scheme 2, the low angle of the lower sloped face not only permitted easy encroachment but made no provision for resurfacing. Scheme 3 did not allow for the desired vehicular sheet metal clearance and was also quickly discarded. Scheme 4 was selected as the most desirable, subject to slight modification, that is the vertical face of the base was increased to 3" and the radius reduced from 3" to 1".

(2) (Next slide please) This slide shows our Standard Details for the 32 inch barrier with various treatments for its placement. The new configuration, as you can appreciate, would not economically lend itself to composite casting and is therefore made entirely of white concrete. The left-hand figure shows the method used when placement is to be made on concrete pavement, with provision for future resurfacing. The center figure is the scheme used for placing over a longitudinal joint. (Note the position of the dowel and the use of roofing paper between the barrier and pavement on the left hand side of the figure). The figure to the right shows the method of construction when used in conjunction with bituminous concrete; below are details for light standards, inlets, and pedestrian crossings.

(Light please) The treatment on bridges is slightly different as it calls for steel reinforcement in the barrier. If anyone is especially interested in this aspect, I have some detail drawings which can be viewed later.

As the barrier approaches bridge piers, it widens through means of a gradual transition on a 10-15-thousand-foot radius. This transition piece is monolithic until it reaches a maximum thickness of 18" at the top. From this point it becomes a split or dual barrier each half maintaining the normal outer configuration, but having a vertical wall on the inside. The cavity is filled with subbase material and topped with 4 inches of white concrete.

The next series of slides show the actual construction in the field. (3) This slide shows the forms for the base with back to back inlets in the right foreground. (4) Here we see the forms filled with concrete and the dowels inserted. (5) This is a close-up of the base and dowels with the barrier forms in place. The wire you see in the foreground is a snap tie that is used to bold down the form and prevent it from floating when the white concrete is poured. (6) This shows a bulkhead at end-of-day pouring. (7) Here's a shot with the bulkhead removed, showing the bituminous impregnated fiber-joint-filler used for expansion joints. (8) This shot shows the grey base and the white barrier after stripping the forms.

As long as we have the projector on, I'd like to show some slides of two accidents that I personally investigated. This accident occurred at approximately 3:30 a.m. A 1965 Ford tractor trailer was traveling south on U.S. 1 when it was cut off by a slow moving vehicle coming out onto the highway. (Slide 9) The tire marks appear to be at an angle of 35-40 degrees. This is an optical illusion as you will see on the next couple of slides. (Slide 10) Actually the measured angled runs between 13 and 15 degrees over a 44 foot length. (Slide 11) This is a close-up of the impact. (Slide 12) This is a back shot showing the skid marks and tire marks on the barrier. Note the tread marks on the top of the barrier where the duals had a tire on each side of the barrier. (Slide 13) This is another back shot showing the length of barrier traversed before the trailer came down. The trailer rode the barrier for 267 feet. Counting the 150 feet length of skid marks before impact, the overall length was 417 feet.

The other accident took place on U.S. 1 in New Brunswick in the vicinity of Route 18. (Slide 14) In the right foreground, is a ramp leading off 18 onto U.S. 1. Cars entering here caused a pick-up truck towing a trailer to encroach on the inner lane. A woman traveling the inner lane then encroached on the barrier. (Next slide 15) This shows scrape marks in better detail. The angle at impact was approximately 11°, with a minimal amount of sheet metal damage. The point I'm making is that in conversation with the woman she said "Thank God for that barrier or else I would have been killed". Since the AADT figure for the area is 60,900 vehicles, I agreed she might have readily become a fatality. (Light please)

The cost per lineal foor varies with the size of the job, however, the weighted average pieces for construction in 1967 are as follows: The normal 32-inch dowelled barrier ran $11.10/ft and the barrier which requires a base ran $14.10/ft, for 13,500 and 19,500 feet respectively. Total cost of maintenance in 1967 for well over a million feet of barrier was $3,578. During the same period, maintenance costs for a 17,000 foot section of dual steel beam median barrier was $3,436.

As to the immediate future, we do not plan any radical departure from the present design; however, several innovations such as built-in reflective surface, low level lighting, a 3" increase in thickness, and the use of white paint on a grey concrete barrier are being studied.

* Slides 3 through 8 were borrowed from Construction Practices for the presentation and returned to them.