The New Jersey Turnpike

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The New Jersey 118-mile Turnpike, under construction for more than a year and scheduled for completion late this year, will offer substantial relief in solving the vehicular traffic problems of the state and, at the same time, will provide a free-flowing artery for interstate traffic that has long been needed. Financing this Turnpike opened up new fields in revenue bond financing.

Because of its location, New Jersey has a highway problem that is unprecedented. The state is a "corridor" through which practically all of the vehicular traffic from New York and New England passes on its way to the south and west.

The state, moreover, forms part of the great New York and Philadelphia metropolitan areas which contain approximately 14,000,000 people, or about one-tenth of the population of the entire country. It ranks 45th in size and is second in density of population. It is in sixth place as an industrial producer and forms part of a cluster of northeastern states which contain 35 per cent of all the industry in the nation.

These factors, plus the record increase in vehicles since World War II, contribute to the congestion and overloading on the state's principal highways and precipitated the urgent need for a backbone expressway, such as the New Jersey Turnpike. Traffic in the state has increased sharply in recent years and many of the public highways are required to carry more volume than they were designed for; in some instances more than double the number of vehicles a day which might be considered reasonable capacity.

The following is illustrative: On Route U. S. 1 in Newark, vehicular traffic has increased by 43 per cent from 1947 to July 1, 1950, a period of two and a half years. In the Lincoln Tunnel it has risen by 36 per cent; over the George Washington Bridge by 43 per cent; over the Pennsville Ferry by 40 per cent; over the Camden Bridge at Philadelphia by 28 per cent and over the Edison

Bridge at New Brunswick by 24 per cent. Highway construction has not kept pace with these increases.

Confronted with this steadily rising and record traffic, the State Highway Department in 1946 made a study to determine the minimum construction that would be required to provide for the then existing volume and found urgent need for a $600 million highway construction program. At the same time several plans were developed for financing this construction involving an increase in gasoline taxes and a bond issue or a combination of both. None

Figure 1. Steel girders being placed on concrete piers at the Passaic River Crossing.

of these plans met with approval and Governor Driscoll, in August, 1948, presented to a special session of the New Jersey Legislature a proposal to create the New Jersey Turnpike Authority to finance urgently needed trunk roads by the sale of revenue bonds to private investors. This legislation, the New Jersey Turnpike Act of 1948, first Turnpike was authorized by the Legislature on April 14, 1949.

The three Turnpike Commissioners, Paul L. Troast, chairman; George F. Smith, vice chairman and Maxwell Lester, Jr., secretary-

treasurer, were appointed by the Governor and approved by the was passed and became a law in October, 1948. The route of the State Senate on March 31, 1949. The Commissioners serve without compensation.

PRELIMINARY ENGINEERING SURVEYS

Early action of the Commissioners was the selection of four nationally known firms of consulting engineers to make preliminary engineering, and traffic and revenue reports on the financial feasibility of the project. The firms were: (1) Edwards and Kelcey, Frederic R. Harris, Inc., O. J. Porter & Co., and Ammann & Whitney, Associated for the northern section; (2) De Leuw, Cather Company for the southern section; (3) Coverdale & Colpitts for traffic and revenues for the entire route; and (4) Howard, Needles, Tammen & Bergendoff, general consultants. These firms were instructed to complete the studies and reports for the Authority in the unprecedented time of four months.

Figure 2. The Passaic River Bridge Crossing is the largest on the New Jersey Turnpike. It will provide six traffic lanes, three in each direction, and calls for about 25,000 tons of steel. In the background are the piers for the Hackensack River crossing.

By September 1, 1949, the preliminary conclusions of the engineers indicated that the project was financially feasible on a self-supporting basis and the recommended route was outlined. This route starts at Delaware Memorial Bridge (now under construction and to be opened to traffic during the summer of 1951) and extends northward, keeping close to traffic generating centers, to a connection with U. S. Route 46 near the George Washington Bridge opposite New York City.

After it became evident the Turnpike could be financed and would be self liquidating, negotiations were started immediately for the selection of nationally recognized firms of consulting engineers to determine the final alignment, prepare contract plans and specifications, property maps and for supervision of construction. The Turnpike was divided into seven sections, and the eight firms selected on September 22, 1949, are, beginning with the southern section: J. E. Greiner & Company; Gannett, Fleming, Corddry & Carpenter, Inc.; Parsons, Brinckerhoff, Hall & Macdonald; DeLeuw, Cather & Co.; Fay, Spofford & Thorndike; Amman & Whitney; Frederick R. Harris, Inc., Edwards and Kelcey, and O. J. Porter & Co., Associated; and Howard, Needles, Tammen & Bergendoff who, also, are general consultants for the Authority.

Figure 3. Construction of substructures for the Rahway River crossing. This dual crossing provides two separate parallel structures, one for northbound traffic and the other for southbound traffic. Both will be identical in size and design.

In addition, Fellheimer & Wagner are the architectural consultants and Frank Grad & Sons, associated architects. Gordon Lorimer is the architect engaged by the general consultants. Paul Godley is radio consultant, Edward Mehm electrical consultant and Stewart Associates is special consultant on asphalt pavement.

FINANCING

The overall cost of the Turnpike, including construction, acquisition of real etsate for the right-of-way, service areas, engineering costs and interest during the period of construction, and a contingency reserve, was estimated in the preliminary engineering reports at $230 millions.

Methods of financing were under study from the date of the appointment of the three Authority Commissioners. The problem became realistic when the preliminary engineering reports were completed in mid-September and the project was shown to be economically sound.

Surveys of traffic and revenues made in 1949 estimated average annual revenues of $10,030,000 during the first five years of operation from 1952 through 1956. With the exception of the first year of operation—1952—the revenues will be adequate to cover the interest on the bonds outstanding, operating costs and, in addition, will produce sums to be applied toward the amortization of the bonded debt. On the basis of the surveys, it is indicated that the bonded debt will be repaid well before bond maturity in 1985.

The sale of bonds to the public, to banks, to the Reconstruction Finance Corp., to insurance companies and, in fact, every known source of capital funds, was explored by the Commissioners. The objective was not only to find a means of financing the project but to select a plan which would provide the best possible terms to the Authority.

The plan finally developed was on the "forward commitment" basis which would enable the Authority to obtain reliable commitments for the total financing, provide for the issuance of bonds and for the payment of interest thereon as construction progressed and the needs for funds actually arose, and for the payment of a nominal stand-by fee of one-half of one per cent on the balance of the Authority's total requirements. Under this "commitment" plan, as finally evolved, the bond issue was reduced from $230 millions to $220 millions. And financing for the latter amount was concluded in mid-February of 1950.

With the inflationary spiral due to the Korean war causing higher unit prices on more recent contracts, it is evident that additional financing will be required and arrangements are being made to obtain the needed funds.

The plan adopted involves commitments from 52 institutional investors, mostly insurance companies, for the full amount. As funds are needed for construction, the Authority draws against the commitments, issuing its definitive bonds therefor. The bonds will carry interest at the rate of three and one-fourth per cent annually and will be allocated on a pre-determined basis to the subscribing institutions. To a recent date the Authority had drawn down $85 million of its $220 million commitment.

In financing the Turnpike, no taxpayers' money is used and neither the faith nor the credit of the state, its counties or municipalities is pledged. When the Turnpike bonds are liquidated out of revenues, the highway will be turned over to the State Highway Department and become a part of the State Highway System in accordance with the terms of the Turnpike Act.

With the full amount of financing available when needed, the Turnpike will be built and completed as a unit late this year, rather than on a sectional basis such as is customary in public highway construction.

DESIGN AND CONSTRUCTION

The Turnpike is designed as a divided, grade separated, fully controlled access express highway. In the southerly 87-mile section the topography is easy and, with some exceptions, in rural intensively developed farming country. Here the design speed is 75 MPH and the width of median will be 26 feet including the inside shoulders. Generally the minimum horizontal radius of curvature is 10,000 feet with some curves up to 100,000-foot radius.

The northerly 30-mile section traverses a heavily developed residential, commercial and industrial area with many intersecting highways, railroads, navigable streams and other improvements that complicate construction. The design speed here is 70 MPH generally, but in some difficult stretches vertical sight distance restricts the design to 60 MPH. Generally, horizontal curvature is in excess of 8,000-foot radius but in two places curvatures of 3,000-foot radius have been used. The median is 20 feet generally, but in a seven-mile length it is widened to 94 feet.

From Deepwater for a stretch of 92 miles to Route 35, near Woodbridge, north of the Raritan River, four lanes will be con-

structed initially. From Route 35 to the Lincoln Tunnel approach, six lanes will be provided initially. The remainder to U.S. Route 46, in the north, will be constructed with four lanes. Traffic lanes will be 12 feet in width.

In addition, there will be stabilized shoulders on either side of the travel lanes; 16 feet on the right, or outside, 10 feet of

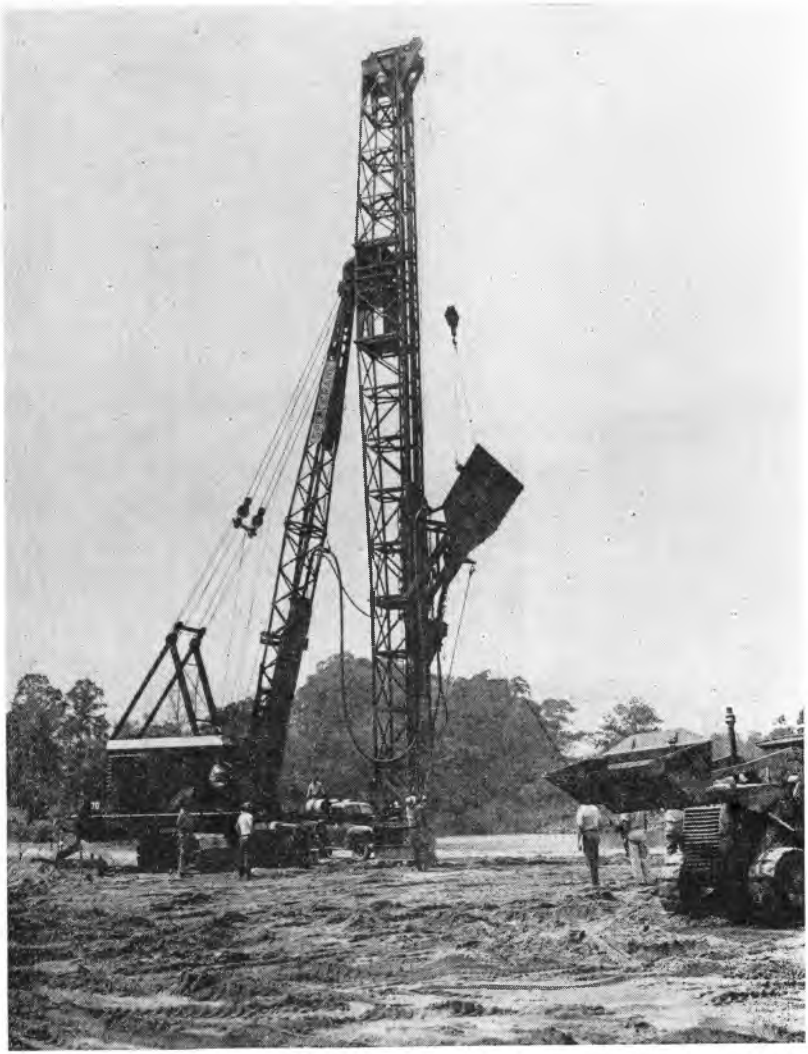

Figure 4. Placing "sand drains" up to 100 feet in depth through swampy areas has speeded up the consolidation of road embankments. This figure illustrates one type of rig used to install sand drains.

which will be paved, and five feet on the left, or inside. North of the Camden area all bridges passing overhead are being designed to accommodate future widening to six lanes to Route 35 and from thence on to the Lincoln Tunnel provision is made to widen to 8-lane, dual-dual.

Horizontal curves of 10,000-foot radius and sharper will be super-elevated and curves with 3,500-foot radius and less will be spiraled.

Figure 5. At a point in Woodbridge Township, the Turnpike passes under two existing highways. The upper route is Woodbridge Avenue, the middle level is Route 4 Parkway. Equipment is shown completing excavation for the lower Turnpike level.

Maximum grades on the Turnpike are limited to three per cent and non-passing sight distance is established as follows: design speed 75 MPH, 700 feet; design speed 70 MPH, 600 feet; design speed 60 MPH, 475 feet.

Through 17 traffic interchanges, including one at each terminal, this modern express highway will serve the people of New Jersey and the eastern half of the nation in a manner heretofore impossible of attainment. This Turnpike is close to, and will serve, the cities of Wilmington, Philadelphia, Camden, Trenton, New Brunswick,

Elizabeth, Newark, Jersey City, Passaic, Paterson, Hackensack, New York and many other communities. In addition, it will provide a major highway connection which has long been needed between existing important interstate and State highways.

It is anticipated that the New Jersey Turnpike will connect directly with the Pennsylvania Turnpike at a point north of Philadelphia within a few years. With the westerly extension of the Pennsylvania Turnpike scheduled to be completed this year, and further connection with the proposed Ohio Turnpike south of Cleveland, for which legislation has been enacted, the movement of highway traffic to and from the middle west, and along the east coast by way of the New Jersey Turnpike, will be greatly expedited. Other improvements now under construction in Maryland, New York and Connecticut, in conjunction with the New Jersey Turnpike, will provide for this free flow of traffic.

Several of the traffic interchanges will be expensive and involve difficult design because of urban development, deep mud, traffic volumes and the necessity for elimination of left turn movements on the existing connecting routes. Deceleration and acceleration lanes 1,200 feet in length, will be provided at interchanges and service areas.

The minimum right-of-way width will be 300 feet from the Delaware Memorial Bridge at Deepwater to the vicinity of the Raritan River, and 250 feet northward, except in heavily built-up areas where a 200-foot width is utilized through fully built-up residential areas for a limited distance.

STRUCTURES ON TURNPIKE

There will be 263 structures required for the Turnpike consisting of 31 stream crossings, 194 highway and railroad crossings and 38 culverts. The structures are designed to comply with AASHO H2-S 16 modified. The major bridges are over the Hackensack and Passaic rivers, although large structures are required for the Raritan and Rahway rivers and Rancocas Creek, while there will be four viaducts 1,000 feet long and upwards to 3000 feet.

The Hackensack and Passaic River bridges will be of plate girder design with 375-foot channel spans, having a vertical clearance of 110 feet above mean high water. All bridges will be of the deck type, without overhead steel work to interfere with vision over the sides of the bridges. No unusual foundation problems are anticipated with any of the structures. The deepest foundations

will be supported on steel piles up to 106 feet long driven to bed rock, or equivalent, and protected from electrolysis and chemical soil action. There will be no movable bridges.

Underpasses, overpasses and viaducts generally will be rolled steel beams surmounted by reinforced concrete roadway decks. The spacing of the beam flanges has been standardized to a large degree to facilitate re-use of deck forms. Minimum bridge clearances over the Turnpike will be fifteen feet.

Service areas for the comfort and convenience of Turnpike users will be provided. These will consist of service stations for the sale of gasoline, oil, accessories and minor repairs and restaurants to serve full course meals, or "snacks". All of these service facilities will be set well back from the Turnpike travel lanes to avoid conflict with moving vehicles and to assure a quiet atmosphere for the traveling public. Ample parking areas will be provided at these facilities.

Quantities involved in the construction of the Turnpike are large as is illustrated by the following figures: Total earthwork 50,600,000 cubic yards; asphaltic concrete (paving) 3,780,000 square yards; asphaltic shoulders 2,300,000 square yards; concrete 520,000 cubic yards; concrete for paving 118,000 square yards; drainage pipe 160 miles; total steel, including reinforcing, structural, piles, pile casings, castings, railings, guard rail, right-of-way fence, etc., 188,190 tons; piles (concrete, steel and timber) 1,787,000 feet and sand drains, 4,800,000 feet. Through the Newark area the Turnpike will cost $8,000,000 per mile.

MEADOWS A MAJOR PROBLEM

The construction of the Turnpike through the north Jersey meadows (swamps) constitutes a major problem not only because of the soil stabilization required but also the time element. The depth of the meadow mud varies from 10 feet to 100 feet. The building of embankments over such depths of mud creates special problems in soil stabilization. Sand blanket materials must be placed and subsequent layers installed with sufficient time interval between placement of layers to prevent overloading and rupture of the soil structure beneath and until sufficient consolidation of the underlying mud has taken place to carry the imposed loads safely.

Where embankments are more than 10 feet high and the mud is deep, consolidation must be expedited in order to secure stable embankments within the allotted time. Vertical sand drains have

been installed in the mud to assure rapid drainage of the water from the mud so that firm supporting material for the embankment may be obtained. The construction of stable embankments in sufficient time to permit pavement construction before the opening of the Turnpike traffic is mandatory.

In ordinary soils, existing ground is required to be consolidated for one foot depth to 90 per cent of maximum density, AASHO modified, prior to placing fills. In addition, materials in cuts are consolidated to 95 per cent of maximum density, AASHO modified, to a depth of four feet and the tops of fills are treated similarly.

Figure 6. More than 30,000 cubic yards of rock were removed from Laurel Hill in Hudson County. To the left and top can be seen approach piers constructed to carry Turnpike traffic to the bridge crossing over the Hackensack River.

Fills are consolidated by controlled compaction and the top layers below pavement subgrade are of selected, frost-proof, free draining materials.

The work is being performed by prequalified contractors awarded contracts on a competitive bid basis. All portions of the construction must be handled in proper sequence so that as each contractor finishes his work, the other parts will be completed in conformance with the predetermined schedule.

By mid-March the Authority had awarded more than 70 construction contracts for grading, drainage and bridge foundations,

superstructures, pavement and other miscellaneous work totaling more than $170,000,000.

The Turnpike construction program for 1951 contemplates expenditures, or contractors' earnings, of about $146,000,000 less the value of certain work which may be carried over into 1952 without delaying the opening of the Turnpike.

Most of the new contracts to be awarded in 1951 will be for the construction of service and concession areas, including buildings, and many miscellaneous items necessary to complete the Turnpike. This year's program includes also (1) organization of operations and maintenance staff; (2) purchase of operating, maintenance and shop equipment; (3) decisions with respect to the gasoline concessions and lunchrooms, restaurants and their operation; (4) the determination of police organization; (5) establishment of speed limits; (6) determination of toll charges and classification of vehicles; (7) procurement of toll accounting machinery and other details.

The Authority, its engineers and contractors are engaged in planning and devising ways and means to overcome possible difficulties with respect to procurement of critical materials. They are confident that the Turnpike will be opened to traffic on schedule.