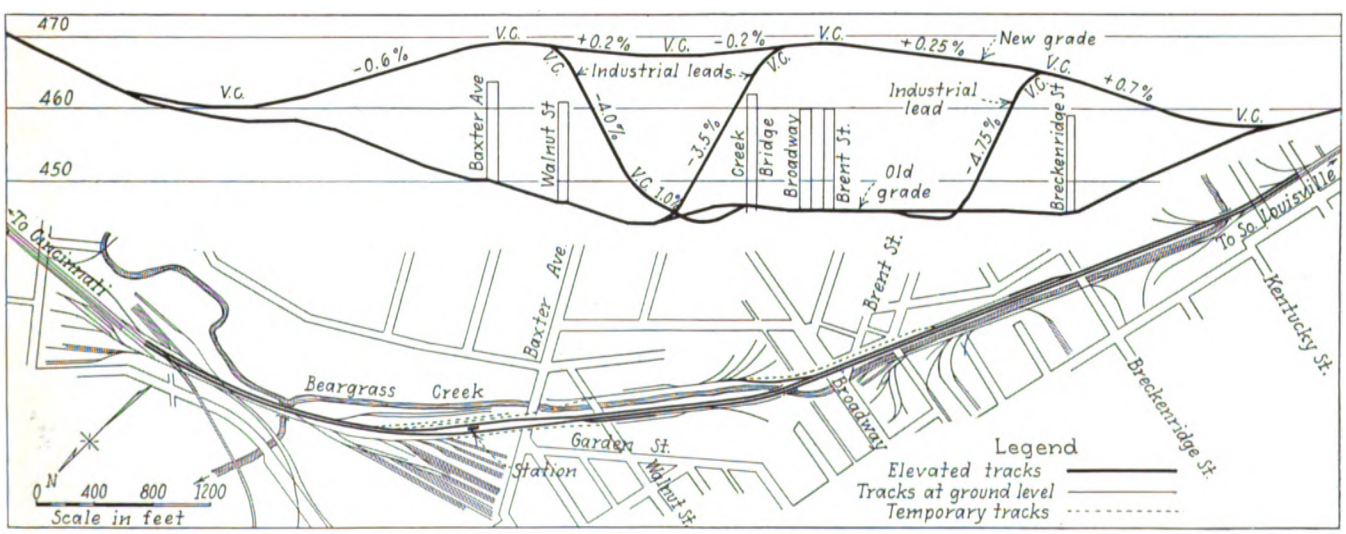
The Concrete Pile Trestle as a Track-Elevation Structure—at the Baxter Avenue Station

Use Concrete Pile Trestle in L. & N. Grade Separation

Project on Cincinnati line in Louisville involves nearly a mile of double-track elevated structure

A REINFORCED concrete viaduct, in which the bents consist of three 24-in. octagonal concrete piles under each track, is the outstanding feature of a track elevation project now nearing completion on the Louisville & Nashville at Louisville, Ky. The project covers a line distance of 8,560 ft., of which 3,353 ft. is embraced in the approach ramps. For the remaining distance the tracks are supported entirely on a structure that includes bridges over five streets and 1,034 ft. of concrete trestle with built-in-place bents and piers. But the pile trestle, including that for the elevated double-track main line and two single-track industrial lead ramps, represents the equivalent of 8,315 ft. of single-track trestle of this type and involved the driving of 1,400 reinforced concrete piles in various lengths up to 55 ft.

The project embraces that portion of the Louisville & Nashville's line to Cincinnati that lies in the valley of Beargrass creek, a small stream that flows in a generally northerly direction across the eastern part of the city to the Ohio river. Owing to the occupancy of adjacent property of industries, unfavorable topography and the necessity for bridges across the creek, only two streets, Broadway and Baxter street, crossed the railway at grade between Kentucky street and Spring street, a distance of 9,000 ft. One other, Breckenridge street, crossed over it on a viaduct. However, because this valley separates the eastern resident section of the city



Map and Profile of the Grade Separation Project at Louisville

from the business center, the concentration of traffic on this limited number of streets gave rise to an urgent demand for grade separation. The project entailed an expenditure of about $1,240,000, of which amount $1,140,625 was allotted from federal grade separation funds, the balance being supplied jointly by the railroad and the city.

Situation Favors Track Elevation

The original location of the railroad in the valley involved a number of crossings of the creek on pile trestles, but during the course of an improvement project that embraced the construction of a concrete-lined channel for the creek and a straightening of the course of the stream as a means of reducing flood damage, the main line was relocated so that it crosses the creek at only three places. However, to provide adequate service for the industries, the railroad has one or more tracks on each side of the creek in most of the affected territory.

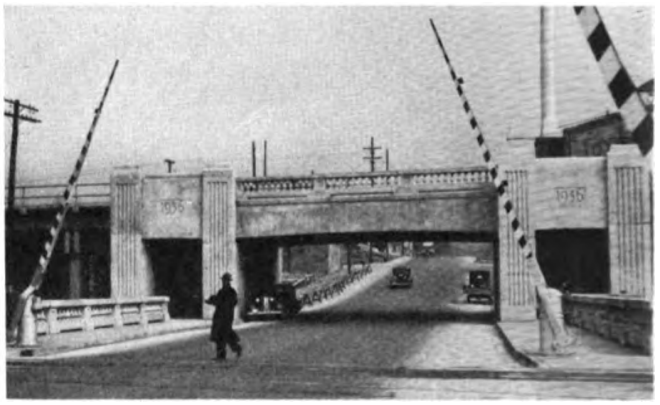
Occupancy of this valley by the railroad required abrupt descents from both the north and the south, a condition that was especially advantageous in the development of a plan for track elevation. As a matter of fact, the required separation of grades—ranging from

The Pile Driving Outfit, Showing the Pipe Used to Core Holes in Locations Near Existing Substructures

17.94 to 23.18 ft.—involved ascents of only 9 to 12 ft., on grades of 0.7 per cent and 0.6 per cent, respectively, compared with descents of 14 to 16 ft., on grades of 0.8 per cent to 0.9 per cent, maximum, on the old grade line. However, to continue service connections with industries it was necessary to construct three leads descending to ground level on grades of as much as 4.75 per cent.

The elevated main tracks occupy substantially the same alinement as the original main tracks on the lower level, except in the vicinity of the Baxter Avenue passenger station, where the two main tracks were spread to make room for a narrow station building and island platform between them.

Train movements during construction were handled over parallel industry lead tracks, together with temporary connections. Between Broadway and Baxter



Breckenridge Street Looking Across the Beargrass Creek Bridge Toward the Undercrossing—Automatic Gates for Industry Lead in Foreground

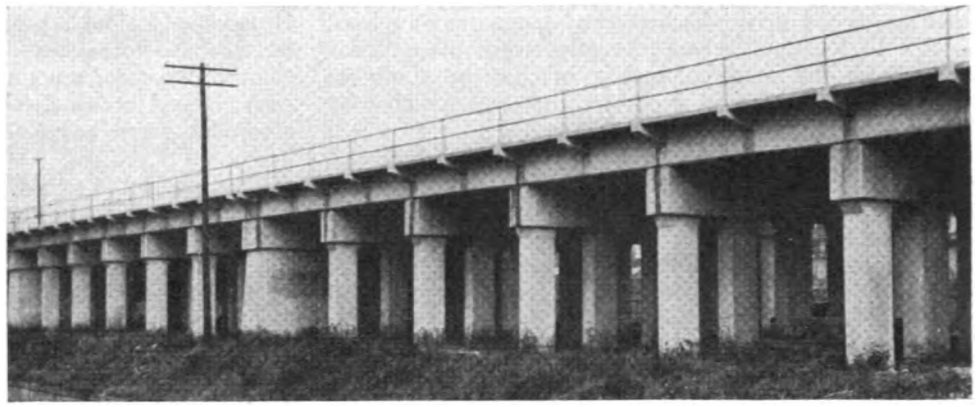
avenue, it was found most convenient to use a track on the opposite side of the creek, entailing the construction of a temporary bridge across the creek just south of Baxter avenue.

Five Street Under-Crossings

Owing to the close promixity of Beargrass creek and of industry tracks on the surface, the raising of the main tracks on embankments with natural side slopes was out of the question. Consequently the choice lay between a fill retained by parallel walls and an elevated structure, and comparative estimates led to the selection of the latter. The agreement with the city called for underpass structures for Broadway and Baxter avenue, for an extension of Walnut street to Hamilton avenue and an extension of Brent street to an intersection with Broadway, as well as an undercrossing to replace the overcrossing at Breckenridge street. The agreement provided also for three-span structures (with columns at the curb lines), accommodating roadways from 33 ft. to 70 ft. between curbs. Except at Baxter avenue, adequate grade separation was provided to permit sufficient floor depth for steel deck girder spans over the roadway, with concrete slabs for ballasted track. At this street, which has a clear span over the roadway of 61 ft., through girders were used. The sidewalks are spanned by reinforced concrete slabs at all streets.

The architectural design of these structures embraces the treatment of the ends of the piers as massive pilasters projecting beyond the faces of the superstructure, and car-

The Beargrass Creek Crossing North of Broadway—Industrial Lead in Background



A View of the Trestle Where Cast-in-Place Bents Were Substituted for Pile Bents

ried above the tops of the spans as pylons. The city plan commission also insisted that the steel girders be masked by concrete facias, which were constructed as girders of an inverted U-section, the top serving as a foot walk. These facia girders are independent of the steel girders and, except in the structure with the shortest span, they are supported at one end on a roller-type expansion bearing. The concrete deck slab on the steel girders was built with a free joint along the center line between tracks, and a copper gutter suspended under this joint carries drainage to the slabs over the sidewalks.

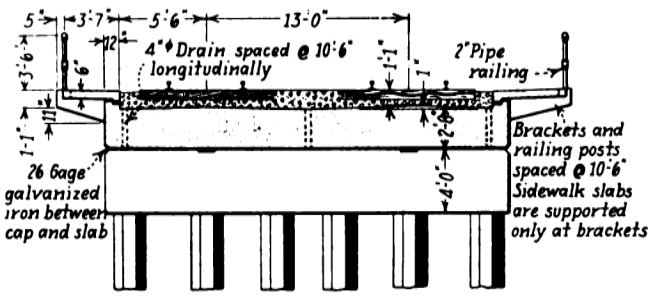
Rock foundation, with an overburden of from 5 to 40 ft. of earth, was available throughout the entire construction territory, and all street crossing substructures were carried to rock. The reinforced concrete trestle is supported on pile bents driven to rock, except for a distance of about 1,100 ft. at the south end, where the overburden is 10 ft. or less in thickness. For this part of the structure, cast-in-place bents were constructed on rock foundation. In other respects, the general design of the trestle is uniform throughout.

The six-pile bents (for two tracks at 13-ft. centers) are spaced 21 ft., center to center, except for odd panel lengths next to the street structures and for the introduction of a double or anchor bent with two rows of piles four feet center to center at intervals of six to eight panels. The piles are topped with built-in-place caps on which reinforced concrete slabs, 26 ft. wide, were cast in place. Brackets extending 3 ft. 7 in. from the two sides were cast with the slabs at one end and the center of the span to support the posts for a pipe railing and precast sidewalk slabs 6 in. thick. Thus, the deck has an out-to-out width of 31 ft. 2 in.

The same design of superstructure was used on the cast-in-place piers. The piers are of a light sill-post-and-cap construction except for anchor piers introduced at intervals of five to six panels.

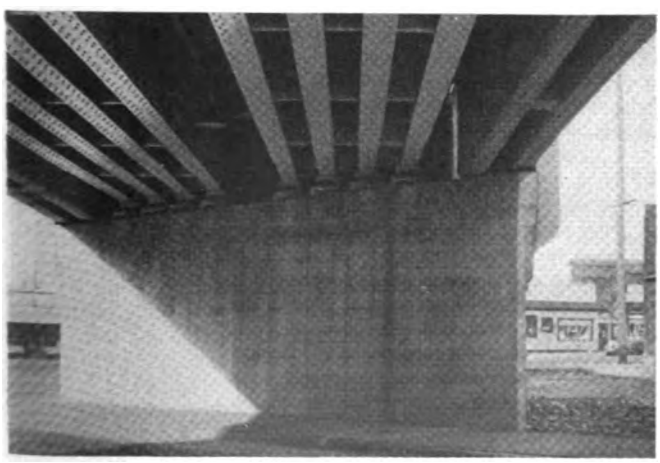
A noteworthy modification of the reinforced concrete pile trestle design was applied for the distance of about 900 ft. from the north side of Baxter avenue to the north end of the structure. Here the main tracks were spread to a maximum of 47 ft. 8 in. to make room for a station to take the place of the old Baxter street station in this location. The new facilities at this point include an island platform about 900 ft. long with a station building at track level 76 ft. 4¾ in. long by 18 ft. 5¼ in. wide.

This platform is supported on bents of two concrete



Typical Cross Section of the Concrete Pile Trestle

piles each, except at the station where three single bents and two double bents of three piles each were constructed. Access to the platform from the street level is afforded by two stairways and a ramp, the lower ends of which terminate in concrete walks under the structure that lead to a station entrance on the ground level on the north side of Baxter avenue.



A View Underneath the Brent Street Under-Crossing, Showing the Double-Girder Concrete Fascias that Support the Trainmens' Walks

Pile Driving Methods

The project was carried out under contract by the Henry Bickel Company of Louisville, and all piles and other precast units were cast in the contractor's headquarters yard which abuts on the railroad in the vicinity of Garden and Baxter streets. The driving of the piles was sublet to the Western Foundation Company of Chicago. As the terms of the contract made the contractor responsible for the length of piles required, special care was taken in making soundings to determine the required penetration. This was done economically and effectively by driving a ⅝-in steel rod with a sledge hammer.

The piles were driven by a No. 0 Vulcan steam hammer with a 7,500-lb. ram, suspended from an 85-ft. boom supported by a skid derrick operating on the ground. The piles were delivered on cars over a track that was

taken up as the driver backed away from the completed bents. In locations where the piles were placed near the walls of the creek channel or in close proximity of sewers, excessive lateral ground thrust was avoided by driving the piles in cored holes. These holes were formed by driving a steel pipe of 15-in. inside diameter that was equipped at its lower end with a detachable alloy steel bell or cutting edge with diametrical diaphragms. In addition, a cable, with one end bolted to the cutter, was extended partly through the length of the pipe. After the pipe had been driven, it was pulled out, the cable disconnected, and the cutter removed from the pipe. Then, by pulling on the cable, the core of spoil was removed from the pipe.

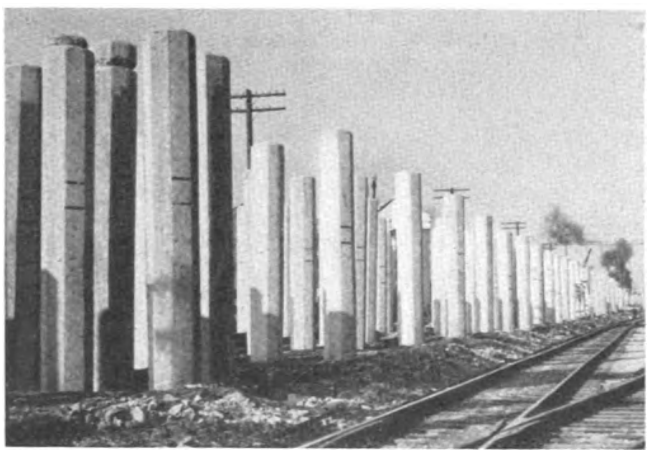
Concrete Work

The cast-in-place concrete was mixed in a plant set up in succession at four different locations along the viaduct. The aggregates were batched into trucks at the plant of the Ohio River Sand Company along the river bank, but the cement, which was received in bulk, was added at the mixer, a one-cubic yard paving-type outfit. All concrete was proportioned for a water-cement ratio of 5¾ gal. per sack of cement, which required on the average about 6.2 bags of cement per cubic yard of concrete.

Concrete for street crossing piers was delivered in agitator trucks and placed in the forms by chuting or with one cubic yard drop-bottom bucket hoisted by a crane. However, the most noteworthy feature of concreting methods was the placing of the concrete for the bent caps and the trestle slabs by the "pumpcrete" method, whereby it was transported through a 7-in. pipe for distances of as much as 800 ft. against a static head as great as 30 ft.

To insure smooth surfaces, all forms in locations where the concrete is exposed to view were faced with Masonite or galvanized sheet metal. Both internal and external vibrators were employed while the concrete was being placed.

The change from an overcrossing to an undercrossing



Trestle Piles Ready for the Caps

at Breckenridge street entailed the construction of a new street bridge across the creek and the crossing at grade of the industry tracks on the west side of the creek, this being the only grade crossing of a track with a street within the grade separation limits. To protect this crossing, which is subject to two switching movements daily, an automatic crossing gate has been installed.

The only crossing of the creek that was seriously affected by the track elevation was the one just north of Broadway, a double-track 65-ft. skew deck girder span on concrete masonry. To adapt this structure to the change in grade, amounting to about 21 ft., the spans were jacked up to the new elevation, after which the abutments were extended by pier shafts of the required height.

This project was under the general direction of G. R. Smiley, chief engineer, and C. H. Blackman, principal assistant engineer, of the Louisville & Nashville; Mack Galbreath, senior highway engineer, U. S. Bureau of Public Roads; and T. H. Cutter, chief engineer, Kentucky Department of Highways. The elevated structure was designed and detailed under the supervision of J. M. Salmon, bridge engineer, and O. L. Vandament, assistant engineer of the L. & N.

Odds and Ends . . .

Air-Conditioning

Amazing as it seems, it was not until September 1 of this year that the first air-conditioned car was placed in service on the railways of India, one of the hottest places in the world where a railway system of any extent is operated. It is planned to have air-conditioned cars for first-class passengers in operation on all express trains between Bombay and Delhi within the next few months.

Railway Minstrels

Some years ago the Booster club of the Missouri Pacific at Memphis, Tenn., organized a troupe of minstrels to give one performance for charity. So popular did the troupe become, however, that they recently gave their 210th performance. They have appeared before more than 50,000 people and have earned more than $15,000 for local charities.

Brothers

Recently on the California Western out of Willits, Cal., the crew of the lead engine consisted of William Monsen, engineman, and Charles Monsen, fireman. The helper engine on the same train was manned by Carl Monsen at the throttle and Fred Monsen at the scoop. All of the Monsens are brothers, whose only employment has been with the C. W. Dispatcher Claude King of that line claims that this is a record for brothers on one train.

A Good Show

The railways have something to show that surpasses in excitement and romance anything that can be produced by any other industry, but for many years they neglected the opportunity. The Erie is one of the roads that have abandoned the old policy of secrecy. At its yards at Marion, Ohio, that railway has a modern plant, equipped with car handling devices, such as retarders, that most people outside railroading know nothing about. In the past few months, the Erie has taken both the Rotary and the Kiwanis clubs over the plant, and the influential citizens of Marion now know something of what the railroad means to the community, as well as the efficiency with which their shipments are handled.

Imperial Engineer

It is 100 years since the first railway was built in Russia, a short line between Saint Petersburg and the Czar's summer home at Tsarskoye Selo. The success of this line induced Nicholas I to order the construction of a line between St. Petersburg and Moscow. As usual, bribery entered the picture, as each city anywhere near the route tried to have the transportation ministry run the rails so as to serve its citizens. The matter dragged on for months, until finally the Czar lost patience. Calling in his Minister of Transport and the engineers, he laid a ruler on the map between the two cities, drew a straight line and commanded that the railway be built along it. Accordingly the tracks were built on a bee line, regardless of important intermediate cities.