GRAND TRUNK RELOCATION ON DETROIT-PONTIAC LINE

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State pays for land and construction, to be repaid in 15 years - heavy grading and numerous bridges - electrification planned

Relocation of 9 miles of railway on a new right-of-way provided by the state, with grade reduction, grade separation, eighteen bridges, heavy cuts and fills and extensive landscaping through residential districts are among the interesting features of an improvement now completed on the Grand Trunk Western Ry. between Detroit and Pontiac, Mich. Filling sink-holes and terracing deep cuts were unusual items in the grading. Provision for four tracks, high speed suburban service and possible electrification of the 26 mile line are other items of special interest. This $7,000,000 improvement was initiated mainly in order to permit the construction of a super-highway, whose widening to 204 ft. will encroach on the railway's old right-of-way. Editor.

A STATE HIGHWAY project for widening Woodward Ave. as a 204-ft. super-highway between Detroit and Pontiac, Mich., was the initial cause of the relocation of 9 miles of the Detroit division of the Grand Trunk Western Ry., but the improvement has included numerous works accessory to the mere relocation. For several miles the railroad right-of-way adjoined the east side of Woodward Ave., so that relocation of the line was necessary before the widening could be undertaken. As the territory between Detroit and Pontiac has been highly subdivided and partly built up as a residential district, the general policy of the improvement included: (1) complete elimination of grade crossing, (2) provision for marginal highways to facilitate traffic affected by street closing, (3) landscaping along the new right-of-way and (4) development of fast suburban railway service. This improvement supplements the extensive grade separation of the Grand Trunk Western R.R. in the city of Detroit, as described in *Engineering News-Record* of July 10, 1926, p. 60. Work was begun in 1928 but was interrupted for one year by litigation, the line being opened officially on Aug. 1, 1931. The cost of the relocation was about $7,000,000. Under the original charter of the Detroit & Pontiac Ry., built in 1838-1843, the taxes paid by its successor, the Detroit, Grand Haven & Milwaukee, later acquired by the Grand Trunk Western, have been based upon a fixed percentage of the capital stock. In recent years the State of Michigan has sought to have this charter surrendered and the railroad reincorporated under the present general railroad law, by which taxes would be charged upon the value of the property. As the special charter was upheld by the supreme courts of Michigan and the United States, it played an important part in the negotiations for the relocation of the railroad.

The most important section was the stretch of line from Royal Oak to a point 3-1/2 miles north of Birmingham, Mich., where the railroad was parallel with and adjacent to Woodward Ave. Relocation was first considered 26 years ago, as encroachments on the right-of-way had limited the line to a single track and there was no possibility of increasing the railroad facilities. But the cost was prohibitive, and the matter rested until 1923, when the state legislature passed a bill to finance the widening of Woodward Ave.

As this improvement necessitated acquisition of the railway right-of-way, negotiations resulted in 1927 in an agreement by which the state undertook to finance initially and to acquire a new right-of-way for the railroad, approximately 3/4 miles east of the original location and extending from mile-post 13 at Royal Oak to mile-post 22, north of Birmingham. It also undertook to finance the initial cost of: (1) grading a double-track roadbed, (2) constructing grade separations at certain streets, (3) constructing a single-track main line and reproducing the other track facilities on the old line, (4) reproducing the equivalent buildings, telegraph lines, water facilities, signals, etc., as existing on the old line. Furthermore, the state agreed to bear the cost outright of all additions and betterments in connection with the highway work, including parallel roads along the right-of-way, while if additional grade separations were required, each party would bear 50 per cent of the cost.

On its part, the railroad undertook to return to the state the cost of land and construction (except for those parts of which the state agreed to bear the cost outright) by annual payments during fifteen years, without interest. It also undertook to bear the entire cost initially and outright of additions and betterments beyond those covered by the agreement. Finally, it agreed to surrender its special charter at the end of the 15-year period and to re-incorporate under the general railway laws of the state. It was further provided that all planning and engineering supervision should be under the direction of the chief engineer of the railroad, subject to approval by the state highway commissioner, while these officials would act jointly in the purchase of land and letting of contracts. All property was acquired in the name of the state, to be deeded later to the railroad company. Agreements with the various local municipalities covered approval of the designs and also provided 15-ft. easements parallel with and adjoining the right-of-way, which were granted to the communities for planting trees and shrubbery to screen the embankment in the residential districts.

Location and grading

Between 1922 and 1928 several locations were studied. The adopted line is 8.82 miles long, or 0.28 mile shorter than the old line. It is all on tangent except for a 15-min. curve at Birmingham and a 2-deg. curve running into the old line at the north end, the curvature per mile being 15 min. as compared with 2 deg. on the old line. The maximum grade is now 0.65 per cent instead of 1 per cent. From Royal Oak to Birmingham, 5 miles, the roadbed is on a fill averaging 14 ft. in height, so that there is a minimum of street excavation at the crossings. Beyond Birmingham there is rolling country and the cuts have an average and maximum depth of 20 ft. and 50 ft., respectively. All cuts and fills were constructed for four tracks, but at present only two tracks have been laid. The grade reduction extends 2 miles beyond the relocation to Pontiac, the new roadbed being cut alongside the old one with an average difference of 24 ft. in elevation. This part of the work was complicated by heavy traffic on the existing line.

For the control of grading operations, rather than the balancing of yardage, the project was divided into three zones with a total of 1,750,000 cu. yd. of excavation. Zone 1, extending south 3 miles from the end of the new line, required 710,000 cu. yd. of fill, while the excavation from cuts and street lowering amounted to 530 000 cu. yd. The additional 102,000 cu. yd. of fill was furnished by the grade-reduction cut on the old line into Pontiac. A sink-hole complicated matters by requiring an extra 100,000 cu. yd. before a stable fill could be obtained.

Zone 2, 2-1/2 miles, involved 290,000 cu. yd. from cuts and 46,000 cu. yd. from street lowering. As the fill was only 300,000 yd., the excess material was used in Zone 3 and for grading a new freight yard at Birmingham. Zone 3, 4 miles, required 640,000 cu. yd. for continuous fill, but street excavations provided only 110,000 yd., the remainder being obtained from the grade-reduction cut at Pontiac. Thus the haul for this zone exceeded 9 miles, while in the other zones it was relatively small. The deepest cut was 50 ft., on the grade reduction north of the new line, this section also having the highest fill, averaging 40 ft. for a length of 6,500 ft. On the new location, the deepest cut was in Zone 1, averaging 40 ft. for a length of 2,000 ft. Cuts are drained by open ditches and subsurface drains of concrete pipe are laid with open joints in trenches backfilled with bank-run gravel. The size of pipe varies with the length of cut and with the amount of flow estimated from a year's observation of the drainage during construction.

Sink-holes cause trouble

In this locality glacial action has formed bowl-shaped depressions filled with unstable material composed of decayed vegetation and in general covered with overburden solid enough to conceal them. A sink-hole 400 ft. long in Zone 1 completely wrecked the construction trestle when 15 ft. of fill dropped, forcing out the underlying muck at the sides. The fill was completed by raising the track on successive dumps until a solid base was reached. Two sink-holes about 300 ft. long and 27 ft. deep occurred in the deep 9,200-ft. cut south of Pontiac. All the muck was removed from these, and 11,000 cu. yd. of stable material was used in backfilling.

Terracing was adopted in the deep cuts in order to minimize sliding or sloughing of the slopes.

Since 85 streets were crossed and no grade crossings were permissible, the location of grade-separation structures had to be studied carefully in order to provide adequately for the highway traffic. The selection was influenced by the master plan system of highways for Detroit and its environs. Besides fifteen railroad bridges and three highway bridges, seventeen marginal highways and numerous street diversions were constructed to connect closed streets with those having bridges.

The railroad bridges conform to a general type developed by the Grand Trunk Western Railway for its grade-separation works in various cities. Their architectural treatment is simple, with plain copings and fascias, paneling being used sparingly and pylons for the hand-railing providing a finish for the abutments. Sidewalk bents are used in all cases, and the sidewalk width averages 7 ft. Box abutments, combining the abutment wall and sidewalk bent, were used at one bridge.

Abutments and wing walls are of the stepped gravity type, except where the height necessitated the counterfort type of construction. The roadway units were designed to provide single 28-ft. roadways or double 20-ft. or 28-ft. roadways, as required. At Oakwood Boulevard, or Twelve-Mile Road, four 28-ft. roadways were provided for a future super-highway 204 ft. wide.

All the bridges have ballasted decks, the spans consisting of I-beams embedded in concrete, with a maximum depth of 4-1/2 ft. from base of rail to underclearance. The only variation from the standard type was at a bridge on 30 deg. skew, where the span length necessitated half-through plate girders with shallow floor beams cased in concrete. All bents are of the arched type, the columns resting on inverted T-beam footings, which are usually founded in hard clay. Plastic clay at one bridge necessitated piling; quicksand at three others required deep footings; large sewers in some cases required steel sheetpilings and other special construction. The bridges were built for four tracks and a minimum highway headroom of 14 ft. Depressed highway approaches have maximum grades of 4 per cent, with vertical curves averaging 400 ft. long in the sag and 100 ft. at intersection with normal street surface.

Standard construction could not be applied to the three highway bridges. As the Trowbridge Court bridge, with seven 33-ft. spans of reinforced concrete, crosses the 50-ft. cut, the unsupported height of columns was reduced by means of spandrel arches. In the end spans a half arch runs into a horizontal girder extending to the abutment. Continuous T-beam and slab construction was used in this bridge and the Derby Road bridge, each of which has a 30 ft. roadway and two 5-ft. sidewalks. The Adams Road bridge, with five 56-ft. spans, is on a skew of 35 deg., and as it required long approach fills, the depth of floor was reduced by using I-beams cased in concrete and carrying an 8 in. deck slab. This bridge has a 40 ft. roadway and 6-ft. sidewalks.

For drainage from the deck and backfill of the railway bridges, three catchbasins placed between the tracks at each end of the bridge are connected to a 6-in. perforated galvanized pipe laid on the first bench of the abutment. Vertical 6-in. galvanized pipes lead thence to a drain of concrete pipe laid above the footings and connected with a street catchbasin.

To determine the efficiency of the upper horizontal drain, the pipe was extended beyond the fill at some of the bridges. During both a severe short rainfall and a prolonged heavy rainfall, which ordinarily would tend to saturate the ballast and backfill, it was observed that this pipe carried a considerable flow and so prevented the building up of hydrostatic pressure in the backfill behind the abutment. During intermittent rainfall this pipe appeared to be of little use, as the porous character of the backfill enabled the water to flow directly to the lower drain pipe.

Stations and yards

For the residential village of Birmingham, Mich., an attractive passenger station has been built, with a tunnel serving stairways leading to the platforms, while a separate tunnel serves the baggage elevators. A concrete plaza provides for automobile parking. South of the station is an industrial development intended to accommodate industries that were located on the old line. Here are provided a fifteen-track freightyard, a teamyard with concrete driveways, and a freighthouse with two house tracks. Passenger facilities provided at three other points for the suburban commuter service include

concrete platforms 400 ft. long, steel shelter sheds and steel stairways to the street level. As [illegible] passenger stations will be built at these places later, tunnels for future platform stairways were [illegible] during the construction of the line.

Miscellaneous work

In consequence of the district traversed being heavily built up, considerable work was required [illegible] the protection of sewers, water mains and other public utilities. Many of the larger sewers crossed were protected by concrete arch saddles, while water mains and the smaller sewers were cased in concrete. But in many cases the old lines were abandoned and new sewers and mains built on different routes. This work was undertaken in advance of grading and constituted one of the major projects. After grade separations had been completed, paving and sidewalks were relaid. House services were replaced, and the side slopes of street approaches were sodded. In the aim to restore or even improve the original conditions, the railroad had cooperation from the city engineers and [illegible] authorities of the several municipalities. The new tracks are laid with 100-lb. rails of A.R.E.A. section on creosoted ties, fully tie-plated and carried in washed and screened gravel ballast. Automatic signals of the three-position color-light type have been installed for the entire distance between Detroit and Pontiac. As the latter city is a manufacturing and automotive center, served by three divisions of the Grand Trunk Western, the company undertook the construction of a belt line to provide better interchange of traffic. This belt line connects with the relocated main line about [illegible] miles south of Pontiac.

Construction methods

Fills were made by dumping the core from temporary pile trestles, the material being hauled on narrow-gage tracks by 5-yd. air-dump cars and gasoline locomotives. Only the caps and stringers of these trestles were recovered. Widening the fills and handling the long haul of material from the deep cut at the north end of the line was done by 12-yd. air-dump cars and steam locomotives, with track plows or spreader cars to level the dumped material. For miscellaneous hauling, including material from street excavations, motor trucks were used, depositing the material in the fill with minimum haul. Steam shovels ranged from 3/4-yd. machines for the lighter work to 3-yd. machines in the heavy cuts. A 6-yd. dragline machine was used on the north cut alongside the old line, where it was necessary to maintain the hauling track on the upper level.

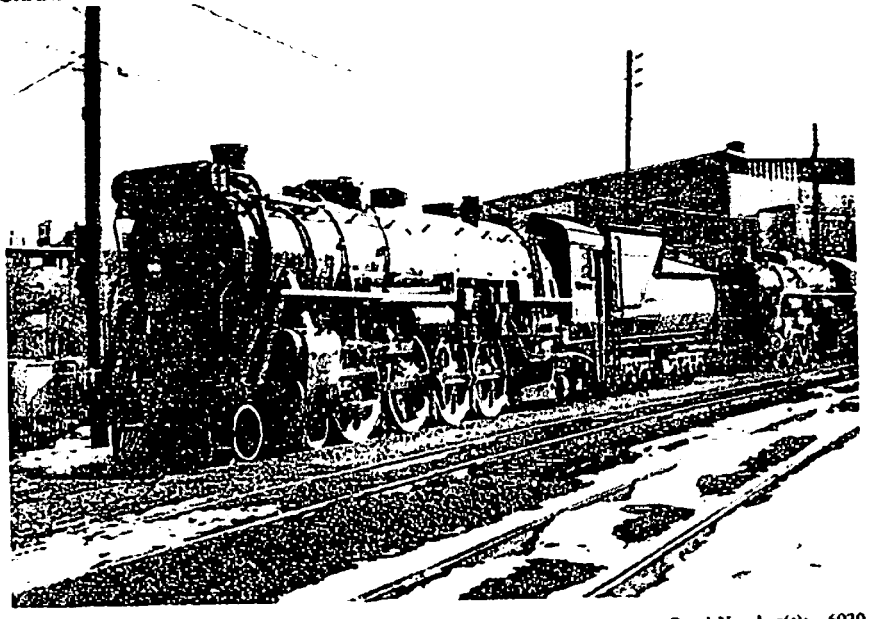
A concrete plant was established at each bridge. Field control included proportioning by the water-cement ratio analyses of aggregates, slump tests and the taking of test cylinders. For the footings and neat work of gravity abutments and wing walls, a nominal 1:2-1/2: 5 mix was used, with a minimum of 7 gal. of water per sack of cement. For reinforced concrete and the footings and neat work of bents and deck slabs, the nominal mix was 1:2:4, with 6-1/4 gal. of water per sack of cement. When concreting at temperatures below 50 deg. F., the aggregates and water were heated and the concrete in place was protected by a tarpaulin enclosure in which the temperature was kept at 60 deg. by steam heat for seven days. During this period the concrete was wetted thoroughly each day, so that in effect the enclosure was a moist chamber for the curing of concrete. Full sections between expansion joints were completed in each pouring. A smooth and even finish was obtained by stripping the forms as soon as practicable and rubbing the exposed surfaces with carborundum blocks. A smooth floated finish was given to the decks of all the bridges.

A waterproofing membrane for the bridge decks consisted of two plies of cotton fabric saturated with asphalt and laid with a concrete priming coat and three moppings of hot asphalt. This membrane was protected on level surfaces by a 1-1/4 in. coat of rolled asphalts and mastic. On the sloping inside face of the fascia girders, asphalt plank was laid, having a molded end that was tucked into a groove in the concrete at the ballast line. Both the membrane and protective coating are carried down over the bridge seat joint to a seat provided 18 in. below on the back of the abutment. The backs of all walls and abutments were given a priming coat and two hot moppings of asphalt mixed with asbestos

Engineers and contractors

The principal contractors were as follows: grading, H.W. Nelson Co., New York, N. Y.; bridges, A. Guthrie & Co., St. Paul, Minn., paving and sewer work, R.D. Baker Co., Royal Oak, Mich.; station at Birmingham Walbridge-Aldinger Co., Detroit, Mich. Tracklaying was done by railroad forces. This entire project was planned, designed and executed under the direction of J.A. Heaman, until recently chief engineer of the Grand Trunk Western, with F.P. Sisson as principal assistant engineer. A.N. Laird bridge engineer, and H.D.F. Ingram, field engineer in charge of construction. The final negotiations and settlements with the State of Michigan, local municipalities and some of the contractors will be directed by P.D. Fitzpatrick, who has recently succeeded Mr. Heaman as chief engineer of the Grand Trunk Western.

GRAND TRUNK WESTERN RAILROAD NO. 6039



Owner(s): Grand Trunk Western Railway
Grand Trunk Western Railroad

Road Number(s): 6039
6039

Whyte System Type: 4-8-2 Mountain

Class: U-1-c

Builder: Baldwin Locomotive Works

Date Built: June 1925

Builder's Number: 58463

Cylinders (diameter x stroke in inches): 26 x 30

Boiler Pressure (in lbs. per square inch): 210

Diameter of Drive Wheels (in inches): 73

Tractive Effort (in lbs.): 65,000 (also reported as 49,590)

Tender Capacity: Coal (in tons): 18
Oil (in gallons): Not applicable

Water (in gallons): 13,575

Weight on Drivers (in lbs.): 231,370

Remarks: Engine has duplex mechanical stoker, vanadium steel main frames, boxpok drive wheels, and a Vanderbilt tender. It has bad cylinder castings.