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Grade Crossing Elimination
Grand Trunk Railway and Grand River Road
between
East Lansing and Okemos

A thesis submitted to
The Faculty of
MICHIGAN AGRICULTURAL COLLEGE

by

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Candidates for the Degree of
Bachelor of Science

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Preface

In the following analysis, we have endeavored to ascertain the feasibility and practicability of a new location of the State Trunk Line No. 16, where it crosses the Grand Trunk R.R. tracks between East Lansing and Okemos, as laid out by the Michigan State Highway Department, and we have carried out our work to the best of our knowledge and ability.

We are greatly indebted to Professor H. K. Vedder for his help and instruction in the difficulties that were met in this analysis.

We are also indebted to members of the State Highway Department, especially Mr. Burton, for the valuable information and assistance given us.

J. C. Ackerman,

N. V. Fullen,

Outline of Procedure.

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History

Grade elimination in the United States is very recent, having come into existence between 1900 and 1905. The first development came with the adoption of elevated Railway lines. Soon after this the surface railroads began to run their lines up into the heart of cities by filling and grading their rights of way. Eastern cities like New York, Boston and Philadelphia, were the first to eliminate the grade crossings.

A good many people have been killed at railroad crossings but a large percentage of the accidents and fatalities are due to carelessness on the part of individuals traveling on the highway. Since this is so, it remains to use systems which are "fool proof", so to speak. Grade separation is the means of accomplishing this purpose.

Introduction.

The elimination of the Grand Trunk R. R. grade crossing on Grand River Road between East Lansing and Okemos, has been desired for some time, and has been under consideration both by the State Highway Department and the Ingham County Road Commission. This crossing has earned an unsavory reputation which has given it the local name of "Death Crossing", since there have been five persons killed, besides several motor cars wrecked, without fatalities, at this place in the last two years.

A curve in the rail line to the southwest, and the high banks of the cut to the northeast, make it an extremely hazardous crossing from either direction, as any long view in either direction is impossible. The road at this point, which is the main Lansing-Detroit road, is a very heavily traveled road. In the summer months it carries practically the entire Pine Lake resort traffic. Traffic counts have shown from 2,000 to 3,000 vehicles daily normal summer traffic. This count is enormously increased on Sundays and holidays by the traffic to Pine Lake, which is linked to Grand River by three miles of improved road north of Okemos. Just east of the railroad crossing, at the Okemos cemetery, is a sharp curve with a high inside bank cutting off the

sight of vehicles approaching each other at this point. The fact that a cemetery is located on the inside of this curve makes impossible any relocation on that side. The State Highway Department, therefore, decided to shift the new line away from the cemetery and include the elimination of this danger point as part of the new project. The center line of the new road at the cemetery is to be shifted 50 feet to the north of the present line in order to have a 100 foot right of way around the cemetery. The State Highway Department has hopes of obtaining a 100 foot right of way all the way from Lansing to Detroit, but no definite action has been started as yet.

Architectural Beauty.

In the design and building of almost any structure, it is best to have it as pleasing to the eye as possible, without damaging its usefulness or efficiency. In road and bridge construction curves and curved lines are more conducive to beauty than straight lines. Thus, in a project of grade elimination, it is necessary that the designer take aesthetics into consideration in his design, especially if the project is in a city or on a much traveled road.

Property Damage

The damage to property is another vital item that must be considered in any building project. The object is to disturb or damage as little property as possible and still make the project complete. In this problem, as in all similar problems, there will be considerable property damage but there are other conditions or features that outweigh the damages.

Drainage

The drainage of the road and bridge will be very simple because of the nearness to the Red Cedar River and the grade possible to be obtained.

Which passes over the top.

Whether the highway or the railroad passes over the other is an economic consideration. Where several crossings which are fairly close together are to be eliminated, the railroad can be raised above the streets or depressed below them. It is not usually economical to depress the railroad. The important elements which determine track elevation, or street elevation or depression are: accessibility of dump for excavated material; the number and length of bridges crossing the railroad; the length of haul to borrow pit; drainage of railroad if depressed; the drainage of streets if depressed; and the architectural question of civic beauty. In the case of the elimination of a single crossing a railroad elevation or depression is not economical, while street grades vary from 2 to 7%. The result is the elevation or depression of the street. This applies not only to a single isolated crossing, but also to the case where several crossings are so far apart that the cost of railroad elevation or depression is high.

Each particular problem must be studied carefully before any plan is adopted. Estimates of cost should be made, if necessary, to determine which method to use.

LEGEND.

- HOUSE ----- [H]
- BARN ----- [B]
- STREAM ----- [wavy line]
- FENCE ----- x-----x-----x-----
- GUARD RAIL ----- [line with cross-ticks]
- RAIL ROAD ----- [line with cross-ticks]
- CENTER LINE OF ROAD ----- [dashed line]



EGE.

OF S.T.L. N^o. 16.

T. R R CR'SS'G.

D.S.

SCALE 1"=100'
J. S. Ackerman
M. V. Fuller

Preliminary Survey

The preliminary survey consists of an investigation of the general features of the country immediately surrounding the project. This survey gives the surveyor a general outlay of features, and from it he obtains some information from which he can determine a temporary method, at least, of attacking the problem.

The preliminary survey of this problem was very brief because it was decided to follow out the temporary design of the State Highway Department.

Topographic Survey

The topographic survey was done with a transit and level rod and a good share of the work consisted of making a topographic map of the territory involved in the new road location. A contour map and other physical features were made as well as a plan and profile map of the new road.

Traffic Survey

A count of the number and kinds of traffic passing on average day and on an unusually busy day was taken to determine approximately how much use the bridge and highway would really receive.

120

110

100

PR

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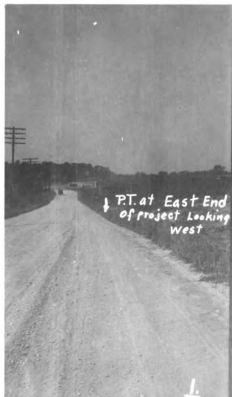
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Views of Project

Below are some views taken both along the present road and the new road as contemplated.





4



6



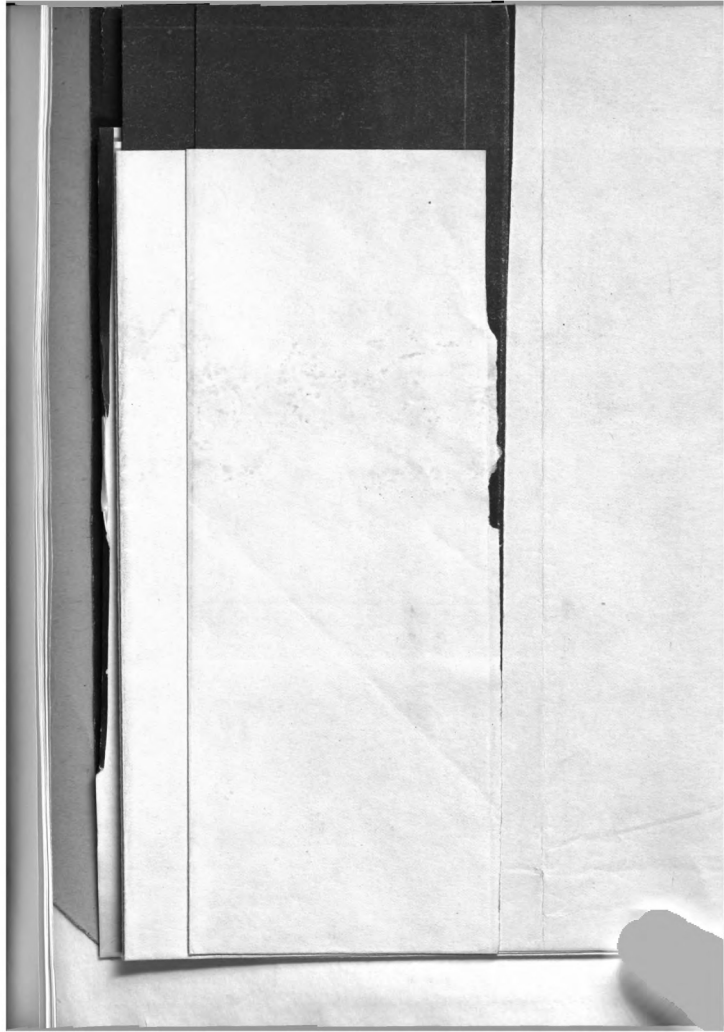
Looking South on
C.T. showing Curve
to the right.

7



Looking East on the
Present road.





Estimate of Cost

The cost of the entire project is estimated at \$80,000 by the State Highway Department. Seventy-five percent is paid by the State and twenty-five percent by Ingham County, while the G. T. R. R. Company pay \$17,500 and are free from further implications.

Bridge and Culvert.

The accompanying blue print sketch of the bridge over the Grand Trunk Railway and the culvert over the Pine Lake Outlet, was made by the State Highway Department.

The bridge is a special type of concrete girder construction, designed by Mr. Melick of the Bridge Department, of the State Highway. The analysis will not be dealt with here but the theory of its peculiar shape is to take care of the larger moment in the center by having a large effective depth. On the ends the effective depth need not be so great because shear is practically all that must be cared for. As shown in the sketch, it is to be 90 feet span which is very large for a concrete bridge other than an arch. The reason for making it so long is on account of the skew of 49° , and also because room enough must be provided to take care of 4 tracks, whereas only two are now in existence at that point.

The roadway is to be 22 feet wide. In the sketch, the bridge is shown as having a clear distance of 22'6" between top of rail and bottom of girder, but, according to statements by highway officials, a special permission will be granted making the distance 20'00". Of course, safety devices will have to be provided for on each side of bridge, so that persons on top of railway cars will be warned upon approaching the bridge.

The culvert over the Pine Lake Outlet must carry a 20 foot fill so it must be built strong enough to withstand the enormous pressure. The roadway is 20' wide, while the length over all is 87 feet. There is a shoulder which extends 28' along the top on each side of the roadway, as shown in the sketch. The waterway is 20 feet wide thus allowing a large flowage of water during a flood time.

OF NEW CENTE
location S.T.L N
- WITH -
Separation & G.
- VERT. 1" = 10' SURV
HOR. 1" = 100' AN
DRAW

51

217

220

Economy of Location

The surveys and some study of the topographical features having been made, an overhead crossing with $3\frac{1}{2}\%$ approaches was decided on at the point indicated in the accompanying sketch. Two factors practically controlled the location of the overhead bridge site. In the first place, the stream indicated flows through a rather deep gully which would necessitate an unusually long barreled arch or high abutments, if a flat slab culvert were used, even though a level approach were possible. With 4% approaches, then, the farther from the railroad that it would be possible to place this culvert, the smaller the structure and consequently less expensive this part of the project would be. On actually estimating the difference in cost between the proposed line and an alternate location a few hundred feet north, the saving on this culvert was decidedly marked.

The second factor was, of course, the necessity for adequate width of right of way at the cemetery corner. In view of the fact of the increasing traffic on this highway, it was decided to secure 100 foot right of way, restoring the right of way lines to the original width of the old territorial road. If, then, the 50 feet for one half of the right of way was necessary opposite the cemetery, and a straight alignment was to be preserved,

the other factor was fixed.

Beginning at the west end of the new location which is at a point where the new 100 foot right of way just clears the large barn a quarter mile west of the old railroad crossing, the new roadway rises on a 0.3% grade to a point just west of the north and south road which is crossed by a four foot north and south hill, then the road rises on a 3 $\frac{1}{2}$ % grade to the overhead structure, which is approached on each end by a short vertical curve and 50 foot of level road, at this point is a 20 foot hill; then down a 3 $\frac{1}{2}$ % grade to a point over the new culvert where the fill is 20 feet high; then down a 0.5% grade to a point just east of the cemetery; and then at a 0.25% grade to the P.T. as shown on the topographic map.

In an attempt to minimize the damage to abutting property as much as possible, quite a detailed study was made by the State Highway of the landscape plan to be followed in the construction of this embankment. There is such a large amount of fill, 50,000 cubic yards, needed that the hummocks near the road on the east side of the track will have to be graded down. That part of the sketch north of the road shown in the accompanying diagram as a suggested county park, is counted on to furnish a majority of the earth needed and it is planned to grade this down to such a shape as to leave it



Proposed Landscape Arrangement - Relocation STL No 16.

desirable for a tourists camping ground or county park. With proper planting as shown and the addition of a grave drive and rustic bridge over the stream flowing through it, this park could easily be made one of the beauty spots of Ingham County. This stream is the outlet of Pine Lake and can be counted on to furnish clear flowing water most of the year.

The property just south of the embankment will be undisturbed in the vicinity of the residence and the objectionable features of this high embankment to the rear are to be softened by the planting of trees, shrubbery and vines to cover the bare slope. Access to the new highway, of this and other properties along the old road, is to be insured by the retention of the old highway as a park drive with a circular return in front of this property. The old grade crossing will be permanently closed so there will be no possibility for future accidents. The property through which the stream flows, south of the fill, is also planned as part of the county park, as the topography of this area is unsuitable for residences.

That part of the area east of the creek, indicated in the plan, is to be graded down in such a way as to furnish additional earth for fill and to provide more suitable location for residences. The private drive on the extreme east end of the project is to be retained

as a means of access to the farm to the north and also for a suggested residence along this drive.

All roads and drives intersecting the main highway are to be graded and a parked space for planting reserved in the triangle between the two branches of the approach.

Feasibility of the Project.

We maintain that the project as outlined by the State Highway Department is entirely feasible and actually desirable.

By the means adopted in grading, the value of the properties along this project will be increased rather than decreased. What is now a hummocky piece of not very desirable farm property, will be graded and can be so planted that it will be a very desirable suburban residence property. Instead of an outlook on a dusty and barren looking highway, there will be a paved road running between lines of trees and shrubs, screening out the objectionable features. All of the safety and freedom from intrusion of a private drive will be given the existing property with the additional advantage of an easy approach to one of the main highways of the state.

The project is further feasible from a standpoint of cost. If the present highway were to be graded up so that the highway could pass over the railroad, there would have to be a detour provided for. The most logical detour would, perhaps, be to turn west in Okemos and go two miles and then back north two miles, striking the S.T.L. 16 again just north of East Lansing. This detour would be four miles long. The average number of cars passing per day is about 2500, which, at 10¢

per mile, would cost \$1000 per day to the public at large. It would take at least two months to build the crossing which would mean a cost of \$60,000 to the public.

There would also be the cost of preparing and maintaining the 4 miles of detour road. This would be no small item with such heavy traffic as this road would have to carry. This cost can be estimated at \$10,000 for two months making a total cost of \$70,000 to the general public besides the cost of eliminating the grade crossing which would probably be \$30,000 more, making a total of \$100,000 cost to general public.

The cost of the whole project as contemplated, is \$80,000 which is \$20,000 less than it would cost to block the present highway.

Besides the smaller cost, the moving of the highway eliminates the blind curve at the cemetery and a curve where the highway crosses the outlet to Pine Lake.

Therefore, from the standpoint of economy and safety, the State Highway Department is justified in their steps to relocate the highway as contemplated in their plans.

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