1931

Some of the difficulties encountered in the construction of a highway subway or underpass

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Department:

SOME OF THE DIFFICULTIES ENCOUNTERED IN THE CONSTRUCTION OF A HIGHWAY SUBWAY; OR UNDERPASS

BY

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THESIS

Submitted to the faculty of the

SCHOOL OF MINES AND METALLURGY OF THE UNIVERSITY OF MISSOURI

In partial fulfillment of the work required for the

Degree of

CIVIL ENGINEER

Rolla, Mo.

1 9 3 1

Approved by Elmo G. Harris
Professor of Civil Engineering

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SKETCHES

The project from which the subject for this work is taken is located in Section 28, T 13 N, R 11 W, of the third P. M., Scott County, Illinois, within the village limits of Manchester, in the north east part of the town. (Sheet No. 1 of accompanying plans) It is a grade separation between the Chicago and Alton Railway and Route No. 3 of the Illinois system of Highways.

The general direction of Route 3 is north and south through the western part of Illinois. It begins at Morrison just across the Mississippi River from Clinton, Iowa, and extends through the towns of Rock Island, Monmouth, Macomb, Rushville, Beardstown, Ashland, Alexander, Jacksonville, Jerseyville, Alton, Granite City, East St. Louis, and ends at Chester. (Note marking on Illinois official road map)

The line of the Chicago and Alton is a cut off between Roodhouse and Bloomington. At the point of this underpass the C & A is double track, one track being the Bloomingtom, Roodhouse Division, and the other a short line from Roodhouse

to Springfield.

The railway tracks and the centerline of the highway meet on a skew of forty-five degrees, as shown on the original Plan Sheet No. 2, which makes a very good alignment from an engineering standpoint.

The construction costs of this underpass were borne one half by each the Highway Commission and the Chicago and Alton Railway Company, each constructing it's own structure and supervising the work done on it's own structure. That is, the Railway Company's false work, the earth excavation, the drainage system and the Railway Company's bridge were the items included in the fifty-fifty agreement. The engineer in charge of the Railway Company's work was the Assistant Division Engineer with headquarters in Springfield, Illinois, and the Highway Engineer in charge was the author of this article. The combined estimate of the entire project, both Railway and Highway was $80,000, $31,000 of which was the Highway estimate.

The Highway project was 1887.9 feet or 0.358 miles in length and the quantities consisted of:
14,353 cubic yards of Earth Excavation,
3,862 square yards of P. C. Concrete Pavement,
2,000 linear feet of Concrete Gutter,
770 feet of 24" Vitrified Sewer Pipe,
24 linear feet of Double Strength Sewer Pipe,
1,184 square yards of Earth Shoulder,
1 Catch Basin,
1 Tile Inlet,
0.6 cubic yards of Class A Concrete.

The contract for the project was let the latter part of July, 1927, and Hartman-Clark Bros. of Peoria, Illinois were awarded the contract at $27,635.80. Their bid ran as follows:
Earth Excavation - - - - - $0.90 cubic yard,
Concrete Pavement - - - - 2.25 square yard,
Concrete Gutter - - - - - - 0.80 linear foot,
24" Sewer Pipe, in place - 5.00 linear foot,
15" " " " " - - 3.00 " " ,
1 Special Catch Basin - - -75.00 each
1 " Tile Inlet - - - -50.00 each

Class A Concrete - - - - - - - - $40.00 cubic yard

I reached Manchester August 7, and had the slope stakes set and the job well in hand before the contractor started work. Work was started August 15, but most of the work was done by sub-contractors. John Raynor of Peoria, Illinois was given the earth work and moved on the job August 9, 1927, with a Bucyrus steam shovel, six end dump Hug trucks with dual rear wheel, and nine men. Several days were spent putting new flues and a new boiler in the shovel before work started August 15. The drainage structures (two culverts) had been left off the plans which oversight required a hurried trip to Springfield to check up on these structures; and before I could return the shovel had started into the cut at Station 768/60 and had headed north. The fill had been made from Station 768/60 to Station 770, thus closing the gap at Station 769/11 in which a 6-6-30 box culvert should have been constructed; but as Illinois does not pay for drainage structure excavation this was no added excava-

tion expense. The other box culvert, Station 771 +10, was small (2-2-53) and was constructed ahead of the excavation.

The fills were made between Stations 769 and 775 first as all the rest of the excavation was wasted in the spoil bank east of the Right-of-Way as shown on Sheet No. 2 of the accompanying plans.

The addition of these two culverts raised the cost of the project considerably as the proposal called for only 0.6 cubic yards of Class A concrete (the bid price being $40.00 per cubic yard) and they contained 72.34 cubic yards additional, making the increase $2893.60. The plans for the project show they were made in October, 1926, and the reason given in the office for the oversight of the culverts was that the culvert plans had been misplaced at the time of moving the office between October, 1926 and July, 1927 so the State had to pay the forty dollars per cubic yard which was twice the current bid for Class A concrete.

Hartman-Clark Bros. built the culverts themselves and constructed the main drainage structure for the underpass proper. They had a force of men on the job the next day after my trip to the office concerning the culverts.

As fast as the shovel made progress toward the north the 24" main drain tile was laid. A change was made in the original plans and the 24" drain tile was moved from the Right-of-Way line on the left to the gutter line or fifteen feet from centerline as shown by Fig. 1, Sheet No. 3 of accompanying plans. The same crew which put in the culverts put in the tile alternating between the two. The ditch for the tile was dug partially with teams and slips and partially by hand power with long handled shovels. The teams and slips were used until the ditch was too deep and then the ditch was finished by man power. When the shovel was in the way of the tile laying the men worked on the culverts and when the shovel had made a little progress they worked on the tile.

Everything worked smoothly until the shovel reached the edge of the old pond bed as shown on Profile of Fig. 1, Sheet No. 3 of accompanying plans. The contractor did not contemplate any such place so did not bring any floats for the shovel. The shovel mired down at Station 766+50 and after two days of hard work it was gotten out of the mud. The contractor proceeded to have four floats made of 4 by 12 bridge lumber, where upon the shovel could travel and not be getting stuck every few minutes.

The muck of this pond bed was so treacherous that we had the contractor excavate two feet below grade and haul in a good clay soul from other parts of the project. When the shovel reached Station 763+50 it slipped off of the floats and mired up to the bottom of the fire box in the mud. The trouble at this low point in the grade was a strata of hardpan a few feet below the grade , dipping south west which made a bed for the underground water to follow and when it reached the roadway it bubbled up and made a bad working con-

dition. After several days of work with railroad ties and crowbars and shovels, the steam shovel was hoisted back on its solid footing, a float.

The contractor had a very unique way of handling the excavation and hauling it away from the shovel. When the cut became too deep for the shovel to load the trucks on top of the bank, a roadway of railway ties was built down into the cut and very few times was it necessary to help get a truck going. Because of the long haul, and the method used, these trucks were the ideal way to haul the earth.

The tile was kept close to the shovel because of drainage. The further north the shovel went the lower the grade, until it reached Station 763+15, the low point in the grade line (Sheet No. 2 of accompanying plans) The 24" tile was started at the outlet end at the edge of a draw, emptying into the creek as shown by Fig. 1, Sheet No. 3 of the accompanying plans, and laid toward the catch basin. The tile was rolled into the ditch

by ropes using man power and then edged into place with crowbars. A 1:2 mix of cement and sand was used to grout the joints to make a more or less monolythic structure, as shown by Fig. 10, Sheet No. 5 of accompanying plans.

When the shovel pulled out at Station 762+80 the catch basin was constructed and a fifteen inch tile laid and the joints gouted; and then the tile inlet was constructed as shown by Sheet No. 2 of the accompanying plans. The hole for the catch basin was started but the hardpan was reached in very few feet. Water was continuously coming in so 2-8-10 wood sheet piling was driven as a cofferdam to keep out the water and mud. As fast as the sheet piles went down the dirt was shoveled out and the bottom grade of the catch basin was reached and held dry during construction. Three inch down spout pipes were placed in the sides of the catch basin (Fig. 7, Sheet No. 4) forming weep holes which would allow the water in the subgrade to escape to a lower level than the opening in the top of the catch basin.

The shovel had much better going on the north side of the railroad until it reached a point low enough to strike this mucky clay caused, as on the south side by the water following the hardpan and then bubbling up in the roadway.

About the time the shovel reached the tracks from the north side and had pulled out we had a hard rain which made a lake on the north side of the tracks. The earth under the tracks served as a dam to hold the water so that it could not escape. But a twelve inch pipe was driven through the dam from the south side soon as possible and the lake of water let into the catch basin. After this we were not bothered by excess rain for it could always get away through the pipe into the catch basin. When the earth had all been moved the twelve inch pipe was removed from beneath the railroad tracks and the water drained away through the weep holes which were put in the catch basin and through the grate opening.

The railroad company had no engineer on the job at that time and there was no set of their

plans available, so the tile inlet was constructed directly opposite the catch basin at Station 763/15. But when the railroad company started work the tile inlet had to be moved south as shown by Fig. 2, Sheet No. 3 of accompanying plans, to make room for the footing of the west abutment. This meant the laying of more double strength fifteen inch tile and the construction of another tile inlet. The new inlet was constructed as shown by Fig. 2, Sheet No. 3 of accompanying plans, and had to have an extension of .92 feet in the top, (Fig. 6, Sheet No. 4) when the gutter was laid to meet the edge of the pavement.

When the shovel reached Station 762/30 it had done all it could, for the pile trestles of the railroad company's false work were so close together that the shovel could not do its work satisfactorily. The pile trestles, as shown by Fig. 9, Sheet No. 5 of accompanying plans, are shown as a section at right angles to the centerline of the trestle work but projected down in the profile on the skew. The bents were spaced approximately

ten feet apart and set parallel to the centerline of the highway. There were three piles to the bent and in all there were twelve bents, six to each track. Each track had its own set of trestle bents but they were tied together with 4"-12" timbers bolted to the piles. That is, the two inside piles of each line of bents were tied together to make them more rigid. The two outside piles of each bent were toed out as shown in Sketch No. 1, and the bents under each track set more or less in line.

The earth between Stations 762/30 and762/80 was moved by hand. That is, the earth was shoveled into wheel barrows and wheeled out clear of the tracks, where it was picked up by a clam shell and deposited in the spoil bank. The clam shell was set on the bank left of Station 763. It raised the dirt from the bottom of the excavation to the bank and piled it at intervals where slips and teams tore it down and leveled it out. This was a slow process and was not finally completed until January, 1928. There were approximately 2,000 cubic

yards of earth to move this way.

As the earth was taken from around the piles they were braced and made very rugged by the Special Bridge Gang of the railroad company. 4"-12" timbers were used for this and bolted very securely to each pile (Sketch No. 1) When all the dirt had been moved down to our subgrade, the railroad company dug its footings, leaving the piles in place. The piles were so driven that the wall of the abutments came between bents and the piles could be left in place until the abutments were completed giving their support to the track when the pile bents were removed.

The paving crew arrived on the job the middle of November, 1927 and after a few days of repairs started paving at Station 765/00 and going south. The standard section was used (Fig. 14, Sheet No. 7 of accompanying plans)

The pavement was sublet to Hurden Construction Company of Springfield, Illinois. They were delayed two weeks by an accident in which their mixer was wrecked on the road from Peoria, Illi-

nois to Manchester, Illinois. The mixer was shipped by freight via C & A.

They bought a new Koering 21E mixer which arrived at Manchester November 10, 1927. The paving equipment consisted of: one 21E Koering mixer, one Lakewood finisher, one Lakewood subgrader one Austin roller, 2200 feet of steel forms, six Model T Ford trucks, one homemade hopper, one worn out P&H crane for loading hopper, one centrifugal 4 cylinder gas pump, 2,000 feet of two inch pipe line, 300 feet of two inch rubber hose.

The paving was further held up until the fill Station 768/50 to Station 774/50 could be water soaked for settlement. This process is commonly called jetting, and in this particular case was accomplished as follows: the pump was stationed at the creek just south of the culvert in the old east and west road on the east bank and the pipe line laid through the culvert north along the east side of the slope up to Station 769/00. A "T" was put in the main line where the pipe reached the

road and the line was run south to Station 773/00. A valve was put in at the "T" to turn the water into either line. Valves were placed about 200 feet apart in the line to tap the water as needed for jetting or paving. (Sketch No. 2 shows plan of pump and pipe line) A two inch hose, approximately 100 feet long, was attached to the water line and a 14"-1" pipe placed on the other end of the hose was used as a jet. The holes were put down as far as possible with a post hole auger, as shown in sketch No. 3, and water under pressure was forced into these holes until the fill was thoroughly saturated. The jetting caused a settlement of one half inch average over the heavier part of the fill which made necessary the hauling of more dirt to make the subgrade.

2-2-18" stakes were driven to crown grade every fifty feet along centerline and off set eleven feet on both sides, and one side tack lined to set the steel forms by. (Shown by Sketch No. 4) The forms were set and pinned and then the subgrade prepared to fit the standard section of pavement

as shown by Fig. 14, Sheet No. 7 of accompanying plans.

The hopper was set up and braced, and everything was ready to start paving with the exception of checking the hopper for quantities, and checking the timing of the mixer. Illinois specifications require that the concrete be mixed a full minute. The mix for Standard Portland Cement pavement is 1:2:3½, that is, one cubic foot of cement requires two cubic feet of sand and three and one half cubic feet of coarse aggregate (stone or gravel). The capacity of a 21E mixer is twenty-one cubic feet which means that with a 1:2:3½ mix a five bag batch is the batch capacity for one bag of cement measuring approximately one cubic foot. These five bags of cement call for ten cubic feet of loose sand and 17.5 cubic feet of loose coarse aggregate which makes approximately 21 cubic feet of mixed concrete, assuming 40% void in the coarse aggregate. The cement does not actually figure in the volume as it is supposed to cement the sand and coarse aggregate together by occupying the

smaller voids. The hopper was set to measure the quantities of aggregate and everything else was ready. Paving operations started November 21, 1927.

Paving usually follows in this order: the forms set and pinned, the subgrade prepared, the center joint and steel placed, including 4 foot gutter tie bars, (see Standard concrete pavement section Fig. 14, Sheet 7, also Section B-B, Sketch No. 5 for gutter tie bars) the forms oiled, the concrete deposited between the forms, and the mechanical finishing machine run over to give a smooth, uniform surface. Then a 10 foot straight edge with a long handle is used to test the surface for evenness. f any irregularities in the surface are found a wood block on a long handle, called a float, is used to smooth up the bump. The straight edge is applied after each operation with the wood float. After all irregularities are remedied the concrete is given a final belting to insure a smooth surface. When the concrete has set up sufficiently to prevent marring

the surface, it is covered with burlap to prevent too fast drying. The burlap is removed the next morning and the cure is spread. The curing process used on concrete pavement during cold weather is that of putting straw one and one half to two feet deep over the green concrete and leaving it at least one week. This prevents freezing. In warmer weather calcium chloride is sprinkled evenly over the surface. Two and one half pounds per square yard is the Illinois requirement.

A head board made true to the finished pavement section, six inches thick, is set vertical between the forms and pinned down to hold it in place. (Sketch No. 6) This head board is used to make a square even joint any time the mixer shuts down long enough for the concrete to set up sufficiently to become brittle.

The Lakewood mechanical finishing machine is a power machine driven by a gas motor which travels on the top of the forms like a train on a railroad track. The wheels are flanged on the inside

to keep the machine on the track. The machine is driven by all four wheels and works the different mechanical equipment in the order given: first a steel strike off, set to the crown of the pavement, cuts the concrete to form, then a heavy wood tamp is worked up and down which compacts the concrete and this is followed by a screed which is a kind of belt made of heavy leather which strokes the concrete transversely. The screed has about eight inches of stroke. Illinois specifications call for this machine to be run over the concrete at least three times pushing concrete ahead of the strike off. During the running of the finishing machine a man with a flat shovel spades the edge next to the form to prevent honeycomb.

After two days of struggling with unfavorable weather it was decided to discontinue paving until Spring. 299 linear feet or 598 square yards of pavement were laid in the two days they worked.

The closing down for winter came with very little of the work done. The rough grading was all done except directly under the railroad tracks,

and that was completed before the crew left. The tile inlet, catch basin, the fifteen inch double strength vitrified tile connecting the two, the twenty-four inch drain tile, the headwall for the outlet of the twenty-four inch drain tile, the two concrete box culverts were all completed as shown, and 299 linear feet of pavement laid. The headwall of the drain tile was the last concrete structure built in 1927. Three steel bars were placed over the outlet of the tile and fastened in the concrete when the headwall was poured as shown by elevation Fig. 16. These bars were placed there to prevent small animals from entering the tile line and stopping it up.

The railway crew worked until the middle of February and completed its structure. Our standard section did not give the railway company room for its footing excavation so within the limits of the railway company's Right-of Way we widened out at the bottom to forty-five feet (twenty-two and one half feet each side of centerline) and set the slope 1:1 instead of 1½:1 (Fig. 7, Sheet 4, also

accompanying original cross sections)

After the abutments were completed, the piles which were in the footings were sawed off at the elevation of the top of the footings-673.5-and the others were cut off at elevation 672.0. A through girder type of bridge was constructed by the railway company, and the outside girders were six foot I beams fixed at one end. I cannot give the details of the railway structure, as I did not have access to a set of their plans.

When this structure was completed, the railway company back-filled behind the abutments to make the slope uniform. (Fig. 37, Sheet 4, and the original cross sections)

About the time construction closed down for the winter, it was discovered that the outlet for a farm drain tile had been covered eight feet under the spoil bank. This is the farm tile shown 400 feet east of the subway (Plan of Fig. 1, Sheet 3) This tile drained practically a quarter section of land and had to be opened up. The land owner showed us about where the outlet was and on a cost

plus basis it was located and extended to the edge of the bank east of the catch basin, thence down the slope to the catch basin. A hole was chiseled in the side of the catch basin and the six inch tile cemented in place. The tile was placed in a four inch bed of concrete down the slope to hold it in place. (Fig. 4, Sheet 4) This increased the contract cost about $175.00.

When the earth was all taken to grade under the railroad tracks and the farm tile outlet extended to the catch basin, all of the Highway's portion of the work was suspended until the Spring of 1928.

The winter broke about the middle of March, 1928, and the contractor showed up on the job to go to work on the twenty-sixth. All machinery was gone over and repaired and everything was ready for paving operations to begin by April 9. The forms were all reset and pinned, subgrade prepared, hopper checked, stored cement tested and work started at noon of April 11. The stored cement had been exposed more or less to the air and

had to be used in the proportions of two bags of stored to three of new, to get the proper strength concrete.

A volume yield test was made and the cement factor for the material used was found to be 53.0 barrels of cement every 100 linear feet or 200 square yards of pavement. Four bags of cement constitute one barrel. This yield test is made by accurately measuring the subgrade 100 feet in length and keeping count of the number of batches of concrete necessary to fill in this space; the volume computed and the cement required figured in terms of 100 linear feet of standard eighteen foot concrete pavement.

The pavement was all laid from Station 765 ⁄00 to Station 775⁄00 (end of project on the south) and the mixer moved north of the tracks.

The new road coincided with the old road south of the tracks which made it difficult to handle traffic on the south end. The street between side walks was narrow (forty feet) making it difficult to handle such vehicles as the Alton Transporta-

tion bus and the large freight trucks operating between Jacksonville, Illinois and St. Louis, Missouri. A detour was built on the left side of the pavement over the street ditch. A fifteen inch tile was placed in the ditch and a cinder roadway built from Station 773 to Station 775. A signalman was kept there day and night to direct traffic as the detour was wide enough for only one vehicle. The portion of the new pavement needed for traffic was opened in ten days and the cinder detour removed. As the pavement was laid along this stretch 6"-6"-3' test beams were made and at different ages--seven, eleven and fifteen days respectively--the strength was tested by breaking these beams. As a rule pavement in Illinois is kept closed to traffic twenty-one days in the warm weather and thirty days in cold weather, unless test beams are made and show sufficient strength to warrent opening the pavement sooner. Tests are always made when it is necessary to open the roadway to traffic as soon as possible.

The mixer moved to Station 758/00 and paved

north to the beginning of the project, Station 755 +62. The subgrade was too soft and spongy for a five bag mixer between Station 758 and Station 765, so this portion of the pavement was put in by hand with a one bag mixer.

The curve on the north end was eleven degrees and thirty minutes to the left which was sharp enough to require two and one half feet of widening and a spiral easment on each side of the pavement at the P. C. and P. T. One half of the curve was in place to Station 756+12.1, having been built on another project which made a fixed point to meet. The mechanical finishing machine would cover only eighteen feet of width so a false form had to be laid on the inside eighteen feet from the outside form through this widening. As the finishing machine was through with the eighteen feet the false form was removed and the concrete wheeled back in wheel barrows to fill up the widening. This widened part was finished by hand. This was a slow process but the 21E mixer finished up its work April 21, 1928.

The 700 feet between Station 758 and Station 765 was very soggy and wet. The water followed the hardpan and bubbled up in the subgrade like springs. It was so soft one would sink in to his waist. It was decided to tile this portion of the subgrade so that it could be paved. The soil was yellow clay which when perfectly dry is very hard and substantial, but when saturated with water very soft and spongy. The tile was laid two feet below grade line along the gutter line and the water emptied into the catch basin on the left and the tile inlet on the right. A hole was chisled through the sides of the inlet and catch basin as shown in Fig. 2, Sheet 3, and the tile grouted in place. One foot of loose gravel was placed over the tile and dirt shoveled into the trenches to fill them the rest of the way. The gravel was used so that none of the joints would be stopped with mud as regular farm drain tile (four and six inch) was used. After a few days the subgrade was dried very well for two or three feet so paving operations were resumed.

At this time it was discovered that the Right-of-Way Engineer had made an agreement with Mrs. Ella Heaton, owner of the land, that if she would give the Right-of-Way, the State would permit her to empty the six inch farm tile west of the subway (Fig. 1, Sheet 2) into the subway by spilling it over the bank right of Station 762/35. This would not have been good practice, so it was decided to extend the six inch farm tile along the railroad ditch and down the slope, and empty it into the subgrade drain tile. The subgrade drain tile was dug up at Station 762/30, and a "T" inserted, then the farm tile connected (Fig. 3, Sheet 4). That portion of the tile from the top of the slope down the slope to the subgrade tile was incased in four inches of concrete to hold it in place.

Because of soft subgrade the form stakes had to be four feet long in order that they would be solid when driven to grade. The steel forms were used but pieces of two foot lumber four feet long were laid side by side like corduroy under each form the full length of the gap and were left there

when the forms were removed. This was done to give the forms a wider base to keep the settlement to a minimum. One half the slab was laid at a time so that hand finishing might be used. The longitudinal bars were placed along the forms, the five and one half inch metal center strip was placed and the four foot tie bars pinned in place. 2-6 lumber was used as a support for said metal center strip and also as a false form by which to finish (See sketch No. 5)

The hand finishing was carried on on very much the same theory as the finishing behind the 21E mixer. The small mixer was set on the pavement at Station 765/15 and the material hauled by truck and deposited behind the mixer on the pavement in small quantities and replenished as used up. A head board was placed across the nine foot strip which was to be paved, set verticle to make a square even joint and the concrete wheeled in wheel barrows and deposited on the subgrade between the six inch false form and the nine inch steel form. Three 3-12 timbers twelve feet long

were bolted together and the bottom sawed to fit the parabolic of the surface of the pavement, and regular plow handles were placed on each end with which to slide the thing back and forth on the top of the forms. An eye was screwed into each end of the timber beam in which a one inch hemp rope was tied. This apparatus was used as a strike-off board and also used as a tamp. When used as a strike-off, four men pulled forward on each rope and one man on each end at the plow handles worked it back and forth across the forms so that it would move forward easier, and roll the surplas concrete ahead of it. When the striking off process was completed for a short distance, the same machine was used as a tamp. (Sketch # 7) The two men at the plow handles raised the timber beam about six inches, and dropped it on the surface of the concrete, one end of the beam falling on the steel form, the other on the wood form in the middle of the eighteen foot roadway, moving the tamp back and forth a little as it was worked. When this hand finishing process was completed, the finishing was the same

as for the full eighteen foot pavement after the mechanical finishing machine had completed its work. When one half of the roadway had been paved from sta 761/50 to sta 765/00, the 2-6 wood form was removed and the edge of the concrete already laid was used as a form by which to finish. When all the slab had been laid from sta 761/50 to sta 765/00, the mixer was moved to sta 757/75 and the remainder of the concrete pavement poured.

The forms along the right side gave way between sta 759/11 and 759/55 causing a very crooked pavement line. This was not acceptable, so the contractor had to tear out nine feet (one half of the width), and replace it at his own expense. The concrete was a week old before this forty-four feet of nine foot slab was removed, and was naturally very hard. Dynamite was used to break the slab in chunks which were pitched into trucks and hauled away. The forms along this stretch were reset and braced so that they held and the pavement was all completed.

The railroad ditch on the north side of the

tracks from the east naturally drained into the subway. That is, if left as it originally was, the water for one half mile east would spill over the bank into the subway. This being impractical, the ditch was dammed at the west end near the top of the slope (Fig. 4, Sheet 4), and the ditch deepened to drain east to the old road. A fifteen inch iron pipe was placed under the railroad tracks to drain the water south down the west side of the old road, (General Plan Sheet 1).

The four foot gutter tie bars were placed after the forms were set and before the concrete pavement was poured. They were three eighths inch Ø bars four feet long and bent so that two feet went into the edge of the slab and the remaining two feet stuck down under the form, Section B-B, of sketch 5. These bars are placed to hold the gutter to the same elevation as the adge of the pavement. After the forms were taken up, the end of the bar which was stuck down under the form was bent back into its original shape so that the bar will be straight, and will

lie in a horizontal position with two feet left to protrude into the edge of the gutter. These gutter tie bars were made of malleable iron which is very soft, and were spaced five feet apart on both edges of the eighteen foot pavement through the entire gutter section.

The gutter forms were made of 2"-4" timbers for the outside and the edge of the pavement served as the form for the inside. The subgrade was prepared to standard section and the concrete mixed and poured. The gutter was cured with dirt as calcium chloride melts when exposed to the air and would have run off before it had completed its work. The dirt, four to six inches deep, was watered two or three times a day to keep the moisture to the concrete. Fig. 15, Sheet 7 of accompanying plans shows the standard gutter section used.

Seven feet each side of the catch basin and tile inlet the V shaped standard gutter was warped into a flat bottom special gutter (Fig. 5, Sheet 4) to meet the flat openings of the

two structures. Fig. 5, Sheet 4, and Fig. 8, Sheet 5 show the detail of this special gutter. The top of the tile inlet had to be raised 0.92 feet to meet the edge of the pavement. This new portion of the inlet was fastened to the old by drilling down six inches into the old inlet and grouting four one foot, five-eighths inch Ø bars and then adding the 0.92 foot of new. (Section A-A, Fig. 5, Sheet 4)

The distance between face of abutments was twenty-four feet which gave three feet on each side of the pavement for the gutter, which when standard required three feet and three inches. The gutter along the face of the abutments was just made three inches shorter, but the same slopes were maintained (Fig. 5, Sheet 4).

Three of the gutter inlets, right and left of station 768/30 and left of station 757/25, were constructed alike. The standard gutter was flattened out as shown by Fig. 17, Sheet 8 of accompanying plans. These three inlets take very little water from the surrounding terri-

tory, so no special intake was necessary, but the inlet on the right of station 757/60 carried quite a bit of surface water, so instead of flattening it out like the other three, the standard gutter was warped into a split cylinder shaped ditch and extended out to catch the surface water, Fig. 17, Sheet 8.

The shouldering up consisted of smoothing up the dirt and bringing the shoulder line to its true elevation, width and alignment. There are no shoulders through the gutter section of the roadway, and over half of the project is gutter section, so there was very little shouldering to do.

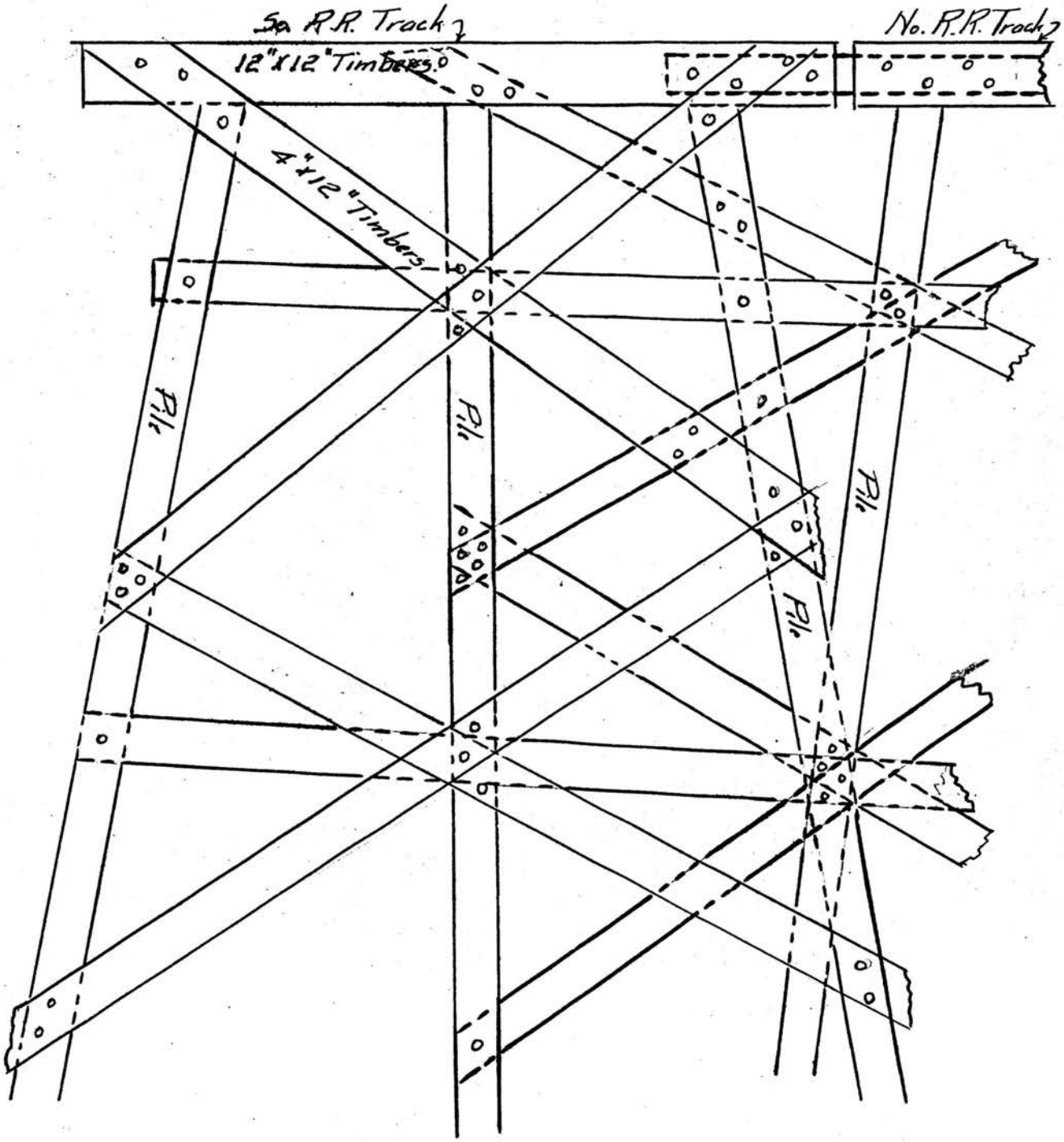
FINIS

BIBLEOGRAPHY

The accompanying twelve sheets of plans are part of the original plans revised by the author, and detailed to show the project as constructed. Sheets No. 1, 2, 6, 7, 8, 9, 10, 11, and 12 were furnished by the Illinois Division of Highways of Springfield, Illinois. Sheets 4, 5, and 6 are detail showing more closely the project as constructed. The dimensions shown in the detail are all from memory, and may vary some from those used in the construction, but the principle involved is the same.

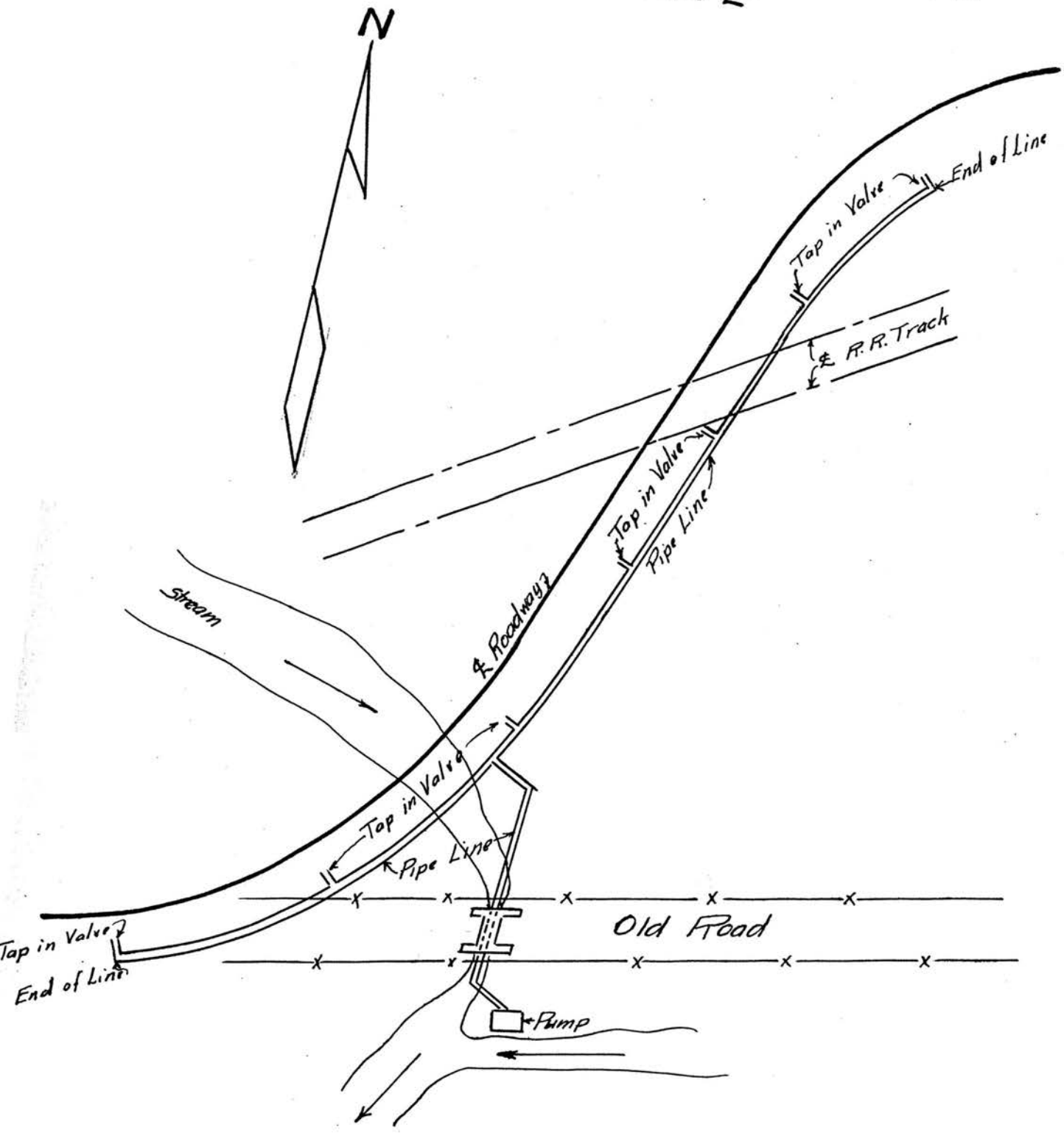
The original plans for Section 84-S State Bond Issue Route No. 3, Scott County, Illinois, (The project upon which this article is based) may be inspected in the office of K. N. Evans, District Engineer for the Illinois Division of Highways, Springfield, Illinois. The plans covering the Chicago & Alton Railway Structure may be inspected in the Division Engineer's office of that company in Springfield, Illinois.

ELEVATION OF PILE BRACING
SKETCH NO. 1



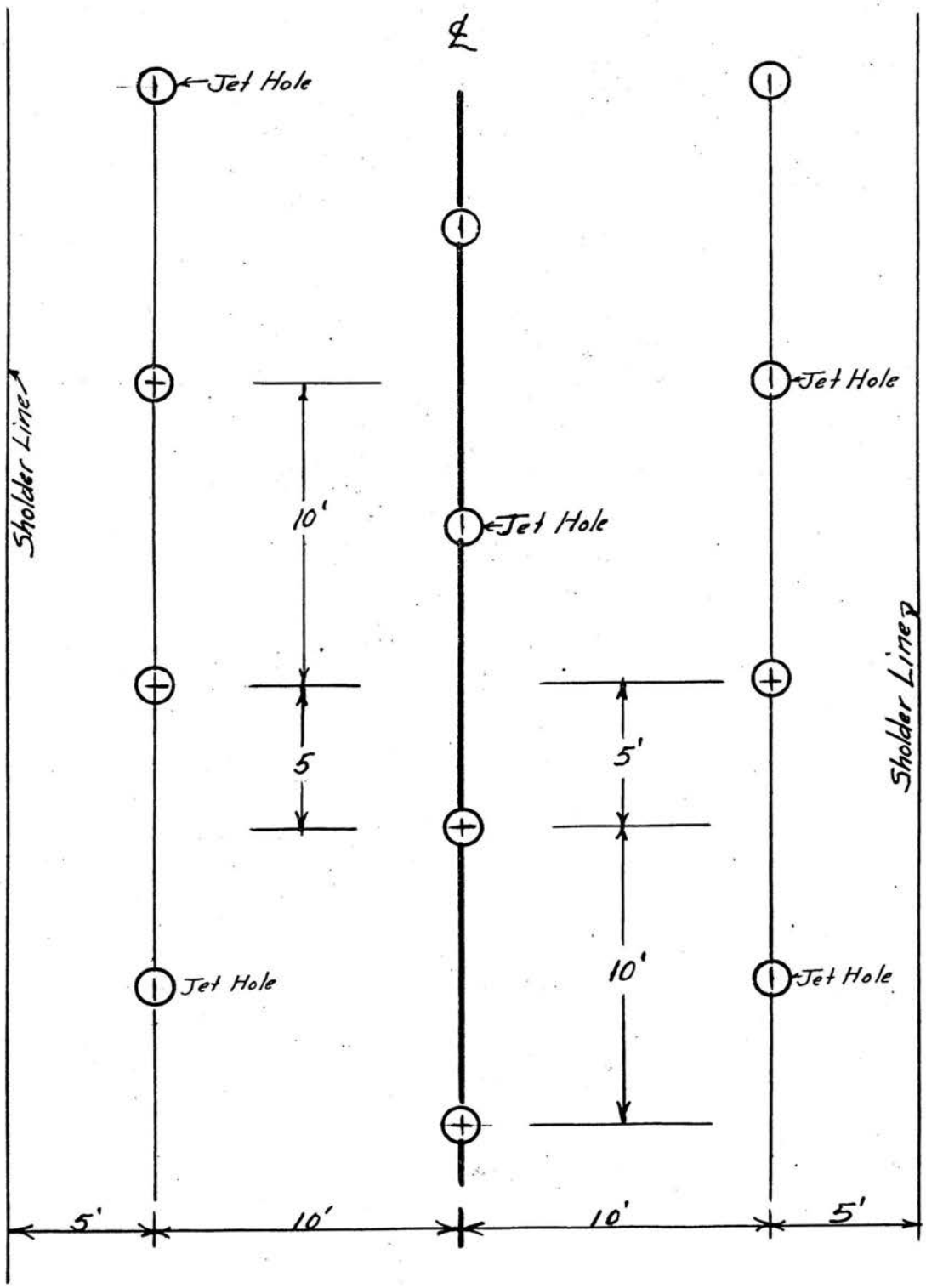
LOCATION OF PUMP & PIPE LINE

SKETCH NO. 2



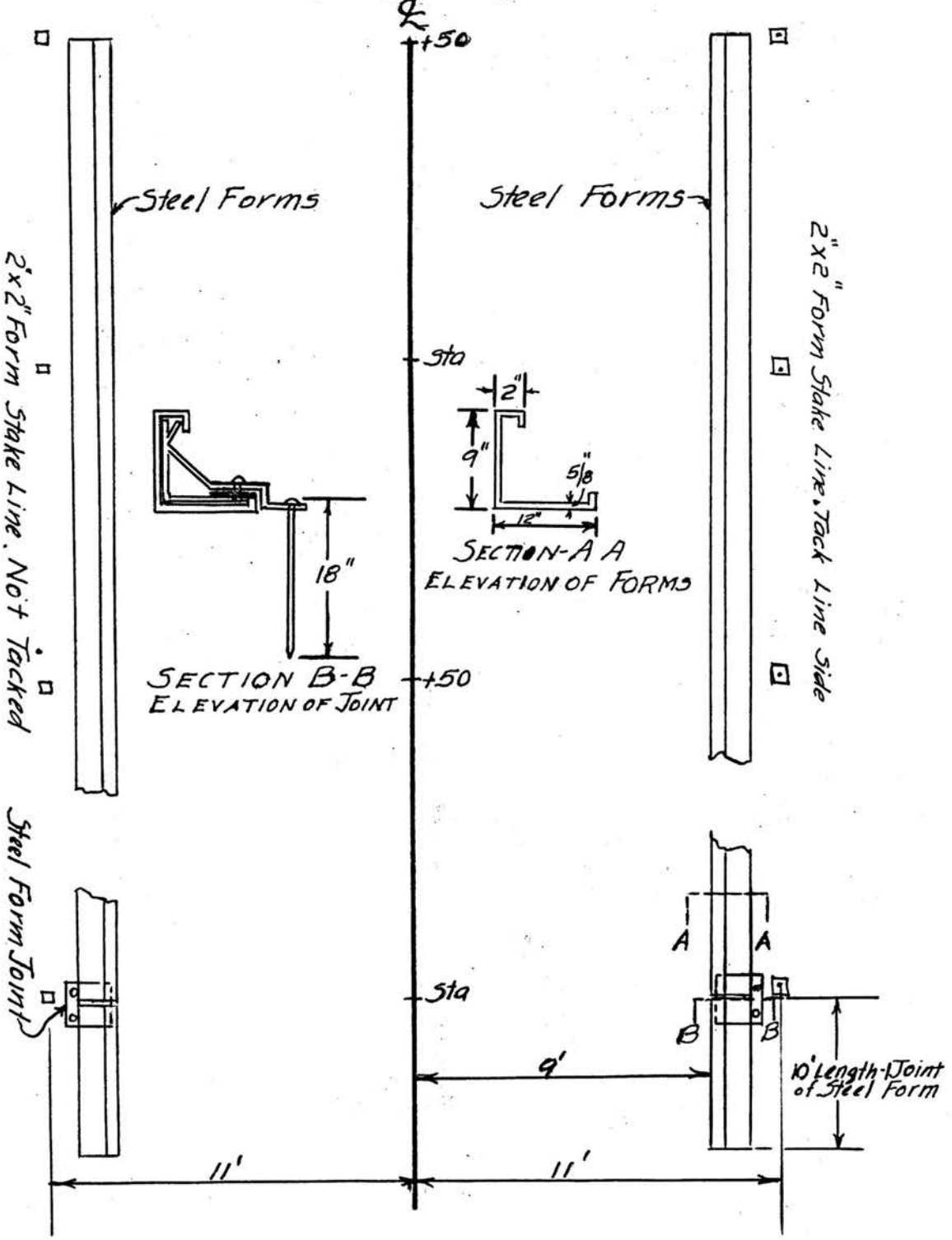
PLAN SHOWING JET HOLES

SKETCH NO. 3.

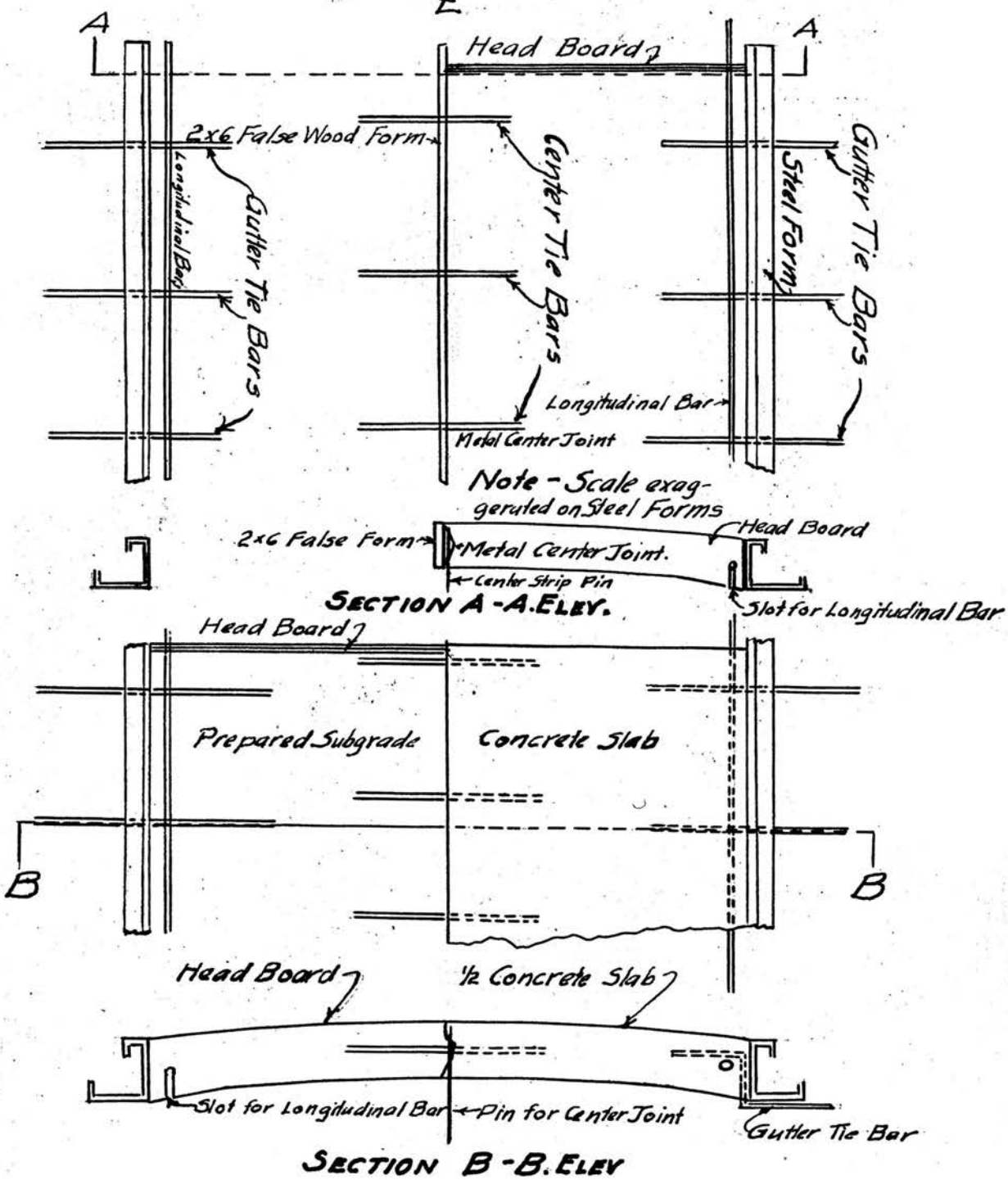


PLAN OF FORMS & FORM SETTING

SKETCH NO. 4

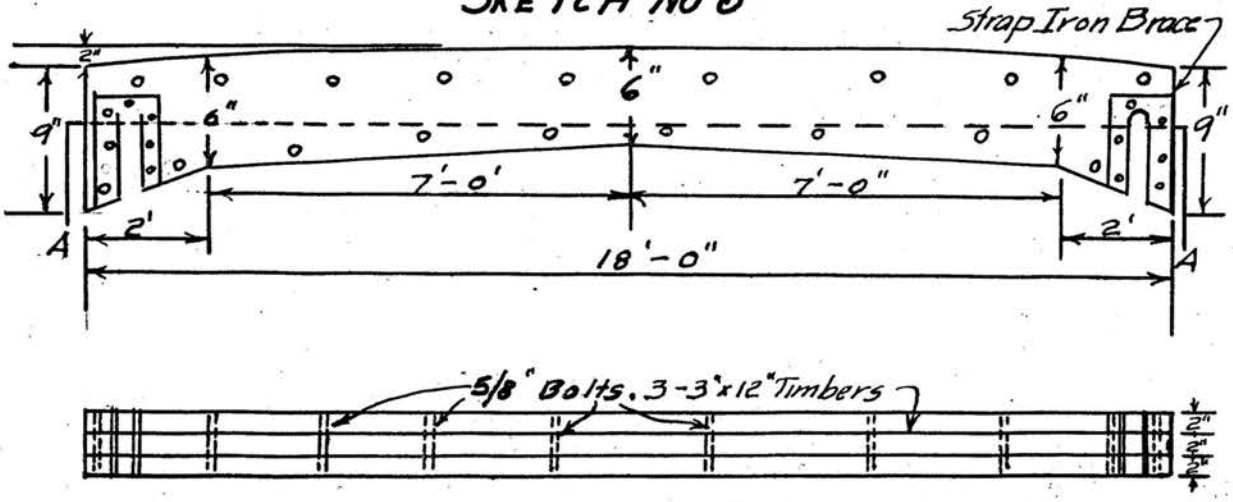


PLAN OF PAVING ½ SLAB - SKETCH No5.



PLAN OF 18' HEAD BOARD

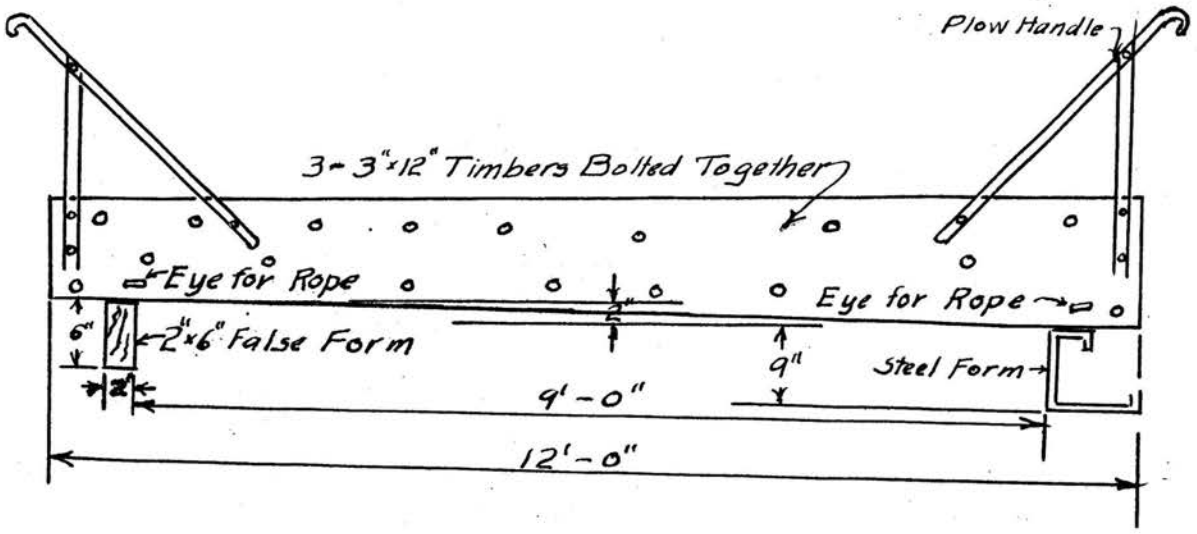
SKETCH NO 6



SECTION A-A

PLAN OF HAND FINISHER

SKETCH NO. 7



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