DESIGN FOR A SUBWAY

AT THE

INTERSECTION OF UNIVERSITY AVENUE AND THE ILLINOIS CENTRAL RAILROAD CHAMPAIGN, ILL.

BY

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This is to certify that the thesis prepared under the immediate supervision of Assistant Professor F. G. Frink by

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entitled DESIGN FOR A SUBWAY AT THE INTERSECTION OF UNIVERSITY AVENUE AND THE ILLINOIS CENTRAL RAILROAD AT CHAMPAIGN, ILLINOIS

is approved by me as fulfilling this part of the requirements for the degree of Bachelor of Science in Civil Engineering

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PROBLEMS GOVERNING THE DESIGN FOR A SUBWAY. AT THE INTERSECTION OF UNIVERSITY AVENUE WITH THE ILLINOIS CENTRAL RAILROAD AT CHAMPAIGN ILLINOIS.

INTRODUCTION.

The tendency in America to-day is to live too much in the present, without making proper provision for the future. Especially is this so as concerns permanent structures which require any considerable outlay of money, and while the need for them is felt and the advantages from their construction recognized; still the inherent disinclination of the people of one generation to provide for those to follow, and the habit of "putting off until to-morrow" mitigates against them. Many times it happens that these improvements could be affected much more cheaply and more conveniently made as soon as their need was felt. The very delay in acting upon them, with the attendant change in conditions preclude the possibility of a practical design. This last applies very directly to the subject in this thesis, the improvement under consideration, for the conditions now, though unfavorable, are by no means formidable, but with the assured future growth of Champaign with the attendant spreading out of her business district, it may not be long before a subway will be impracticable at this point. Therefore if it is to built at all, it is quite essential that action should be taken at once.

LOCATION.

The Illinois Central Railroad tracks while located in Champaign are not very far from the dividing line between the two cit-

ies Champaign and Urbana. These cities have a combined permanent population of something over 16000 people and for nine months of the year, during the session of the University of Illinois, it has about 2500 more. A glance at the map of this portion of the city, in the back of the book, will show that University Avenue is not only centrally located as concerns the two cities and contains a street car track over which passes all the traffic on the local line between the two cities, and on the Danville, Urbana and Champaign Interurban, but that it also intersects the Illinois Central Railroad tracks at its most traversed point, crossing as it does practically through the center of the yards and passing between passenger depot and freight house.

DESIRABILITY.

A close study of the existing conditions would, I think, convince any fair minded person that a subway is very desirable at this point, in fact almost essential from both an economic and a social view point. "The Grade Crossing Question" is one of the most important before the engineering profession today, and in all our large cities wherever practicable and where the traffic warrants, the grade crossing is replaced by a subway, which has taken precedence over the formerly popular but now nearly obsolete viaduct. When one considers how inadequate and unfavorably located the subways at both Green Street and Second South Street are, and that practically all of the traffic between the two cities use this crossing, an average of 250 street cars and 3000 vehicles per day, count being kept at the instigation of the Mayor of Champaign and the result kindly submitted to the writer, with the attendant delay and danger to life and limb, it seems a wonder that a subway

was not built long before this. The delay occasioned by this grade crossing affects three different parties i.e.:- the City, the Street Railway Company and the Illinois Central Railroad. The city is directly affected through the delay to its citizens both pedesrian and vehicular, by the passing of long and slow freight trains which block the street very often for as much as five minutes at a time, and the possible delay of its fire engine from the same reason. The Street Railway Company is not only blocked during the passage of trains, but each time before crossing the Illinois Central Railroad tracks, the car must stop and allow conductor to run on ahead to ascertain if everything is clear; this occasions a considerable loss of time in a whole days running. The loss of time to the Illinois Central Railroad is also considerable as all movements over crossing must be slow and attended with caution, they are also prohibited by city ordinance from keeping crossing blocked more than five minutes and therefore if they are unable to pull train "in the clear" before that time they must cut the train to clear crossing which is another loss of time.

The money saved to these three parties is also appreciable, although not easily measured in the case of the city, since it affects more directly its individuals. Any saving of time is a saving of money to a street railway company as many persons will walk if a car is not on time. The Illinois Central Railroad would affect a considerable saving if a subway was put through, by the discontinuance of the Gate Tender whose salary amounting to $600 per year is 5% of $12000 invested capital; which would go a long way towards its share of the expense in building the subway. Another very important financial item which would be saved to the railway

company are the losses sustained in personal injury suits. Again a subway at this point, with the proper disposition of First South Street, which will be taken up later, would eliminate every grade crossing through the business portion of the city, the railway company could then exercise much more freedom as to speed and disposition of trains; and this is a very important item where they do the amount of business as is done at this place.

But aside from all these practical considerations, the fact that a subway would eliminate the danger accruing to life and limb at this place is alone sufficient to warrant its being built, and in this recognition and respect for the rights of humanity, the city should take the initiative and do all in its power to affect the building of it.

LEGAL PHASES.

A bill passed by the State Legislature of 1903 enacts that in cities having a population under 28,000 and over 20,000 a petition signed by one half of the owners of the abutting property must be submitted to the council before any action could be taken towards making improvements. This would evidently not include Champaign which could therefore go ahead and make improvements without petition from the contiguous property owners. This law however was recently contested before the Supreme Court and declared unconstitutional; therefore the case reverts back to the old law in force since 1899 which is as follows:- "In cities of a population of 10000 or under (according to last United States census), no ordinance for making any improvement shall be adopted unless a majority of resident property owners affected by such improvement shall petition for same". The resident property owners affected

being construed to mean both those having frontage on line of improvement and all others in any ways affected by such improvement.

The statute further specifies, that in cities with a population of less than 50,000 the city council shall provide by ordinance that the Mayor appoint a Superintendant of Streets and a City Engineer to act with himself as a Board of Local Improvements. No ordinance for any local improvement to be paid wholly or in part by special assessments or special taxation shall be considered or passed by the city council, of any such city, unless the same shall first be recommended by the board of local improvements. A petition for any such local improvement shall be addressed to said board. Said board shall have the power to originate a scheme for any such local improvement, either with or without petition, and shall adopt a resolution describing the proposed improvements, which shall at once be transcribed to the records of the board. When the proposed improvements will require that private property be taken or damaged, such resolution must describe the property proposed to be taken for the purpose. The board shall cause an estimate of the cost of the proposed improvement(omitting land to be acquired) to be made by the City Engineer and made a part of the record of the resolution. The board shall also fix a day and hour for public hearing of proposed improvement and if at this hearing nothing is heard against the proposed improvement sufficient to cause the board to abandon it, it is modified if necessary and submitted to the city council. If it be necessary that private property be taken or damaged, a petition shall be attached to ordinance praying that steps be taken to ascertain the just compensation to be made to said property owners and also to ascertain

what property will be benefited by such improvement and the amount of such benefits.

This ordinance with petition attached will be filed in the Court of Record in the county in which proposed improvement is to be made. The court will appoint two Commissioners to act with the Superintendant of Special assessments who shall investigate and report to the court the just compensation to be made. "Such Commissioners shall further estimate and report what proportion of the total cost of such improvement (including therein their estimate of value and damages, and the estimate of cost) will be of benefit to the public and what proportion thereof will be of benefit to the property and shall apportion the same between the municipality and such property so that each shall bear its relative equitable proportion". If the parties affected are not satisfied with such apportionment they have redress to trial by jury.

When the city by ordinance provides for the making of any local improvement it shall by the same ordinance, prescribe whether the same shall be made by special assessment, or by special taxation of contiguous property or general taxation or both. The city cannot compel any contiguous property owner to make local improvement, but can condemn the property and make improvement, subject to conditions afore mentioned, and apportion the cost thereof.

Such are the legal phases governing local improvements as gleaned from the statutes. The writer thinks it possible that he has gone into these legal matters more thoroughly than the circumstances warrant, but wished to record all the law relating to the subject so as to provide for any contingencies that might arise.

DISPOSITION OF FIRST SOUTH STREET TRAFFIC.

A subway at University Avenue under the existing unfavorable conditions would not be considered by the Illinois Central Railroad unless the crossing at First South Street (which as can be seen on the accompanying map, branches off from University Avenue and crosses tracks about seventy-five feet south of University Avenue) was abolished for the reason that if this crossing was retained, they would have to still maintain a Gate Tender at this place and cut train to clear crossing as they do now; and therefore the benefits of a subway at University Avenue would not warrant their share in building it. But on the other hand if First South Street is closed without proper disposition of traffic and regard for the rights of contiguous property owners, the city would object.

The practical adjustment of this matter was one of the hardest problems encountered, and the writer after a thorough investigation of the situation decided upon the following plan and course of procedure. The vehicular traffic coming from the east on First South Street is diverted into the subway by grading down Oak Street until it intersects subway as shown on plan in back of book. On a 7% grade thisintersects street grade of subway, with twelve feet clearance, at a point one hundred feet east of the east girder line and both pedestrian and vehicular traffic to and from South Street can go through subway with no appreciable inconvenience. The west retaining wall of Oak Street is flared out as shown on plan so as to afford easier access to and from subway and to obtain a better view of possible conflicting traffic in subway. As First South Street is used to a considerable extent by pedestrians,it being in fact a short cut from Champaign to the University, the present sur-

face sidewalk will be retained across Illinois Central Railroad tracks. The pedestrians may use this, or if more convenient, as when crossing is blocked by train, they may pass down through subway. Vehicles however will not be permitted to use grade crossing but must pass down through subway.

On the west side of Illinois Central Railroad tracks the present surface sidewalk will be retained for pedestrians, one will also branch off from this leading into subway. All First South Street vehicular traffic bound for any point east of main tracks must use subway to cross tracks and then may ascend grade on Oak Street to First South Street. To afford access from South Street to Chestnut Street, street between freight house and business track, First South Street will be cut down on a 7% grade from the business track, west until it intersects street grade of subway, which is also on a 7% grade, but ascending. Vehicles therefore, eastward bound on First South Street, can if they wish to cross Illinois Central Railroad tracks , continue down a 7% grade into subway,or if they wish to reach Chestnut Street ascend a 7% grade on First South Street.

DISPOSITION OF BREWERY TRACK.

The brewery track is a side track connected at both ends to the main track and crosses University Avenue at a point one hundred twenty five feet east of the north bound main track. Its chief purpose is to afford freighting facilities to the two breweries, one on each side of University Avenue.

The writer proposes for the following reasons to discontinue this crossing and put a bumping post on either side of University Avenue, making two "dead end spurs" out of the side track:-(1) It

is by no means essential for efficient operation of the yards that the cars cross University Avenue, in fact this crossing is very seldom used for that purpose, for the breweries can be served as well, though perhaps slightly less conveniently to the Illinois Central Railroad by the spurs. (2) The retaining of this track across street would add very considerably to the cost of a subway, owing to the necessary increase to the abutments, excavation and iron work. (3) It would be impracticable unless this crossing is discontinued to divert the traffic from First South Street into the subway on account of the excessive gradient necessary. (4) Owing to the close proximity of Water Street, about two hundred feet east of the brewery track, the retaining of this track would necessitate the depressing of Water Street, which would also add greatly to the cost of the subway through the necessary additional excavation and retaining walls, and be impracticable on account of the resulting damage to property.

DISPOSITION OF BUSINESS TRACK.

This track is also connected at both ends to the main tracks and crosses University Avenue at a point one hundred seventy-five feet west of the north bound main track. It is used as a teaming and unloading track for freight, coal and lumber. A subway could could be built much cheaper and with practically no damage to property, if this track could be treated in the same manner as the brewery track, but this would be impracticable from the railroad point of view, and it would indeed be an injustice to them to do this.

It is therefore proposed to retain this track across the street for the following reasons:- (1) This track is used considerably on

both sides of the crossing and as most of the cars are "spotted" from the south end of the yards, it is highly desirable for their efficient operation that this crossing be retained. (2) It is desirable in order to provide for the future growth of the Illinois Central Railroad that the abutments be continued out beyond the west line of the depot and freight house as there is room between this line and the street by infringing on the station park, or between the business track and street, by moving traffic of the street over to this park, for another track. It will then involve but little additional expense to extend the abutments under the business track. In connection with the future growth of the Illinois Central Railroad , I would add that it would be more desirable if this could be provided for east of existing main tracks as there are no permanent structures such as the depot or freight house on that side; but the greater importance of the business track over the brewery track, together with difficulties encountered through the extention of the grade of a subway to the east, makes this feature of the design impracticable. (3) The retaining of this track across University Avenue, while adding considerably to the expense,owing to the necessary increase in abutments, excavation, iron work and damage to property; will not seriously affect the practical design of the subway.

It would be impracticable to put a subway under the business track at its present level, as it would then be necessary to depress Market Street, which is an important business street, crossing University Avenue about two hundred feet west of the business track. This would involve greatly increased cost from damage to property and besides it is unlikely that the city would permit a

subway to be built if this were done. It is therefore proposed to raise the business track two and one-half feet which, since Market Street is six tenths of a foot lower than the present level of the business track, willpermit the approach of a subway on a 7% grade; to run out at Market Street.

The raising of this track will not be detrimental to any business interest connected with it, as the unloading of material can be done just as well with track raised and in some cases, as the unloading of coal in sheds, can be done better. Of course Chestnut Street will have to be graded up to the level of the track.

DISPOSITION OF TRAFFIC ON OAK STREET ACROSS SUBWAY.

Oak Street is nothing more than an alley and at present has but little vehicular traffic, mostly drayage from the breweries, and practically no pedestrian traffic. North of the proposed subway the traffic on Oak Street across the subway must turn at the corner of University Avenue and go east until it reaches the mouth of the approach to the subway, into which, it will turn descending to where the grade of Oak Street from First South Street intersects the street level in the subway. South of the subway any traffic on Oak Street across the subway must of course proceed in the reverse manner.

PROVISION FOR ACCESS TO BUSINESS HOUSES ON UNIVERSITY AVENUE AT EAST APPROACH.

The existing conditions as concerns the business interests on University Avenue, make it essential, that sidewalks for pedestrians on both sides of that street and a portion of the street for vehicles on the north side of the street, be retained at their present grade. To affect this the writer proposes the following

plan:- University Avenue is sixty-four feet wide from property line to property line. On the south side of this street a six-foot sidewalk will be retained at its present grade, and the south retaining wall of the subway will be built directly under this sidewalk; the inner edge of the sidewalk being the inner top edge of the retaining wall. This sidewalk will continue up to the corner of Oak Street and University Avenue at which point steps are employed to allow pedestrians to descend to the grade of Oak Street which will be cut down to intersect with the grade of the subway at that point. From here the sidewalk will continue through the subway on the inside of the retaining wall, which west of Oak Street is set out six feet to the south for this purpose.

From the inner edge of the south retaining wall ,twenty-six feet of University Avenue will be used for vehicular traffic through the subway and ten feet more will be used for the street car track. This leaves twenty-two feet between the inner edge of the north retaining wall and the north property line, and of this, six feet will be taken for the side walk, leaving sixteen feet for vehicular traffic at the present grade, which will be ample. This sidewalk will continue at its present grade until it reaches Oak Street where it will divert into the subway, the retaining wall being offset six feet to the north for this purpose.

PROVISION FOR TRAFFIC ON CHESTNUT STREET ACROSS SUBWAY.

It is quite essential in order to facilitate access to the freight house and depot, and to provide for all ordinary traffic on Chestnut Street, that means be provided for crossing the subway As it will be impracticable to cut down the grade of Chestnut Street to intersect the street level of subway, owing first to the

difference of elevation between street car track and street proper, second to the disproportionate expense of excavation and building of retaining walls, and third to the desirability of retaining Chestnut Street on a level with the business track; a lattice girder highway bridge designed for a dead load of one hundred pounds per square foot, will be put across subway at this place, its ends resting on the abutments and having the same head room as the business track.

DAMAGE TO PROPERTY.

It is a very difficult matter to estimate with any degree of accuracy the amount of damage accruing to abutting property through an improvement of this kind, since what may seem a reasonable amount and what the court will sustain are often entirely different

If the subway is constructed according to the proposed plan herewith submitted, there does not seem to be any damage whatever to abutting property east of the main tracks of the Illinois Central Railroad. All the present business interests can be served as well after the subway is built as before. West of the main tracks the damage to property though somewhat more evident is hardly appreciable, as the only property affected, a lumber yard on north side of street, having its entrance for vehicles cut off by the subway, has its main entrance facing Market Street which seems adequate for the business involved. It seems desirable however to make some allowance for damage to property to cover possible claims sustained by the court. The writer believes that $500 will be ample allowance for this.

PROPERTY TO BE ACQUIRED.

In order to make possible the proposed plan of cutting down

the grade of First South Street from the business track to the west until it intersects street grade of the subway, it will be necessary to widen this street in order to obtain necessary width. This is done, as shown on the plan, by taking out the elbow occuring at this place, and this can be readily accomplished, as there are no permanent structures on the property. This property to be acquired amounting to eight hundred square feet will cost about $500.

HEAD ROOM.

The limiting conditions as to length of approaches made this a difficult problem. Each class of traffic through the subway namely, street car, vehicular, and pedestrian, had to be provided for separately and these will be discussed in the above order.

(1) It was found to be desirable for two reasons that the minimum practical clearance be allowed for street cars, in the first place, as the west approach can not extend beyond Market Street, on account of the resulting damage to property, every additional foot of clearance over twelve and one half feet can only be obtained by raising the business track a like amount. In the second place, every foot of depth adds considerably to the expense of subway, not only as to cost of abutments, retaining walls and excavation, but also to drainage.

Cooper Specifications calls for fifteen feet head room for Class B bridges, Interurban Bridges, carrying heavy electric cars. It was at first supposed however that fourteen feet would suffice in this case, until the writer personally measured up one of the largest cars at present in the service; this measured thirteen feet nine inches from the top of rail to the top of trolley stand. It is therefore evident that nothing less than fifteen feet will suf-

fice.

(2) The head room for vehicular traffic is limited on the east side by the intersection of the grade of Oak Street with the subway, it being essential that the elevation of this intersection be made as low as practicable so as to make possible the diverting of First South Street traffic into the subway. On the west side the head room is limited for a like reason by the intersection of the grade of First South Street with the subway.Coopers Specifications for Class D bridges, county bridges carrying only ordinary highway traffic, calls for twelve and one half feet clear head room. The Second South Street subway however which seems to provide for all ordinary traffic has only twelve feet head room, and the Green Street subway, which however does not receive any of the heavier vehicles has but eleven feet. With these examples as well as the limiting conditions in mind, the writer proposes to allow twelve feet clearance for vehicular traffic.

(3) The head room for pedestrians is limited by the provision for access to business houses on University Avenue, east of subway, necessitating that sidewalks be retained at their present grade up to a point one hundred twenty feet east of the subway, where they are diverted to the inside of the retaining walls, and down into subway as shown by the plan. After looking up specifications and measuring head roomof subways already built, the writer proposes to allow eight feet clearance for pedestrians.

WIDTH.

From the total width of University Avenue after making provision for surface traffic as here before specified,forty-eight feet is left for the width of a subway, with sidewalks inside of retain-

ing walls, and deducting from this, twelve feet for two sidewalks, leaves thirty-six feet for vehicular and street car traffic.

Owing to the difference in head room and to the desirability of separating the vehicular and street car traffic (for the purpose of eliminating danger to vehicles from cars decending a 7% grade), the writer proposes to place the street car track on the north side of the street and put a retaining wall, surmounted by an iron railing, between them. After measuring the width of the widest cars at present in the service of the Street Railway Company, and the distance between centers of the double tracks occuring ~~on different~~ on different streets, it was decided that ten feet would be ample to allow for street car traffic. This leaves twenty-six feet for vehicular traffic, which is none too wide but gives four feet more available width than the existing Second South Street subway. Furthermore quoting from Baker's Roads and Pavements Page 317. "A width of eighteen feet affords sufficient room for a vehicle to pass when another is standing on each side of the pavement", as there is no occasion for vehicles to stand on either side of the pavement through the subway, this width will suffice.

GRADIENT.

The maximun grade used in the proposed plan for vehicular traffic is 7%. This is high; yet owing to the necessity of making practicable the intersection of Oak Street and First South Street with the street grade of the subway, it cannot well be made less. Besides, this grade is not excessive, especially for brick pavements and short haul.. Baker's Roads and Pavements, Page 515 under " Permissible Grades for Brick Pavements" gives a list of the maximum grades of brick pavements used in sixteen large cities of the

United States, and these range all the way from 5.6% to 15% with an average of 8.6% .

The maximum grade used for the street car track is 7% and this is also high but not excessive, as a street car can ascend without difficulty any grade that a loaded vehicle can. Furthermore this same Street Railway Company have at Danville Illinois a stretch of 8% grade which they ascend without difficulty.

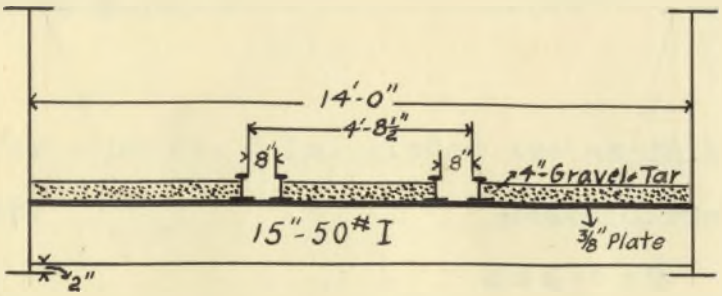
The maximum grade used for sidewalks is also 7%. Quoting from Baker's Roads and Pavements page 591, "The longitudinal slope of the sidewalk must conform at least approximately, to the grade of the street; and ordinarily if vehicles can use the carriage way pavement, pedestrians can use the sidewalk, unless it is proportionally considerably smoother than the carriage-way pavement, in which case the sidewalk may be built in sections having flatter grades with one or more steps between the sections."

GIRDERS FOR ILLINOIS CENTRAL RAILROAD TRACKS.

The girders proposed in this design are through plate girders, designed according to the Illinois Central Railroad standard practice using Cooper's E50 loading, plus impact as given by $I = \frac{L.L.^2}{L.L. + D.L.}$ where L.L. is the live load and D.L. is the dead load, and for a tension of 15000 lb. per square inch. On account of the limiting conditions as to head room it is desirable to have the distance from the top of rail to the bottom of girder as small as possible. This was accomplished by riveting the I beams, spaced one and one half feet apart, direct to girders. Upon these I beams is placed a 3/8-inch plate to which the rails are fastened. In addition to traffic rails, guard rails will be fastened inside of and parallel to these, to keep cars on roadbed if they leave the track. A mix-

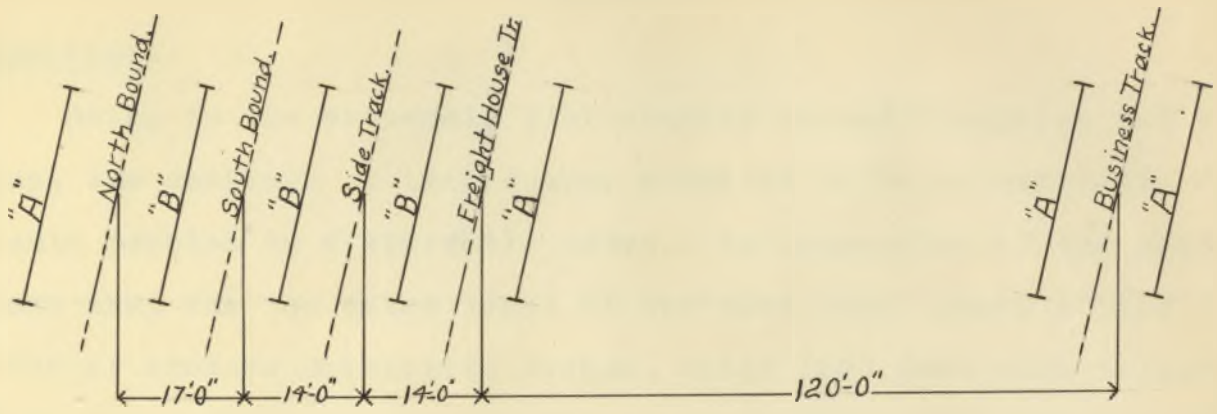
ture of gravel and tar four inches thick will be placed on top of plate to deaden the noise of train in crossing subway.

Following is a cross section of girders showing arrangement of track.



The details of girder and fastening of I beams are shown on page 26.

University Avenue intersects the Illinois Central Railroad tracks at an angle of 71° 30', and this was taken into account in determining the length of girders, which was found to be fifty-eight feet and six inches. The ends rest on a cast iron pedestal thirty inches square and six inches high. There will be seven girders required in all, four of which will be light girders and the other three heavy ones. The heavy girders as they are placed between tracks get one half load from two tracks while the light girders placed on the outside get only one half load from one track. Two of the light girders are used for the business track. The following sketch shows the arrangement of girders, A = light girders, B = heavy girders.



The sections for a 58 ft. 6 in. girder are as follows:-

Light Girder.	Heavy Girder.
2 6"×6"×5/8"	2 6"×6"×7/8"
2 COV. PLS. 14"×1/2"	2 SIDE PLS. 12"×1/2"
1 " " 14"×3/8"	1 COV. " 14"×3/4"
1 Web " 66"×7/16"	1 " " 14"×5/8"
	1 " " 14"×1/2"
	1 Web " 66"×5/8"

The weight of the metal required for the girder spans is as follows:-

195	15-in. 50 lb. I Beams	at	800 lb.	156000
4	"A" girders	"	26000 "	104000
3	"B" "	"	48100 "	144300

DRAINAGE.

Owing to the extremely flat country around Champaign and Urbana, the drainage of this subway promised to be an extremely difficult problem to efficiently solve. An inspection of the profile shows that the low water level of the"Bone Yard" creek at the place where it crosses University Avenue, about 1200 feet east of subway, is at practically the same level as the lowest point of the subway making direct gravity flow into the"Bone Yard" out of the question. After concluding that the only possible way of draining the subway was to construct a sump large enough to hold the accumulation of water from a storm of average duration and then by means of an automatic pump, raise water high enough to enable it to run by gravity into the "Bone Yard"; the problem was unexpectedly simplified by learning of the fact that Champaign has under serious consideration, with every indication that it will be put through, the building of a new storm-water sewer which will cross University Avenue at Second Street, which is about 900 feet east of the subway, and enters the "Bone Yard" at Wright Street. The sewer at Second Street where it crosses University Avenue will be eighty-one inches in diameter, and the top of the invert of this sewer will be twenty-nine feet lower than the top of rail of Illinois Central Railroad tracks. As the drain pipe for the subway will start about twenty feet lower than the top of rail, there will be ample fall for drainage.

The grades of the streets near the approaches of the subway slope away from the mouth so that very little surface water from that source could find entrance into the subway. The drainage question then involves only taking care of the storm water which

falls on the exposed surface of the subway.

A line of fifteen inch vitrified clay pipe will be used to carry off water from subway to sewer. To convey water from the subway to this drain pipe, five catch basins will be used, two of which will be placed on south side of pavement, and the other three into which will also be drained the water falling on the street railway, will be placed on the north side. One man-hole will be placed over drain pipe in the center of subway.

ABUTMENTS AND RETAINING WALLS.

These will be made of concrete designed to conform as nearly as possible with the Illinois Central Railroad practice. For the abutments, the width of the bridge seat must be wide enough for a 30"x 30" pedestal casting set six inches back from the edge of coping, and at an angle of 18° 30' with the parapet wall. The width at footing of abutment will be made four tenths of the height. The top width of the main retaining walls will be two feet throughout, and the width of each sucessive stepped portion of section of wall will be made four tenths of the height at that point. The interior retaining walls between pavement and street railway track, and the sidewalk walls will have a top width of twelve inches and a bottom width sufficient to afford the necessary stability.

ROAD BED FOR STREET RAILWAY.

As it seems undesirable to put ballast and ties on a 7% grade and in order to afford an impervious surface such as will readily allow the water to run off; the writer proposes that a concrete roadbed be used as shown on plan, with high flanged rails imbedded and tied together with tie rods.

FALSE WORK.

To provide for the operation of the Illinois Central Railroad during construction, temporary trestles will be put up in sections under each track, the lateral timbers being only long enough to span one track and being spliced to the sections adjoining after erection. The trestle bents will be spaced fourteen feet center to center and each bent will contain four piles capped by a 12″ x 12″ timber upon which will be laid the track stringers (7″ x 16″), six being placed under each track.

OPERATION OF STREET RAILWAY LINE DURING CONSTRUCTION.

The Street Railway line will be operated during construction by moving a portion of the tracks now on University Avenue to First South Street and Water Street as shown by dotted lines on the map.

ACCESS TO DEPOT.

It occurs to the writer that what might be considered an objectionable feature to the design as proposed, is in making it necessary for pedestrians on University Avenue to use surface sidewalks across tracks in going to and coming from depot. The necessity for crossing tracks can be overcome, and at the same time facility of access to depot afforded by continuing the sidewalk on north side of subway under girders on a 7% grade for about ninty feet; the top of sidewalk being about a foot higher than top of rail of Street Railway line. At this point an opening can be made through abutment and steps placed, leading out of subway to surface of ground, and thence through present park to depot. This will afford access to depot for street car passengers as well as pedestrians.

APPORTIONMENT OF COST.

Judging by the manner in which the Green Street subway was built, by agreement, the Illinois Central Railroad paying for the abutments and iron work, and the city paying for excavation, drainage, and paving, it is unlikely that any legal complications will arise, and from the fact that the three different parties concerned, the City, the Street Railway Company and the Illinois Central Railroad, are benefited by a subway at this point it would seem that the practical way to build this subway is also by agreement, the cost being apportioned among the three parties in proportion to the benefits accruing and amount of property abutting. Having these considerations in mind and with the desire to make such an application of them to the proposed subway as will best promote its accomplishments; the writer proposes the following apportionment of cost:-

The City shall pay for the retaining and sidewalk walls, paving, sidewalks, railing, property to be acquired, latticed girder highway bridge and the excavation except the strip apportioned to the Street Railway Company.

The Illinois Central Railroad shall pay for the abutments, girder spans, and all work pertaining to alterations and maintenance of their tracks.

The Street Railway Company shall pay for the excavation of a strip ten feet wide through subway and approaches (which is the width monopolized by their track) for the drainage, and for all work pertaining to alterations and maintenance of their tracks, and shall assume responsibility for damage to property.

Estimate of Cost.

404300	lbs.	of metal in I.C.R.R. girders	at 3 1/2 cts.	$14115.00
10450	"	. of metal in latticed girder highway bridge	" 3 1/2 "	365.00
3815	cu. yd.	concrete (for abutments and retaining walls)	" $5.50	20982.00
282	" "	" (street railway roadbed)	" 5.00	1410.00
970	" "	cinders (filling for business track)	at 0.27	262.00
16200	" "	excavation	" 0.25	4050.00
2450	sq. yd.	brick paving	" 1.40	3430.00
8340	sq. ft.	cement sidewalks	" 0.17	1419.00
3600	" "	gravel and tar floor for girders	0.08	288.00
1400	lin. ft.	railing	" 0.50	700.00
False work at $6 per ft. of span per track				1800.00
Raising and surfacing business track				265.00
Storm-water sewer 15-in. pipe				1468.00
Damage to property				500.00
Property to be acquired				500.00
				$51554.00
Engineering and contingencies		10%		5155.40
		Total cost		56709.40

APPORTIONMENT OF ESTIMATE.

The City:-

10450	lb.	of metal in latticed girder highway bridge	at 3 1/2 cts.	365.00
13360	cu. yd.	excavation	" 25 "	3340.00
2164	" "	concrete (for retaining and sidewalk walls)	at $5.50	11902.00

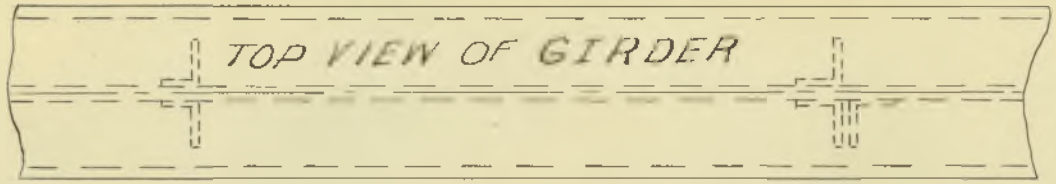
2450 sq. yd. brick paving	at $1.40		$ 3430.00
8340 " ft. cement sidewalks	" 0.17		1419.00
1400 lin. " railing	" 0.50		700.00
Property to be acquired			500.00
			21656.00
Engineering and contingencies	10%		2165.60
Total cost to city			23821 .60

The Illinois Central Railroad.

404300 lb. of metal in girders	at 3 1/2 cts.	14115.00
1651 cu. yds. concrete(for abutments)	at $5.50	9080.00
970 " " cinders(for filling business track)	at 27 cts.	262.00
3600 sq. ft. gravel and tar(floor for girder)	at 8 cts.	288.00
Raising and surfacing business track		265.00
False work		1800.00
		25810.00
Engineering and contingencies	10%	2581.00
Total cost to Illinois Central Railroad		28391.00

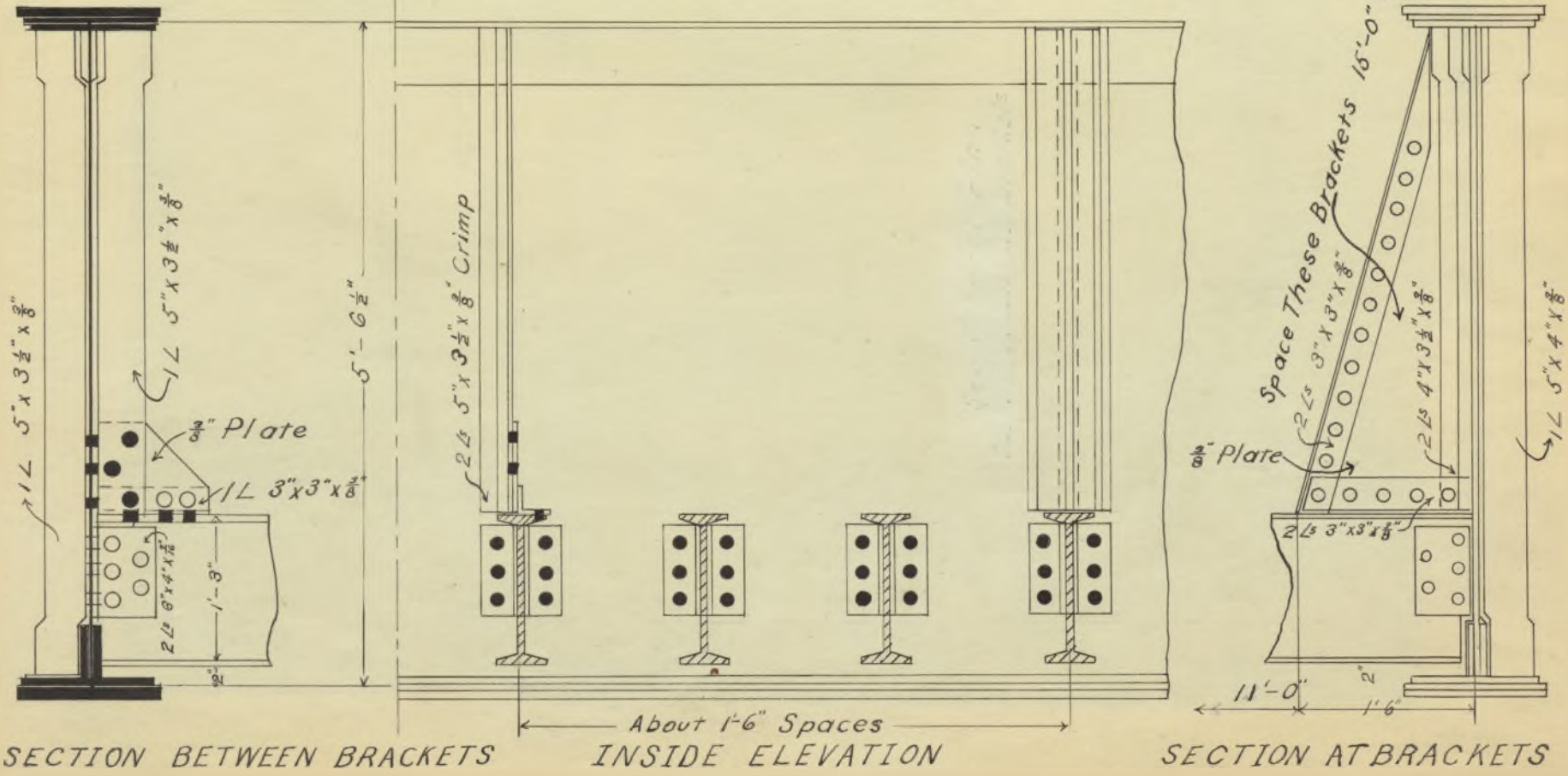
The Street Railway Company.

2840 cu. yd. excavation	at 25 cts.	710.00
282 " " concrete(for roadbed)	"$5.00	1410.00
Storm-water sewer 15-in. pipe		1468.00
Damage to property		500.00
		4088.00
Engineering and contingencies	10%	408.80
Total cost to Street Railway Company		4996.80



METHOD OF FASTENING I BEAMS TO GIRDER

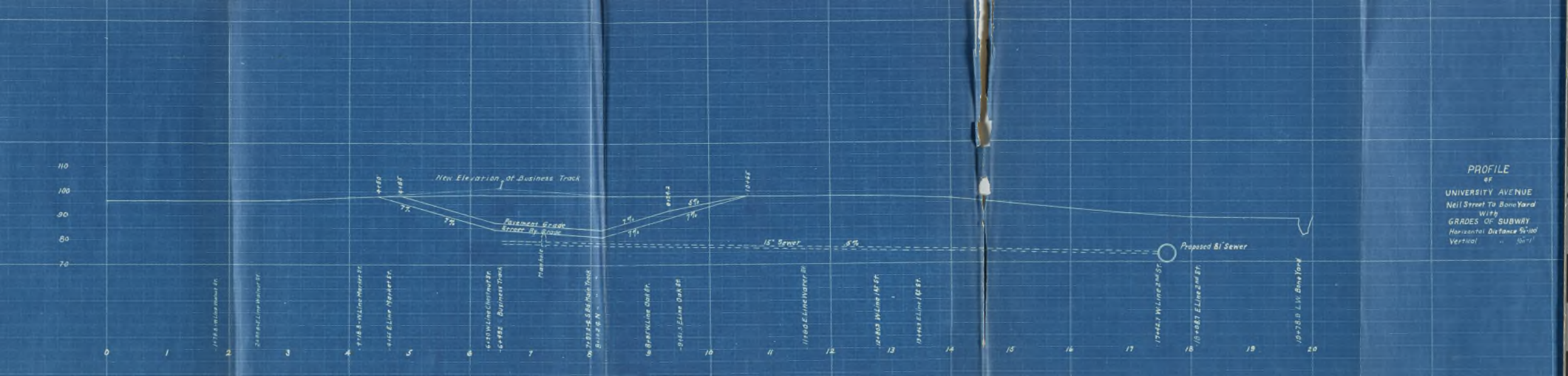
Scale 1/16 - 1'-0"



SECTION BETWEEN BRACKETS

INSIDE ELEVATION

SECTION AT BRACKETS


PROFILE
OF
UNIVERSITY AVENUE
Neil Street To Bone Yard
With
GRADES OF SUBWAY
Horizontal Distance 1"=100
Vertical " 10=1'
New Elevation of Business Track
Pavement Grade
Street Ry. Grade
15" Sewer
Proposed 81 Sewer
110
100
90
80
70
0
1
2
3
4
5
6
7
8
9
10
11
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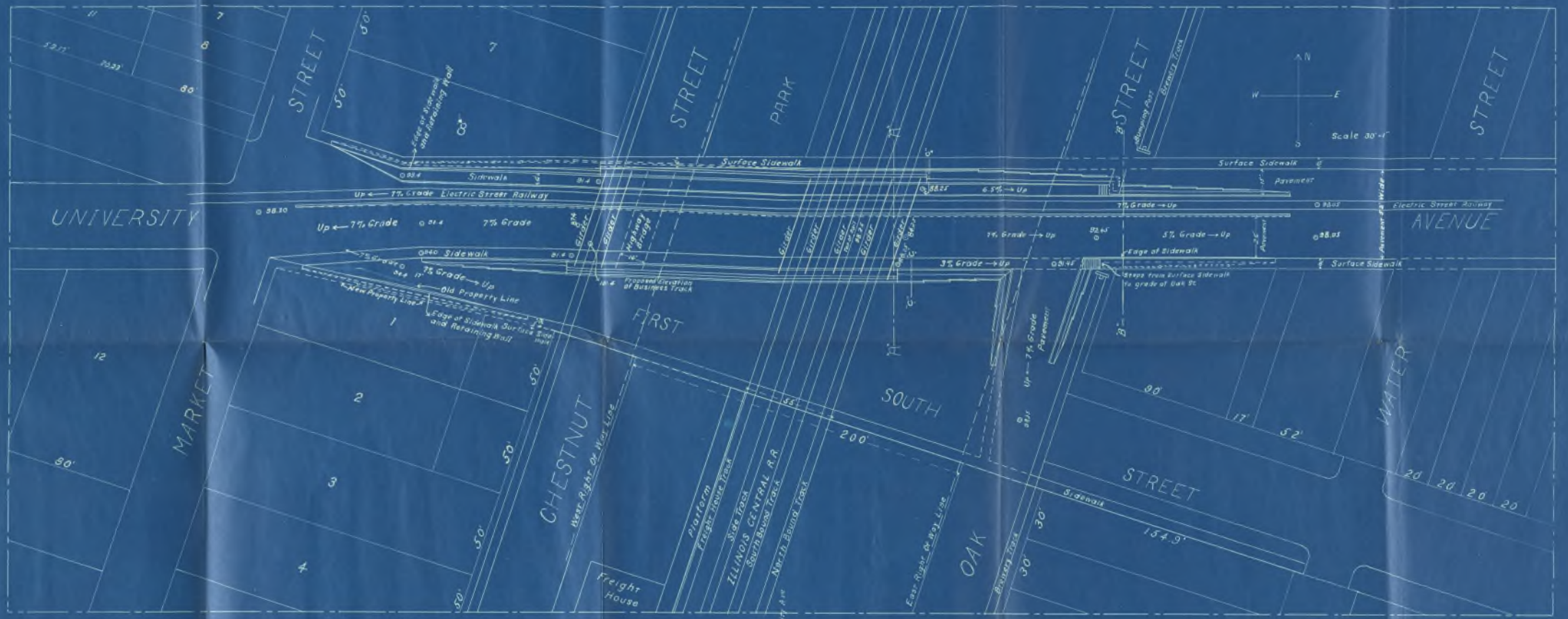
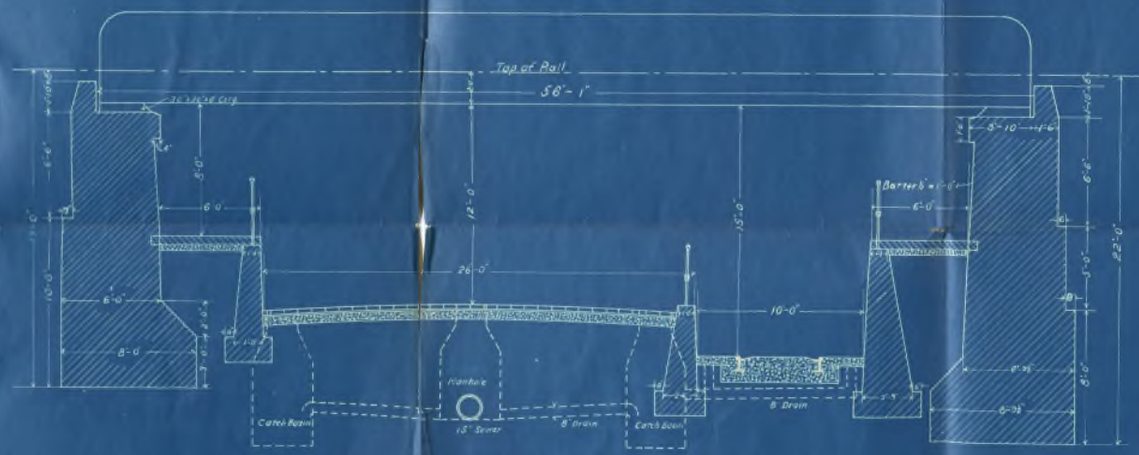
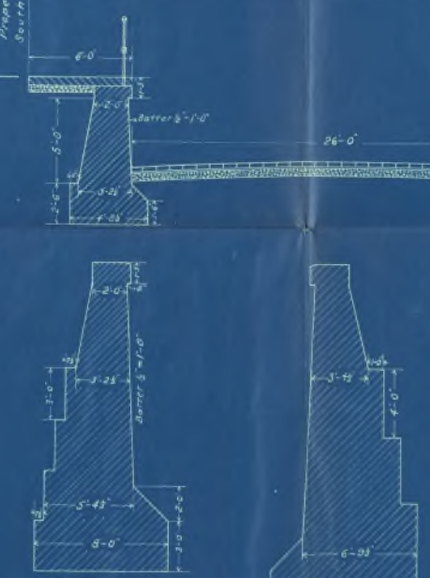
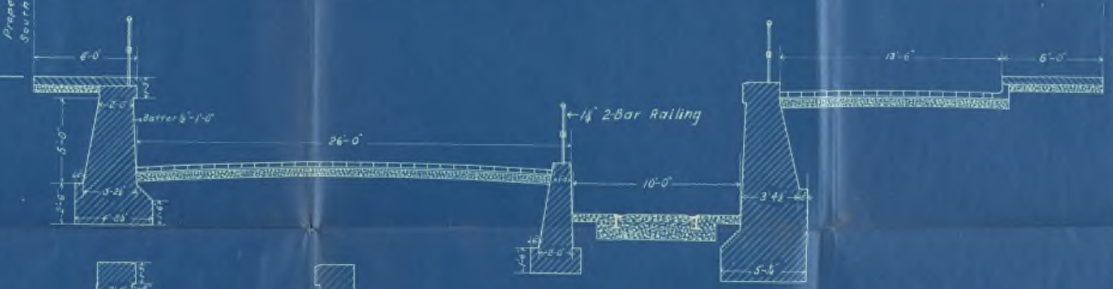
20









GENERAL PLAN
FOR
UNIVERSITY AVENUE SUBWAY.
CHAMPAIGN ILLINOIS.
DESIGNED BY — E.P.L. Lonergan.
JUNE. 1906.