THE BLOOMSBURG BRIDGE.

JOHN A. WILSON'S REPORT, AND THE ACTION OF THE COUNTY COMMISSIONERS THEREON.

It was our intention to publish last week the report of John A. Wilson on the river bridge at this place, and the action of the commissioners, but it was unavoidably crowded out, and we therefore issue an enlarged paper this week in order to make room for it.

Mr. Wilson is a civil engineer of wide experience and high reputation, and his services are sought for all over the country.

The present board of commissioners on assuming their official duties, found that they had resting upon them the responsibility of building a bridge across the Susquehanna River at Bloomsburg, under a contract made by their predecessors in office, involving the expenditure of about seventy thousand dollars.

When the first abutment on the other side of the river was completed the commissioners inspected it, and were not satisfied with it, and refused to pay the bills according to the estimates furnished.

In the dispute that followed with Joseph Hendler, the contractor for the stone work, the latter told the commissioners that they knew nothing about such work, but if they would employ a competent person, naming several and among them John A. Wilson, he, Hendler, would listen to him.

Accordingly, Mr. Wilson was sent for, and after examining the masonry he made the report which is printed below.

The commissioners assert that they have no intention or desire to do anything to hinder or delay the erection of the bridge, and they could not annu the contract if they had such desire, but they are anxious to have the work done properly, and according to the specifications, hence their action in the matter.

Warren Eyer has been employed by them as assistant engineer, and is present at the work constantly and supervises it for them as it progresses.

It is probable that matters are now satisfactorily adjusted, and the bridge will be completed without delay.

To one who does not pretend to know anything about masonry it looks as though the workmanship in the abutment on this side of the river is quite an improvement on that on the other side.

MR. WILSON'S REPORT.

W. H. RHAWN, ESQ.,

Solicitor for Commissioners of Columbia County, Penna.

DEAR SIR:—At your request, I spent March 30th and 31st at Bloomsburg confering with yourself and the Commissioners relative to the construction of the new county bridge across the North Branch of the Susquehanna river at Bloom Ferry. I went to the site of the bridge, examined the work that had been done, conferred with Mr. James C. Brown who is acting as Engineer of the work, and examined sundry contracts, drawings, papers, &c. I now have the honor to report the results of my investigations.

The bridge is intended to cross the river square, i. e. practically at right angles with the current of the river, and, as I am informed, will consist of six spans of iron superstructure supported on masonry piers and abutments.

The spans are each about 189 feet in length giving a total length of 1150 feet for the bridge exclusive of approaches.

There will be two abutments located at the river banks and five piers in the river.

I have been shown two contracts, viz: one dated November 25, 1893, with Joseph Hendler, of Wilkes Barre, Pa., for the masonry; the other dated November 24, 1893, with the King Bridge Company, of Cleveland, Ohio, for the superstructure.

When I visited the site, I found that a piece of masonry had been constructed on the South side of the river for an abutment, and that excavation was in progress for the North abutment, also a considerable quantity of iron work for the superstructure had been delivered and stored on the ground adjacent to the N. & W. B. R. R. south of the river and a short distance east of the Bloom Ferry Station on that railroad.

I had been informed by you that the Acts of Assembly relative to the construction of county bridges, require that before the construction of such a bridge can be authorized, plans and estimates must be filed, and that neither the Engineer nor the Commissioners have any right to deviate from the plans filed, without going through special formalties. This, of course, is a matter of law, which I am not supposed to know about except as I am advised by you.

In my interview with Mr. Brown, I asked for the map and profile of the bridge, but received answer that there was none, except a rough profile which had been furnished to the King Bridge Company and which was not filed.

I was shown three blue prints, which I was informed were the *plans filed*. One was entitled "Abutment River Bridge, Bloomsburg, Pa., South Side; another entitled "Abutment River Bridge, Bloomsburg, Pa., North Side;" a third entitled "River Pier No. 1."

All were noted as being on a scale of ¼ inch to a foot, but were simply crude outline sketches with only a few dimensions noted on them.

I was also shown a paper purporting to be an estimate which contained the following information, viz:

Excation	$ 100.00
Masonry	30,456.00
Timber for foundations	700.00
Superstructure	38,000.00
	$ 69,256.00

There should be on file an accurate map showing the river banks, the topography of the ground on both sides of the river, with the positions of the public roads which the bridge is intended to connect, and the center lines of the bridge with the position of the piers, abutments and approaches.

There should also be on file a profile showing the bottom of the river, high and low water lines, the position of the masonry, depths of foundations, top of piers, &c., the floor lines of the finished bridge and the banks of the river and natural surfaces on the line of approaches; all these being indicated by actual figures of elevations referred to some permanent Monument or Bench Mark, without having to trust to scale measurements. With the exceptions of the words "Bloomsburg, Pa.," on the two abutment blue prints, there is nothing on the plans to show where the bridge is to be situated, and a strange Engineer, furnished only with these filed plans, and without verbal explanation, could not form the slightest conception of the work. On referring to the contract for the Superstructure, I find there is attached to the blue print, from the King Bridge Company, marked approved November 24, 1893, and which blue print is filed, it does not however, give any assistance in understanding the location of the bridge or the construction of the masonry, as it is simply a detail of iron construction.

I have been shown some detailed plans of the masonry construction. These refer to the several pieces of masonry separately, and appear to be only for the information of the contractor, but they are not complete and show nothing about the location of the bridge, position for tops of piers, &c. They are as follows:

Drawing of Pier No. 1	dated	Jan	10, '94
" " Cofferdam	"	"	13, "
" " South Abut.	"	"	17, "
" " Caisson	"	"	26, "
" " Pier No. 2,	"	"	25, "
" " " " 3,	"	"	25, "
" " " " 4,	"	"	25, "
" " North Abut.	"	"	25, "

All these are dated subsequent to the contract for the masonry.

My idea of a complete set of plans for the masonry of a bridge is that they should be such as to enable any competent engineer, after examining them to locate the bridge on the ground, and proceed with the construction intelligently. There are of course matters of minor details which will arise during the construction, and which the supervising engineer must provide for and settle, and I do not want to be understood as claiming that such matters should be covered by the general plans, but I am very sure that an engineer who was strange to the locality, and who was furnished only with the filed and detailed plans above referred to, could not find the sight of the bridge, nor lay the work out and direct its construction. The estimate previously mentioned gives in detailed information as to the character, quality, quantity, or prices of the various kinds of work in the proposed bridge, and can hardly be classed as an engineer's estimate. I am informed that the approaches of the bridge are not included in the existing plans, estimates and contracts.

While this is a matter which the County can hereafter arrange for by making additional contracts, and with increased expenditures, I would respectfully call your attention to the decision in the case of Westfield borough vs. Tioga county, Pa., State Reports No. 150 (Monogam 1892) page 152 to 163, in which the Supreme Court announces the very sensible doctrine, that the definition of a bridge includes the approaches necessary to make it accessible to public travel and that until thus completed there is no bridge. (page 157.) It might be well to note in this connection, that both the contracts hereinbefore mentioned contain clauses making them subject to the laws of Pennsylvania, relative to bridge inspectors.

Coming now to the construction of the masonry; as previously stated the South abutment has been built, and foundations are being prepared for the North abutment. I questioned Mr. Brown as to how he obtained the distance across the river, and fixed the points for the masonry. This is entirely a matter of surveying, dependant on the skill and care of the surveyor. Mr. Brown's methods as explained by him verbally, appear to be in the main, correct. The iron work will be manufactured to be very close dimensions, and it would be a serious matter, if it did not fit on the masonry. I hereby call attention to this matter as one of the details which requires the utmost care and attention. With regard to the five river piers, the dimensions as shown by the filed and detailed plans, appear to be sufficient, though I think that in a stream like the Susquehanna, subject to floods and heavy ice, it would be better to have dressed the faces of its ice breakers, and rounded the down stream ends of the piers. The filed plans do not indicate the character of the proposed foundations, but the detailed masonry plans and Mr. Brown's verbal explanation indicate that No. 1 (from the South side of the river) will be located on the rock, the foundation being put in through the medium of a coffer dam. For the other four piers my understanding is that it is proposed to use timber platforms on the present bed of the river, the platform being floated into place, wooden sides being built up to exclude the water, thus forming a caisson, and the caisson being sunk with the weight of the masonry built inside of it. On inquiry I am informed that the bottom of the river is formed of gravel and coal dirt, but that no examinations have been made to ascertain what is below the surface of the gravel.

It seems to me that a great risk is being taken, in founding the piers of an expensive and important bridge in the river bottom, without any knowledge of what is below. Assuming, however, that the river bottom is hard gravel, it will be necessary to protect the timber bottom with riprap (which is not provided for in plans, specifications or contracts) and obstructions will thus be formed in the river, the result of which will be to cause the channels in the river to deepen by washing. This, it is well known, will occur in the hardest gravel, and in a few years the bottom of the piers might be above the rest of the river bed, with more or less tendency to be injured with heavy freshets or ice floods. My opinion is that the foundations of the piers should be placed not less than 3 to 4 feet below the present river bottom except when they rest on rock. It might be found by examination, that rock could be reached at a reasonable depth below the river bottom, in which case it would be advisable to use coffer-dams and sink to it. The same question comes up relative to the foundations of the north abutment. When I was at the site the excavation had been made a few feet in depth. The material was hard gravel but with water flowing freely as if from springs, I was informed that after I left the place on March 30th, the foundation timbers were hurried in for fear that quicksand might be struck. Mr. Brown, however, said to me that he had tested the place with bars, and found several feet of gravel below the proposed foundation level.

If I were professionally responsible for the work, I would want to make more satisfactory examinations before constructing an abutment for a large river bridge of that kind, and if there were any quicksand there, I should want to know it before putting masonry on it. The south side abutment I understand is on rock which of course makes a good foundation. I have stated that the dimensions of the piers appear to be sufficient, but I regret that I cannot say the same of the abutments. Take first the north abutment. The filed plan shown for the main abutment wall, a thickness at top of foundation courses of 7 5½ and a height to the bridge seat of 25 feet. This wall should be 11 feet thick of neat work, with a corresponding increase in width of foundations.

On the same filed drawing, the wing walls are noted to be 4 feet thick at the bottom when they should be 11 feet thick.

Turning now to the detailed masonry plan for the same abutment, we find noted a thickness of main wall at bottom (resting on timber) of 8 feet with a height of 28 feet which requires for strength and stability at bottom a thickness of 12 feet.

For the wing walls the thickness is noted at the bottom in figures as 6 feet, when it should be 12 feet. The required thickness of wall depends on its height, and the filed and detailed plans do not give the same height.

Now take the south abutment. The filed plan shows for the main front wall a thickness at bottom of 7 10½ for a heighf of 34 feet, whereas the thickness of the wall should be 14½ feet.

The wing walls on the same drawing are shown as 4½ feet thick when they should be 14½ feet thick. On the detailed drawings of same abutment, the main wall is noted to be 8 feet thick at bottom for a height of 33 feet, when it should be 14 feet thick, and the wing walls are noted to be 6 feet thick when they should be 14 feet thick at the bottom. It is to be understood that I am giving the correct thickness at bottom, and it is proper to reduce the thickness by offsets, keeping its thickness not less than 3-7 of its height at any point. The simple fact is that these walls are called upon to sustain the embankment of clay, gravel, or other ordinary material they will not stay there, and it would be necessary to back them in with rock laid by hand, which would not need any support from a wall to keep it in position. Relative to this south abutment, Mr. Brown stated at our conference that he had made the main wall 10 feet thick at the bottom, and that on account of finding rock bottom, the height had been reduced to 30 feet, also that he had increased the thickness of the wing walls proportionately. The main wall then under these conditions, should have a thickness of 13 feet at the bottom and the wing walls should be the same thickness where they join the face wall, reducing of course further south if the foundation rises and they may have less weight. In view of the legal requirement to adhere to the filed plans, it is difficult to see how changes in the thickness of the walls could be made. Now with regard to the design for the wing walls. I noticed on the detailed drawings that these wings are flared, that is, being wider apart at their rear end than where they join their main abutment wall, also that they step down towards the rear end. The driveway on the bridge is 18 feet wide with wheel and hub guards provided. It is customary on wagon road bridges to construct the wing walls masonry to the full height of the approaching roadway, widening the embankment out so as to fill in level between the walls and then to build a masonry parapet to 3 or 4 feet above the road surface, thus forming a complete guard to guide teams into the bridge proper, and give proper space for teams that may be passing each other. On railroad bridges this is not necessary, as all that is required there is to preserve the proper width of road bed for the tracks, and the side slopes may run off either way, the walls being built to the proper height to retain them. In the case of the Bloom Ferry bridge there is no data on the plans by which I can work out the slopes, proper position of wing walls, &c., at the north end of the bridge, but at the south end where the masonry is now built, the thing shows for itself. The total width between wing walls where they join the front wall is about 20 feet. Mr. Brown advises me that there is an ascending grade southward of the bridge of about 1 foot per 100 feet, and that the same grade extended will reach the level of the N. & W. B. R. R. track. (N. B.—A proper profile of the bridge would show this.) The result will be, the way the masonry is now built, that a roadway of not over 20 feet wide with a steep slope on each side will form the approach to the bridge from the south, and it will be very difficult to maintain any proper fence or guard on the top edge of this roadway. Country teams coming along are apt to be timid on approaching the railroad, and it may be difficult to handle them and avoid accident especially if a train should be passing or standing at the station. These wing walls should have been built in the way and usual custom for country bridges, and with a masonry parapet or strong fence above the road surface. This, I consider a serious defect in the design of this bridge and I doubt if the approaches as now designed will be satisfactory to the citizens of Columbia county. It is further a question whether the material composing the embankment on the approaches will not flow around the end of the wing walls, down to the river bank.

If this occurs, the embankment of the approaches is liable to be damaged at every flood in the river. The remedy for this latter difficulty would be to construct additional dry masonry walls to hold up the slopes, which, of course, will add just so much to the cost of the structure. My opinion has been asked as to the specification and contract for the masonry and the quality of the work being done by the masonry contractor. The contract and specifications are in many respects indefinite, but on the whole call for good work. The foundations are to be constructed, as in the opinion of the engineer, may be necessary to secure a solid bearing. The masonry of wing walls of abutments is to be third class masonry, that is, rubble-work, otherwise the masonry is to be rock range work, the "face stone to be accurately jointed and bedded, and laid in regular horizontal courses" —"The stones for the heart of the wall will be the same thickness as the face and back, well bedded but not jointed, but must be well fitted in their places." This means dressed stones in regular courses throughout, excepting the wing walls. My inspection of the only piece of masonry laid up, in the south abutment shows a fair quality of rubble work in the wing walls, so far as external examination can determine. Just how the work may be bonded in the interior of the wall could be ascertained only by observation during the progress of the work. The main wall, however consists of range work on the face with rubble backing, and is thus clearly not in accordance with the specifications and contract. The wall is thin and the stone used are in heavy courses. It therefore becomes difficult to secure a good bond and tie the work well together. My judgment is that there is very little bond between the face and back of the wall, and I am clear that this wall is not in accordance with the contract and its accompanying specifications. It is somewhat difficult to pass an opinion upon the merits of the wall where only the outside can be inspected. I examined the stone delivered on the ground for the purpose of the work, and so far as strength and durability is concerned need not be any question raised about it. The cutting of the stone is not perfect and is open to the usual criticism on all work of this character but on the whole the face stone which I saw, if properly laid will make good strong work. Of course care is necessary to get the proper headers and stretchers and judgment must be used on the part of the mason and the inspecting engineer. I inquired about the cement, and was informed that the contractor was using Lesly and Trinklers Improved Union Brand. This brand of cement has a good reputation and should be all right. I examined the sand placed near the north abutment, it is clean and mostly pure quartz, but not sharp, being water worn. I am told that it is the best obtainable in this locality. The specifications require that the rock face of the stone shall not extend 4 inches beyond the neat lines for the ordinary work, and 2 inches is fixed as the limit on the faces of the ice breakers. The work however built shows greater projections of the rock face. I do not consider this a serious matter, though of course if the Commissioners insist on it the contractor should scabble the face down to the specification limits. My opinion has been requested as to the inspection of the mason work during construction. I have no hesitation in saying that a reliable and competent inspector in the employ of the County should be on the ground the whole time that masonry is in progress, to see that the work is done properly, and he should give special attention as to the mixing and use of cement, to insure the proper amount being used, and the mortar being made fresh, as needed, so that the cement will not be spoiled in its manipulation.

My opinion as an engineer has been asked respecting certain estimates, as to what is usual and customary in the business, and what should be a proper interpretation on the contract in this respect. Copies of two estimates in favor of Joseph Hendler, contractor, certified to by J. C. Brown, engineer have been shown me, viz: Estimate No. 1 approved December 30th, 1893. for 1100 yards of stone dressed at quarry ready to be shipped, $5940.00. Estimate No. 2 approved February 7th, 1894, for sundry items including stone dressed in quarry, stone, cement and sand delivered on the work &c., amounting to $5395.82, after deducting the assumed payment on Estimate No. 1. Contractors are often men of small means and it is usual and customary to make them monthly payments, and the written contract generally reads "for materials delivered and work done." This is fair and right and in accordance with the customs of the business. But in no case should the Engineer estimate and pay a contractor anything for materials not delivered and not in the custody and the control of the owner of the work. All materials estimated and paid for must be so deposited that the owner of the work shall have a clear title to it, as against all other claimants, and it is evident that stone dressed in a quarry, perhaps 50 miles or more from the site of the bridge, cannot be in the physical possession of the owner of the bridge and consequently is not in proper shape to be included in an estimate, and cannot safely be paid for. In the particular case now under consideration, whoever prepared the contract for the masonry omitted to mention "materials delivered" as an item in making estimates. The contract with Mr. Hendler distinctly recites prices for work in place completed. My opinion of a contract of this kind is, that the contract is the law which governs the Engineer, that he derives all his authority from the contract, and cannot go beyond it, and that the County Commissioners should not make payment except in accordance to the contract. Therefore, I am of the opinion in this case no payments can be made to Mr. Hendler except for completed and accepted work in place, and that materials delivered at the site of the bridge, or stone out in the quarry, ready for shipment, &c., &c. should not be estimated. The King Bridge Company understand this matter, and in their printed form of contract, which has been signed by the Commissioners of Columbia County, they recite that the monthly payments are to be made on acceptable material at the shops, delivered on the ground; and in course of erection. In their case I am of the opinion that the Commissioners have obliged themselves not only to pay for materials delivered on the ground, but also for that in the shops at Cleveland, Ohio, and they will have to depend on the solvency of the Bridge Company and their bond as security for the money paid out. Whether the clause in the contract making the contract subject to the laws of Pennsylvania, relative to Bridge Inspection, will modify this condition or not is a question which I cannot answer. Under the conditions hereinbefore stated, it is evident that the Commissioners of Columbia County were perfectly right and justifiable in passing their resolution of March 1st, 1894, rejecting estimates No. 1 and No. 2 in favor of Joseph Hendler, contractor, as not binding on the county, the special points being that said estimates were for work in place, (south abutment) not constructed in accordance with the specifications and contract, and for materials delivered or prepared at the quarry, which were not the subject of an estimate under the contract.

I have been requested to state figures of cost for various kind of masonry. This is somewhat difficult to do, as the cost will vary with local circumstances, and be governed largely by the freight charges on material, the cost of quarrying and cutting the particular kind of stone, and incidental expenses due to the particular location of the work. On the Philadelphia & Reading Terminal work in the city of Philadelphia from May, 1891, to fall of 1893, I have been paying for masonry constructed of Conshocken stone, and laid in Portland cement mortar the following prices:

Rubble work in retaining walls: $6 25 per cubic yard. First class masonry in abutments; $9.75 per cubic oard. First class masonry in piers: $12.75 per cubic yard.

This masonry in its execution and finish is superior so far as that done at the Bloom Ferry Bridge, and the backing in first class masonry is all coursed.

In answer to an inquiry propounded to me I would state (though perhaps I have covered the point previously) that the filed plans of the bridge masonry are in my opinion crude and indefinite, that the quantities of masonry and other work cannot be figured from them. The original estimates filed are also indefinite. The object as I understand it in filing plan and estimates is that the Commissioners shall have in their office a definite statement of what the work is going to cost, and also to have a check on the estimates returned from time to time from their Engineer. The preliminary estimate should be in detail, giving the measurement of each kind of work, with probable price and this would be a check as to quantities on future returns. I understand from you that under the law the amount of the original estimate cannot be exceeded. It is usual in making such estimates to include an item of ten per cent. for engineering and contingencies which appear not to have been done in this case, therefore any incidental expenses must be charged against the general account. In Mr. Hendler's contract the work done is to be paid for by the cubic yard, &c., but there is nothing in the contract fixing a limit as to the number of yards, &c., or the ultimate cost of the work.

The superstructure of the bridge is covered in the contract with the King Bridge Company. One drawing showing details of the iron work is attached to the contract of November 24th, 1893, and is marked approved by Mr. Brown as of that date. Six other blue prints were handed to me, being dated respectively, December 6th, 1893, January 13, 17, two prints 18, and 20, 1894.

Two or three of these sheets were given me just before I left Bloomsburg, and I did not have an opportunity to examine them carefully at that time. From my first hasty look at the drawings, I was under the impression that no strain sheet had been furnished; on a closer examination I find that most of the information is contained on the blue prints, though it is not in the shape that we are accustomed to see it. I have not had the iron work drawings examined and figured over, as it would take some time to do it properly. It can be done hereafter if you desire it, and could be covered quicker with some additional information from the Bridge Company, Mr. Brown informed me, in answer to my inquiries, that the strain sheet had not been checked over, that no test had been made of the quality of the iron and steel used in the structure, and no inspection had been made of the workmanship at the Bridge Shop. It is usual for the Engineer to attend to all these matters, otherwise you are simply taking and paying for what the Bridge Company chooses to give you. The examinations and tests of the iron work should undoubtedly have preceded the certifying of estimates by the Engineer, in favor of the Bridge Company. The work may be all right and it is now too late to test the material, as it has been worked up into shapes, and a portion delivered on the ground ready for erection. The Bridge Company may have had tests made of the material and be able to furnish certificates. I will await you further instructions before doing anything more with the matter of the Superstructure.

Respectfully Submitted,

Signed, JOHN A. WILSON,
Civil Engineer.