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WAIWAKAIHO BRIDGE.

Provincial Secretary's Office,
New Plymouth, 7th April, 1858.

TENDERS for the erection of a Bridge over the Waiwakaiho River will be received at this Office, till noon on Friday, the 7th May next.

The Plans, Specifications, and Conditions of the Contract may be seen at this Office on and after Friday, the 16th inst.

I. N. WATT,
Provincial Secretary.

BURNING OF STANDING FERN.

Provincial Secretary's Office,
New Plymouth, 9th April, 1858.

NOTICE is hereby given that the Police are strictly enjoined to proceed against all persons who shall wilfully fire the fern within the limits of the Town of New Plymouth; the Municipal Police Ordinance imposing a fine not exceeding Five Pounds in every such case.

I. N. WATT,
Provincial Secretary.

WAIWAKAIHO BRIDGE.

Provincial Secretary's Office,
New Plymouth, 14th April, 1858.

THE Designs for the Waiwakaiho Bridge may be seen at the Council Chamber, between the hours of 1 and 4 o'clock p.m., on Friday, 16th, Tuesday 20th, and Thursday, 22nd instant.

I. N. WATT,
Provincial Secretary.

Provincial Secretary's Office,
New Plymouth, 14th April, 1858.

THE following Letter from Colonel MOULD, R.E., is published for general information.

I. N. WATT,
Provincial Secretary.

Royal Engineer Office,
Auckland, 6th March, 1858.

Sir,—I have the honor to acquaint you that I have returned per schooner Pelsart the designs, 14 in number, as in the enclosed list, for a bridge over the Waiwakaiho river, received from you in a box, and also another, No. 15, which was received through the Post Office with a letter enclosed unsigned. I have taken this latter design into consideration notwithstanding it reached me in an irregular manner, but as though it possesses merit, I do not consider it entitled to one of the premiums, the irregularity in the mode of its transmission is of no importance. I however send it to you that it may be returned to the designer whose address I presume you have.

In considering the several designs I eliminated one by one, those which palpably in my mind were insufficient in point of strength and one on the suspension principle which was not trussed to diminish as far as practicable vibration, oscillation and undulation and which was otherwise weak. In this way I set aside the first five in the list, leaving ten or rather nine (for V Z and X X by the same hand do not differ in the

principle of the bridge) for more deliberate consideration.

Taking the designs in the list in succession I come to No. 6, which notwithstanding the calculatious made by the designer, accurate as far as they go, I must also set aside as not sufficiently strong. The designer assumes that the rule for calculating the strength of a simple homogeneous beam is applicable to one built according to his design in short lengths and in several thicknesses, and therein is a serious error at first starting, besides that he has not taken into consideration the weight of the beams themselves which should be an element in the calculation ; further he takes the value of S (the ultimate transverse strength) in my opinion at too high a rate : doubtless the experiments made at Sydney would give the value stated, but it must be recollected that all such experiments are made with carefully picked seasoned material of short lengths, small scantling and straight grain under the most favorable circumstances, an allowance should therefore be made for defect in strength of less carefully chosen, less seasoned material whose grain may be twisted and not equal throughout the whole section of a wide beam or plank. The arched form given to the girders in this design would add to their strength provided the abutments were sufficiently substantial and immoveable, and doubtless the designer felt he wanted such addition, but as a simple inspection of the Sketch will shew that the portions of the abutments of which the designer has availed himself are insufficient to resist the great thrust of so flat a segmental arch, and as they may be moved by earthquakes, they cannot be depended on to compensate the deficiency of strength in the beams. The designer's calculations of the available strength as compared with the possible weight to be thrown on the bridge are very close, viz., 45 tons of capability to meet a possible weight of 44 tons, and it cannot be considered that the available strength is taken too low at one fourth of the calculated breaking weight, for it has been ascertained by careful experiment that any load beyond that destroys the elasticity of the beam, and thus an element of destruction is at once introduced. It must be further considered that a drove of cattle is not a dead weight, but a moving weight causing a vibration and resolving itself to a certain extent into a percussive force, which would add by so much to the load. Taking all these points into consideration, that a serious error has been made in the calculations of the strength of the bridge, which without that error are too close, comparing capability and duty, to be safely carried into practice ; that the ultimate strength of the material is taken at too high a rate ; that no allowance is made for the percussive force of a moving weight, nor for the percussive force of high winds impinging obliquely on the road way ; I cannot come to any other conclusion than that stated at the beginning of my remarks on this design. Besides that it is not an economical design, the quantity of timber in the beams alone, if judiciously disposed, would have constructed the whole of a safe and sufficient bridge, and the Estimate is palpably too low. I have entered thus at length into the consideration of this design because the calculations at the commencement of the description give a specious air of sufficiency to it which might have imposed upon those who were not thoroughly qualified by professional education to detect their comparative fallacy, but in making these remarks I do not wish it to be understood that I am of opinion there was the slightest intention on the part of the designer to mislead.

Of No. 7 I will simply remark that the tie rods on which the whole strength of the bridge depends are quite insufficient to meet the tension that would be brought upon them considering there would be to a certain extent a transverse strain where the struts rest upon the junction between the double and single rods, besides that neither the drawing nor the specification gives any thing like sufficient information to enable a builder to make a proper estimate of and tender for the work.

In No. 8, apparently by the same hand, in consequence of the great obliquity of the principals of the truss to the tiebeam, the necessary great thrust and the smallness of the abutting ends, which bear unrelieved by any other abutments the whole thrust, they would be unavoidably crippled ; further considering the great length of the principals and the straining beam, and their scantling, I believe there would be a tendency to buckle which would be fatal to the stability of the bridge. The design is not an eligible one, and I cannot assign it a favorable place in the competition.

Nos. 9, 10, and 11 are, I should judge, by the same designer, and they require some special consideration before they are placed in the category of ineligible designs which I regret is the place I must assign them. No. 9 strikes an observer at first sight from its simplicity, but on close examination I cannot come to any other conclusion than that it is very insufficient in strength. With the depth of the girders I think no reasonable fault can be found nor with the sectional area of the sides of the girder, but the sectional area of both the top and the

bottom, the first to resist compression, the latter extension are much too small. It has been found by experiment that the strength of all girders whether of cast or wrought iron depends upon the strength of the top and bottom, the difference between the two materials requiring a different arrangement of the strength; in the case of cast iron which give a greater resistance to compression than to extension the bottom flange of a girder is made of a greater sectional area than the top; the properties of wrought iron in respect to compression and extension being reversed, the position of the largest flange (so to speak) in girders formed of this material is also reversed. I have before me the records of the experiments made to ascertain the strength of wrought iron tubes before the section of the Conway tubular bridge was decided, and the following are some of the dimensions and results. In the final experiments the tube or girder was 75 feet in length between the supports, it was 4 ft. 6 in. in depth (about one-seventeenth of the span), 2 ft. 8 in. in width, the sectional area of the plates forming the top of the tube was 24 square inches and that of the bottom of the tube in the first experiment 8 4-5ths inches the breaking weight was $35\frac{1}{2}$ tons, the lower flange or bottom giving way. The sectional area of the bottom of the tube was gradually increased to $2\frac{1}{5}$ inches (the top remaining constant) when it appeared there was an equilibrium between the respective capabilities of the top of the tube to resist compression and the bottom to resist extension. The breaking weight in this case was $86\frac{1}{4}$ tons. Compare the above with the dimensions of No. 9 design as given with the dimensions of the experimental tube, in the table below.

	Span.	Depth of tube.	Proportion of depth to span.	Sectional area of top of tube.	Sectional area of bottom of tube.	Breaking weight.
				sq. in.	sq. in.	tons.
Experimental tube ..	75' 0"	4' 6"	1/17	24	8 4/5	$35\frac{1}{2}$
Girder No. 9 Design	120' 0"	6' 0"	1/20	7 7/16	7 7/16	

From the above it will be seen that the sectional area of the top of the girder or tube of No. 9 design is less (with a greater span) than one-third that of the experimental tube. and the sectional area of the bottom of the tube is one-eighth less than that of the bottom of the experimental tube as first tried. With these dimensions it is not too much to assume that the breaking weight of the tube or girder in the design would be not greater than one-fifth of the breaking weight of that recorded in the first experiment on the tube, say 7 tons, and as a beam or girder should never be loaded beyond, I will say for iron, one-third of the breaking weight, any greater proportional weight destroying its elasticity, each girder in the design would carry $2\frac{1}{3}$ tons, or the three girders 7 tons. Girders for this bridge must perform a much greater duty than that.

I come next to No. 10, which is a variety of the American lattice bridge. Here the principle of this mode of construction has been departed from by diminishing the depth of the truss at the abutments, and from the circumstance of the upper string being made somewhat in the bow form and of greater dimensions than the lower string or tie, it is presumed that it was intended to act to a certain extent as a suspension girder which is not its duty and for which it is undoubtedly insufficient. I do not mean to say that the girders are insufficient in strength, but if the principle of this kind of construction had been carried out, they might have been formed with a less expenditure of material. It is to be observed also as far as would appear that every alternate girder only of the floor is trussed: that such trussing of girders 12 x 12 with a bearing of 23 feet is requisite there can be little question, there is therefore defect of strength in the intermediate ones. But the most serious defect in the design is the evident insufficiency of the abutments. A simple inspection of the drawing, and comparison of the massive superstructure with its supports I think will shew to any person that the latter are very far from being in due proportion or sufficient. I observe that the designer of No. 12 in his preliminary remarks states that the river is gradually receding from the East bank, if so doubtless it is encroaching in a corresponding degree on the West bank, and the configuration of that bank seems to favour the presumption; should that therefore be the case, the West abutment of No. 10 would be shortly isolated and placed in a very precarious condition even if it met its proper duty from the first, hence for this and the foregoing explained defects this design is not a suitable one. I may observe also in conclusion that there is not any specification attached to this design, and wanting that and sufficient details on the drawing, it cannot be clearly ascertained how the different parts are to be connected: for instance it does not appear how the vertical struts 1' 6" x 9" crossing the intersection of the diagonal struts are to be framed, nor how the props

supporting the ends of the untrussed girders are to be carried. The want of a specification alone would in strictness according to the terms of the Prospectus, which requires a "clear and comprehensive Specification" put the design out of the pale of competition.

In No. 11 the abutments and approaches are better than those of No. 10 and are sufficient for the purpose, but in this design, as in No. 10, the true principle of this especial mode of construction has not been carried out. The wrought iron tube from the comparative looseness of the connection between it and the lattice bars, a simple clip round the tube, to which the lattice bars are "pinned" has no effect in stiffening the bridge, and it resolves itself into an independent girder acting as a suspension girder to the rest of the construction, but as it is quite clear that it is not sufficiently strong for that purpose, it might in my opinion for all useful purposes have been left out of the design altogether, thus for want of the necessary stiffening or compressing portions of the girders I have considerable doubts whether it would possess sufficient vertical strength. The essence of the principle of the lattice bridges are the string pieces and their firm connection with the lattice bars or struts: the upper string pieces are the straining beams of the truss and these must not only be strong enough in themselves to resist the compression to which they would be exposed, but the struts must as in simple trusses abut firmly and immoveably against the ends or some intermediate point or points thereof, which is not the case in the design. There is no doubt of the tube being equal to the compressive force that would be brought to bear on a string piece properly connected with the lattice bars (indeed two-thirds of the sectional area of iron in the tube properly and firmly fixed, say similarly to the wrought iron bars at the bottom of the trusses, would have been sufficient) but in this construction the tube would not be exposed to compression but to a transverse strain to which it would not be equal. Considering therefore the doubts that may be very reasonably entertained of the strength of these girders, and also that the true principle of this and all other trussed constructions, into which lattice girders resolve themselves, has been departed from, I cannot assign it a place amongst suitable designs. I come to this decision irrespective of the probable cost of such a design which I feel satisfied could not be executed, for want of local facilities, competent workmen, &c., for at least double the Estimate made by the designer; indeed I will go farther and express my belief that an iron bridge on the most economical construction, including abutments and approaches could not be erected under an outlay of £3000. Thus the designer of any iron bridge would be under the conditions of the Prospectus really devoting his time and talents without the least hope of obtaining a reward for the same by the adjudication of a premium. Feeling this had the design last under consideration been one that I could have recommended for adoption, and had the Estimate accompanying it been fairly made shewing approximately the probable cost, I should have urged that the condition I have referred to should have been waived and one of the premiums been awarded, even though the Provincial Government could not have devoted the funds necessary for its erection.

I now come to No. 12 to which I cannot hesitate to assign the first place. It displays evident careful consideration of the subject in the general design and its details, both in the drawing and in the description and specification; no essential point has been neglected. Not that it is an original design, for the designer in his general preliminary description modestly and candidly states the fact and quotes an instance of its application; his merit therefore consists not in the conception but in the adaptation of the principle and the proportioning of the several parts to the locality and span. I may here remark that most of the other designs are also imitations of bridges actually executed or of the principles embodied in them, but unfortunately the designers have failed in aptly carrying out those principles, or in proportioning their works to what they would have to bear. Reverting to No. 12 I desire to point out that the bow girders substantially connected with the tie beams are amply sufficient to support the roadway, so also are the suspension bars, and the construction is stiffened and undulatory motion guarded against by the introduction of proper strutting; lateral pressure has also been met by horizontal strutting under the road way; farther, the strutted beam across the small span is fully equal to its duty. It is only to be regretted that the designer did not boldly span the whole stream at once instead of proposing the erection of a pier which *pro tanto* would diminish the water way even at the ordinary level of the river, and might in floods form a serious check to the free passage of large trees; he has not however departed in this respect from the conditions of the Prospectus. Two, not precisely defects or affecting the principle or strength of the bridge, but still matters which I deem it necessary to notice, I must draw attention to. One is that

the naked flooring of the roadway is in my opinion unnecessarily loaded with timber; it is composed of transverse girders, longitudinal binders and transverse joists; now I think that the binders may be dispensed with, the girders being placed somewhat closer together to diminish the bearing of the joists, and diminished from the centre towards each end, similarly to the transverse joists (which would become longitudinal) to give a "hogging" to the roadway. The other point is that to make security doubly sure and to compensate any defects in the timber, I should be inclined to give the strutting towards the centre of the bridge, where they are of considerable length, a trifling increase in scantling, say to 7 inches square, instead of 7"x5". The duty of this strutting is lighter than that in a truss, the object being merely to stiffen and to restrict the undulatory motion of a suspension bridge for which they are sufficient, but if only for proportion sake, for the longer the strut the more with the same weight is it inclined to buckle, the increase should be given to the longer struts. I am not quite satisfied that there would not be an excess upon the designer's estimate which is not in sufficient detail to enable me to go critically into it, as neither quantities nor rates are given. I observe however that in the preliminary description and remarks he states in a note the rates respectively for puriri and rimu; these rates, as far as I can judge, not being aware of the ruling prices of the locality, are fair, and if the timber is carried out at those rates with a competent addition for labor, that item will probably be sufficient. Of the item for masonry I am doubtful, especially considering that it is for a great part an hydraulic work, in executing which unforeseen difficulties may occur involving considerable outlay; and the items for wrought and cast iron appear small. Further I do not observe any sum voted for scaffolding, for this, however, an allowance may have been made under the several items. These doubts, I think, should not affect the award of a premium, especially as the designer has fairly and candidly given a second estimate exceeding the amount proposed for a timber bridge, providing for timber material of a superior and more durable nature than that which he could afford to use if the amount to be expended was limited to the sum of £1500 or thereabouts. Finally, in respect to this design, I would wish to recommend that if its principle should be carried into execution, its designer should be asked to consider whether he would not so far modify it as to make but one span of the bridge, which might I think without injudiciously encroaching on the water way of the river be limited to say 135 feet, 15 feet only more than his large span at present, the encroachment being made on the East bank where the depth and consequently the rapidity of the stream at the part where the encroachment would be made would be very small and that only at the highest freshets.

Nos. 13 and 14 by the same hand, which only differ in the abutments, I shall consider as one design. The trussed bridge itself is unobjectionable, nay good, perfectly practicable, simple and inexpensive in construction, and easily susceptible of repair in its component parts; yet I am bound to take the design as a whole into consideration, and doing so I must strougly object to the project of making the proposed embankments. They would narrow the waterway, in one of the designs, No. 13, V Z, according to the designer himself to the extent of one-sixth, and I have little doubt they would be washed away, especially that on the East bank, and thus the ground plates of the abutments would be laid bare and the whole abutments be exposed to the violent concussions of floating trees, jeopardising the whole structure. Further there is an absence of horizontal strutting to stiffen the roadway, and the floor which is of 3 in. plank on girders taking the place of joists has a bearing of upwards of 5 feet, which is too great. It is to be regretted that the designer, who has evidently taken pains with his subject and considered almost every necessary point, including the facilities (scaffolding) for raising his structure, should have fallen into the error above adverted to which renders his design ineligible; had it not existed, and secure abutments had been proposed, I should have recommended the design (the two considered as one) from the very suitable construction of the main trusses as deserving the second premium. I will also remark that the Estimate is the most fairly drawn of the whole.

No. 15 is an imitation of the American lattice bridges which possess advantages in point of simplicity and facility of construction and repair, and the principle might be advantageously adopted for a bridge in the locality. The designer, however, in his desire doubtless to diminish his Estimate has cut his trusses too fine both in scantling and depth. In practice the scantling of these lattice bridges is, according to the span, from 10" by 3" to 12" by $3\frac{1}{2}$", with double trusses on each side of the bridge substantially connected together through the string pieces, and the depth of the trusses as a rule is from one-twelfth to one-tenth of the span. Now the lattice bars of this design are 6"x 4" the latter dimension

diminished somewhat by notching and the effective depth of the trusses is about 10' 6", being somewhat less than one thirteenth of the span. The greater the span the greater the depth required for the truss; the span in this case being considerable, equal to the greatest of which I have seen an example, the depth of the truss should have been about the maximum that is to say, about one-tenth of the span, whereas it is less than the minimum of one twelfth. Add to this defect in the depth of the trusses the insufficiency in depth or width of scantling, very partially compensated for by the superior description of wood the designer proposes to use, and it will be evident that the bridge would not bear even a comparatively moderate weight. The designer has paid considerable attention to the abutments and the approaches of the bridge, to the details of construction, and to the specification; it is a pity, therefore, that he had not given a little more consideration to the effective strength of the main part of his design, which obliges me to place it amongst those not eligible or sufficient. I cannot give him credit for his Estimate, which though in tolerable detail, is quite insufficient: taking one item of material alone, viz., Totara timber; the price, exclusive of labour, is carried out at £6 per thousand feet, 12s. per 100; now considering that the price of pine is from 20s. to 22s. per 100 feet at New Plymouth, as appears by several of the Estimates, and that Totara is a superior hardwood, more costly in preparation, it is not too much to assume that its cost would be at least fifty per cent above that of Pine. In point of fact in one Estimate the rate of 35s. per 100 feet has been taken for Totara, which I believe is not above the mark, if sufficient to pay for its delivery on the spot; thus the item for timber would be about three times that taken in the Estimate for the design under consideration. As the item for the abutments is not in detail I cannot analyze it, but it appears to me small considering there is a certain amount of cut stone in it.

Having now considered each design, I will remark that to endeavour to satisfy the competing designers I have not confined myself to giving a simple arbitrary decision, but have endeavoured to explain in as popular terms as possible, and by reference to examples and actual experiments which are more valuable than simple theory unconnected with practice and experiment, the reasons for my judgment. Doubtless many parties will be disatisfied, looking on their designs with a partial eye, especially as the only premium that I think ought to be awarded will fall, if I mistake not, on a Civil Officer under my orders, whose hand writing in the specification I could hardly avoid recognising. This recognition caused me some momentary embarrassment, but it made me feel the necessity of most cautiously and impartially considering my judgment, and having arrived at an opinion it would have been a weakness and an injustice to have hesitated in recording that opinion because it was in favor of a design by a person I believed attached to my Department. It may be also considered that I have been over strict in not recommending the award of a second premium, but when in my firm belief there was not a second design that was by any means eligible or that ought to have been carried into execution, either from defects of strength in the bridge itself, insufficiency of abutments or other causes, the recommendation of an award would have been tantamount to a deception on the Provincial Government who might have carried the second design into execution if apparently at first sight more economical than the best design, (for instance Design No. 15, is very creditable in many respects, and the Estimate low) to their eventual grievous disappointment and loss and my own discredit.

There is one more point to which I would wish to direct attention, it is not adverted to in the Prospectus but it is one upon which the security of the bridge may most material depend. It is understood that trees are brought down the river by freshets and so large as to require one span of upwards of 100 feet to admit of their passing through if coming down with their length across the stream; it is possible that these trees may not be so denuded of branches but that large limbs may be projecting above the water sufficiently to catch the roadway of the bridge, and corresponding limbs be dragging on the ground at the bottom of the river; thus checked in their progress and to a certain degree acting as a dam to the water running down with almost irresistible force, either the branches of the tree or the bridge must yield. None of the designs shew a greater height than 8 feet above the level of the water in the highest freshets, and the best designer, No. 12, gives that clear height; whether this is likely to be sufficient or not I cannot from want of local knowledge decidedly state; the question, therefore, should be maturely considered on the spot, and, if requisite, such increased height be given to the abutments as will place the bridge clear of every obstruction and danger. The cost of the abutments and approaches, and of the appliances for raising the bridge would necessarily be somewhat increased, but this should not be a consideration if the exist-

ence of the bridge would otherwise be at stake.

Should you desire any farther opinion on this subject I shall be happy to afford it to the best of my ability, but future communications in reference to Public Works, Provincial or otherwise, should be sent through the General Government, for whom I am acting as Inspector.

I have, &c.,
THOS. R. MOULD,
Col. Commanding Royal Engineers.

His Honor the Superintendent,
New Plymouth.

LIST of DESIGNS received for a BRIDGE over the Waiwakaiho River at New Plymouth.

No.	Motto or Device.	Nature of Construction.
1	Star with six points.	Wood, arched girders, trussed with tie rods
2	Circle in a diamond.	Iron, arched latticed girders
3	Triangle.	Wood, arched trussed girders
4	"Publico."	Wood, lattice trusses
5	"Haud ignotus."	Wood, bow girders with suspension rods untrussed
6	Two triangles crossed	Wood, arched girders, depending on abutments.
7	J C with a cross	Wood, cambered girders, under trussed, with tie rods
8	S C with 8 dots	Wood trussed, iron king and queen bolts
9	"Tarry a little in the beginning that we may make an end the sooner."	Iron, hollow girders
10	"Except the Lord build the house they labour in vain that build."	Wood trussed
11	"Qui laborat orat."	Iron, lattice girders
12	"Egmont."	Wood, bow girders trussed and suspension rods
13	V Z	Wood, trussed
14	X X	Wood, trussed
15	Concentric circles	Wood, lattice trusses

THOS. R. MOULD,
Col. Commanding Royal Engineers.

12 March 1858.

RETURN of the names of all persons to whom Scrip has been issued as Military Settlers under the 39th clause of the Land Regulations of the Province of New Plymouth from the 1st to the 31st of March, 1858, inclusive.

To whom issued.	Rank and Regiment.	Date of issue.	Amount.
		1858.	£ s. d.
John Kennist	Private 65th Regt.	19th March	40 0 0
John Watson	,, ,,	,, ,,	40 0 0
John Crozier	,, ,,	22nd ,,	40 0 0
John O'Neill	,, ,,	24th ,,	40 0 0
			£160 0 0

I. N. WATT,
Provincial Secretary.

Provincial Secretary's Office,
New Plymouth, 31st March, 1858.

PROVINCE OF NEW PLYMOUTH.

A RETURN of the SALE of CROWN LANDS and of RECEIPTS from the 1st to the 31st of March 1858 inclusive.

No. of Allotment.	Contents.	Bidding per acre.	Price.	Purchaser.	Cash.	N. Z. Government Scrip.	Provincial Scrip.	N. Z. Co.'s Land Orders.	Military Remission.
	A. r. p.	£ s. d.	£ s. d.		£ s. d.		£ s. d.		
10	100	10	50 0 0	Alfred Marsh	30 0 0		40 0 0		
11	100	10	50 0 0	William Allan	30 0 0		40 0 0		
12	100	10	50 0 0	William Paynter	30 0 0		40 0 0		
	300	£	150 0 0	£	90 0 0	£	120 0 0		

I certify that the above is a true Return of the sale of Crown Lands and of Receipts from the 1st to the 31st March 1858 inclusive

W. HALSE,
Receiver of Land Fund.