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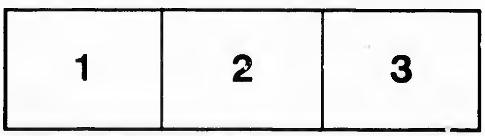

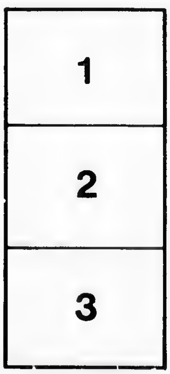

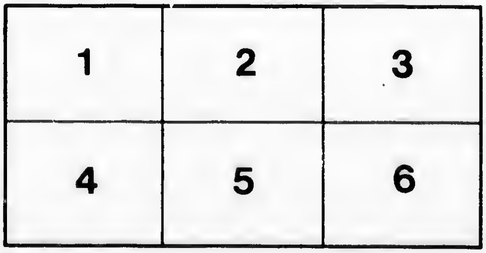

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INTERCOLONIAL RAILWAY.

General Instructions (No. 4.)

Setting out Culverts and Bridges, Foundations &c.

1. A Bench Mark should be established within a convenient distance of the intended structure for easy reference.

2. The character and clear water-way of a Culvert having been determined on information previously obtained, the next thing necessary is to stake out its exact site on the ground; in doing this care must be taken to secure a free and uninterrupted passage for the water at all times.

3. In the majority of cases there will be no difficulty in placing the Culverts at right angles to the line of Railway, and this position for several reasons is preferred when it can be easily obtained; occasionally a slight diversion or rounding of the channel of the stream at one or both ends may become necessary. Position of Culvert.

4. If, however, there should be any obstacle in the way, the Culvert must be placed at such angle to the Railway as will best answer the purpose, and leave the channel of the stream with a natural and easy flow for the water.

5. In all cases where the position of the Culvert does not correspond with the direction of the stream, either in line or level, the latter must be altered so that the water may be conducted to or from the Culvert without abrupt bends, and in the manner best fitted not only to facilitate easy drainage, but to prevent undermining and the possibility of destruction of the works by the mechanical action of the water. Alteration of Stream.

6. Having established the horizontal direction of the Culvert, it next becomes necessary to determine its vertical position — that is to say — its relative elevation with respect to the formation level and the general datum.

Section of Stream.

7. The centre line of the Culvert should be staked out, and a section thereon made to the distance of 50 or 100 feet, as circumstances may require, above and below the slope lines of embankment. On this section the fall of the stream should be shown by a line representing the lowest points in its bed; these points having been found by levels and offsets in the usual way.

Line of Paving.

8. A straight line drawn on the section a few inches under the lowest points in the bed of the stream will represent the intended surface of Paving, or artificial bed. In ordinary cases the surface of Paving, or invert of the Culvert, should be, say 6 inches under the lowest points in the natural bed, and with an inclination not exceeding 1 in 20, or 5 per 100. All Culverts with these moderate inclinations will for convenience be designated ordinary culverts, and will be constructed in accordance with the Lithographed General Plans of Level Culverts.

Ordinary Culverts.

Inclined Culverts.

9. Some sections of the Railway extend along side hill ground where the streams flow with a rapid fall. In such places it would add very largely to the cost of the work were ordinary Culverts insisted upon. For side hill ground a modified plan will therefore be adopted, having such an inclination as the circumstances of each case will justify.

10. The surface of Paving having been established in the manner above described, the length of the Culvert may now be ascertained, and the walls set out.

Length of level Culverts.

11. *Table A* is prepared for the purpose of finding readily the exact lengths of all ordinary kinds of Culverts; the vertical distance between formation level and paving being known, *Table A* will give the half lengths of the box or arch, for all heights of embankment up to 80 feet, assuming the Culvert to be level, and at right angles to the centre line of Railway.

Length of inclined Culverts.

12. *Table B* is calculated for inclined Culverts, and it will give the upper and lower half lengths for all inclinations up to 1 in 5, and for all embankments ranging up to over 70 feet on the centre line.

Skew Culverts.

13. *Table C* is the result of calculations made for the purpose of enabling the Engineer to ascertain very readily in the field the proper length of Culverts of every description *on the skew.*

14. All these Tables are now furnished for the purpose of facilitating the work of setting out, and in order also to secure *uniformity* and *accuracy* on the various Districts, Divisions, and Sub-divisions.

15. The following examples will shew the intended use and application of these tables.

Use of Table A.

16. Suppose the vertical distance between the surface of Paving and formation level to be 50 feet, then by *Table A* we find the half lengths of the box or arch in each respective case to be as follows. Wings of Culverts, at least so much of them as extend beyond the barrel of arch, are not included in the following dimensions:—

Box Cu vert,	2 ft. 6×2 ft. 6	83 feet.
Do.	2 ft. 6×4 ft.	81 feet.
Arch Culvert,	4 feet span	77 feet.
Do.	5 feet span	75 feet.
Do.	6 feet span	73 feet.
Do.	8 feet span	69 feet.
Do.	10 feet span	66 feet.
Do	12 feet span	64 feet.

These are the half lengths or distances to the right and left of the centre line of the Railway for the various kinds of Culverts, formation level being 50 feet above Paving; the Culvert being horizontal, and at right angles to the Railway.

Use of Table B.

17. If the Culvert be inclined to the horizon, then the upper half length will be shortened, while the lower half length will be extended; but the increase and diminution will not be in the same proportion. If we assume the inclination of the Culvert to be at the rate of 18 per 100, we shall find on reference to *Table*

B that the following are the upper and lower half lengths for the same height of embankment at centre line, viz.—50 feet:

	Level half lengths per Table A.	Half lengths per Table B. Inclination, 18 per 100. Upper.	Lower.
Box Culvert, 2 ft. 6×2 ft. 6	83 ft.	65.3	113.6
Do. 2 ft. 6×4 ft.	81 ft.	63.7	110.9
Arch Culvert, 4 feet	77 ft.	60.6	105.4
Do. 5 feet	75 ft.	59.0	102.7
Do. 6 feet	73 ft.	57.4	100.0
Do. 8 feet	69 ft.	54.3	94.5
Do. 10 feet	66 ft.	52.0	90.4
Do. 12 feet	64 ft.	50.4	87.6

Skew Culverts.

18. In the case of a Culvert on the skew, its length can be ascertained, if it is an ordinary level Culvert, by multiplying the length given in *Table A*, by the natural cosecant of the angle which the Culvert makes, with the centre line of Railway; but if the Culvert, in addition to being *skew*, is inclined to the horizon, its upper and lower half lengths become more difficult to calculate. To find the lengths required under all conditions of skew is the design of

Use of Table C.

Table C; whether the Culvert be level, or inclined, it will only be necessary to multiply the half lengths found in *Table A* and *B*, as the case may be, by the quantities found in the proper column in *Table C*, and opposite the angle of skew — that is to say — the angle which the Culvert makes with the Railway.

Skew Level Culverts.

19. If we take the case of a *level*, 2 ft. 6 by 4 ft., Box Culvert, with formation level 60 feet above Paving, and having its centre line at an angle of 55° to the line of Railway. By *Table A*, opposite 60 feet in the first column, will be found the half length 97. In *Table C*, opposite 55°, we find in the column for level Culverts 1.221 — this multiplied by 97, gives 118.4 feet, the half length of the Culvert. I need scarcely say that both halves of Culverts on the level are the same length.

Skew sloping Culverts

20. If we suppose the same Culvert to have an inclination of 20 per 100, then in *Table B*, opposite 97, and in the inclination column of 20 per 100, we

find, for the upper half length, 74.8 feet, and for the lower half length, 138.6 feet; but these are the half lengths for a Culvert placed at right angles to the centre line of the Railway. We must turn to *Table C*, where opposite 55° in the 20 per 100 inclination column, we find for upper half lengths 1.162, and for lower half lengths 1.348; these quantities multiplied into the former will give the true half lengths of a Box Culvert 2 ft. 6 × 4 ft., on a skew of 55°, and on an inclination to the horizon of 20 per 100.

Use of Table C.

$$74.8 \times 1.162 = \ \ 86.9 \text{ feet—the upper half length.}$$
$$138.6 \times 1.348 = 186.8 \text{ feet—the lower half length.}$$

All measurements in horizontal and vertical lines.

21. It should be clearly and distinctly understood that with the exception of vertical distances, all distances are calculated, and must invariably be set out on the ground on lines parallel to the horizon. The Engineer should invariably run out the slope lines of embankment at each end of Culvert, after the operation of setting out has been completed, as a rough check, in order to make certain that no mistake has been committed.

Plan of construction.

22. In constructing Culverts on an inclination, the foundation and the work generally must receive the closest attention. The drawings which accompany this shew the general plan intended when the inclination is considerable. The following points must especially be kept in view:

Precautions

(1.) The walls must be regularly stepped to insure stability.

(2.) Every precaution must be taken to prevent any portion of the water of the stream from getting underneath the paving, or the walls, or behind the latter.

(3.) The line of paving must be considerably lower than the original natural bed of stream; the exact depth will depend on the inclination and other circumstances.

(4.) The walls at the upper end should be entirely built in cement, and their connection with the ground made impervious to water by a liberal use of concrete deposited in a trench made for that purpose.

Concrete wall.

(5.) A concrete wall must be formed underneath and around the body of the Culvert about one-fourth or one-third of its length from the upper end, this wall must be made a perfectly water-tight partition across the ravine, at least as high as the crown of the arch at the upper end.

(6.) The footings of walls must be full bedded in cement mortar, and as a rule, all the masonry must be built in the same material.

Concrete filling in.

(7.) The spaces underneath the paving, between and behind the walls, must be filled in solid with concrete. The Paving must be laid before the concrete sets, and grouted in solid with cement.

Drawings Nos. 1, 2, and 3.

23. Drawings of Arch and Box Culverts have been prepared for the purpose of shewing the plan of construction rendered necessary where the inclination is considerable. Drawing No. 1, which accompanies this, is the plan intended for Culverts having inclination ranging from 6 per 100 to 12 per 100, inclusive. Drawings No. 2 and 3 are for Culverts having inclination ranging from 14 per 100 to 20 per 100: these drawings will explain themselves. If it should prove necessary, in any case, to construct Culverts with a greater inclination than 20 per 100, special designs must be prepared and approved. All ordinary Culverts — that is to say — those that have a less inclination than 6 per 100, will be built in accordance with the General Plan of Level Culverts.

Depth of masonry.

24. In all cases the masonry must be carried down to a firm and solid stratum, sufficiently firm to resist the superincumbent load, and it must be at such a depth as to be entirely out of the way of frost, and such that it never can, under any circumstances, be exposed to the undermining action of running water. When the foundation pits have been excavated to a sufficient depth beyond the frost limit, and the stratum reached, appears at all insecure, the soft material must either be removed to a greater depth, or proper means taken to form a firm and durable artificial support for the masonry.

The sub-stratum.

25. The masonry must not be commenced at any place, however solid the stratum may appear (unless

it unquestionably be solid rock) until the nature of the substratum be ascertained. This may be done by driving iron rods, or in special cases, by means of borings sunk at various points over the base of the intended structure. There must be no doubt left in the mind of the Engineer in charge as to the perfectly firm nature of the foundation, and he must leave nothing undone to satisfy himself on this point before any portion of the masonry is proceeded with.

Artificial foundations

26. When any doubt is felt as to the sufficiency of the foundation stratum, the unfirm soil must either be removed to a greater depth, or the District Engineer immediately consulted as to the means to be employed in preparing a solid foundation by artificial means. In some cases a platform of timbers laid with concrete will suffice, or it may be necessary to enclose the whole in a substantially constructed cofferdam of sheet piling. If the structure be large, and the superincumbent load very heavy, it may be necessary to drive piles over the entire base of the intended structure, to assist in bearing the load.

27. In all cases every means deemed necessary to secure perfect stability must be adopted. In foundation works, more especially, it will not do to run any risk whatever.

Rock foundations.

28. Where the stratum on the site of the intended structure is rock, it will not be necessary to excavate to the same depth as in ordinary cases.

29. It will be sufficient to remove all rotten, loose, or decayed parts of the rock, and to cut and dress it to horizontal plain surfaces at such depth under the bed of the stream as will leave the surface of the Paving on the proper line.

30. It will be necessary, however, to exclude all water from between the rock and the masonry, to prevent any injurious results from frost. All cracks and hollows in the rock must therefore be filled in with hydraulic cement and concrete, and the first courses of masonry must invariably be laid in a full bed of cement mortar.

Before masonry is commenced

31. Before the masonry of a Culvert is commenced, it will be necessary to see that the stone and cement

delivered on the ground is of good quality, and in sufficient quantity to enable the contractor to carry on the work regularly and systematically. The Engineer in charge must be perfectly satisfied that the foundation pits have been excavated to the proper depth, and in accordance with instructions.

Structure Book.

32. A Structure Book must be kept, shewing the details of all masonry work executed on each contract; it will exhibit each structure in consecutive order; and in the case of Bridges, each abutment and pier will be shewn separately.

Levels and measurements to be kept.

33. Whilst the masonry of any Bridge or Culvert is being commenced, the Engineer in charge will ascertain by levelling from the Bench Mark and by other measurements, the exact level of the foundation pits, and the exact position of every point where there is a change of level or of line in the walls, he will enter these in his Note Book, and he will, as soon as convenient, make a plan of the masonry exactly as built.

Plans of masonry as executed.

34. The levels and measurements of the foundations must on no account be overlooked, as plans of each structure, precisely as executed, will be required, properly attested by the Engineers in charge. These plans must shew the exact height of the foundations at the centre and ends of the Paving, and of other prominent points in the structure, above datum. The levels, &c., should invariably be made as the work is executed, and before any portion is covered up. Plans of all masonry executed, with full dimensions written thereon must, without delay, be forwarded to the District Office.

Standard drawings.

35. The General Drawings, including those which accompany this, are to be adhered to as *the standards* for works to be constructed. It will frequently be necessary to make minor alterations to meet local peculiarities, but the District and Division Engineers will see that the general designs, the specifications, and these instructions are substantially carried out. Special plans of structures must be approved by the undersigned.

Change of structure in certain cases.

36. Without reducing the standard or efficiency of the works, a change in the form or character of

the structure may in certain cases very greatly accommodate the Contractors, for example — the only quarries available in the locality may yield stones better suited for building $2\frac{1}{2}\times4$ Culverts than 3×3 Culverts; or it may prove altogether impracticable for the Contractor to procure within a reasonable cost the covers required for large Box Culverts, while suitable materials for small Arch Culverts may easily be obtained. In all such cases the District Engineer may sanction a change, maintaining, of course, the original water-way; he will also communicate the circumstances to the undersigned.

37. The scheme alluded to in General Instructions No. 3, and requested to be carried out, will afford the resident officers on contracts daily opportunities of drawing attention to any question that may come up; to any difficulty met with; to any neglect of orders; to any bad workmanship, or defective materials; to any dispute, or to any other matter or thing which should be made known to those over them; and they should not fail to take full advantage of the opportunity so provided. In the event of bad material being delivered on the ground, or bad workmanship executed, a single reference to it will not be held sufficient; the matter, whatever it may be, should be alluded to frequently until rectified. Daily records and reports.

38. Masonry must be set out with the greatest precision. All instruments used in setting out or measureing up must be kept in perfect adjustment. Standard measures must be maintained in efficient condition at all the District Offices, and at one office at least on each contract: it will be the duty of District and Division Engineers to see that this is not neglected. All measures in daily use must be frequently tested with the standards, and kept in true adjustment. Standard measures.

SANDFORD FLEMING,
Chief Engineer.

HALIFAX, June 1st, 1869.

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Table A.

Shewing the half lengths of Culverts (from Centre Line to the end of arch) for every height of Embankment (above paving) up to 80 feet, assuming the Culverts to be on a level— that is to say—without any inclination between the Upper and Lower ends, and also at right angles to the Centre Line of Railway.

Height of formation level above paving in centre of Culverts.	Box Culverts.		Arch Culverts.					
	2.6 X 2.6	2.6 X 4 ft.	4 feet.	5 feet.	6 feet.	8 feet.	10 feet.	12 feet.
5 *feet.*	11.0							
6	12.5	10.5						
7	14.0	12.0						
8	15.5	13.5						
9	17.0	15.0						
10	19.0	17.0	13.0					
11	20.5	18.5	14.5					
12	22.0	20.0	16.0					
13	23.5	21.5	17.5	16.5				
14	25.0	23.0	19.0	18.0				
15	27.0	25.0	21.0	19.5	17.5			
16	28.5	26.5	22.5	21.0	19.0			
17	30.0	28.0	24.0	22.5	20.5	16.0		
18	31.5	29.5	25.5	24.0	22.0	17.5		
19	33.0	31 0	27.0	25.5	23.5	19.0	16.5	
20	35.0	33.0	29.0	27.0	25.0	21.0	18.0	16.0
21	36.5	34.5	30.5	28.5	26.5	22.5	19.5	17.5
22	38.0	36.0	32.0	30.0	28.0	24.0	21.0	19.0
23	39.5	37.5	33.5	31.5	29.5	25.5	22.5	20.5
24	41.0	39.0	35.0	33.0	31.0	27.0	24.0	22.0
25	43.0	41.0	37.0	35.0	33.0	29.0	26.0	24.0
26	44.5	42.5	38.5	36.5	34.5	30.5	27.5	25.5
27	46.0	44.0	40.0	38.0	36.0	32.0	29.0	27.0
28	47.5	45.5	41.5	39.5	37.5	33.5	30.5	28.5
29	49.0	47.0	43.0	41.0	39.0	35.0	32.0	30.0
30	51.0	49.0	45.0	43.0	41.0	37.0	34.0	32.0
31	52.5	50.5	46.5	44.5	42.5	38.5	35.5	33.5

Table A—*Continued.*

Shewing the half lengths of Culverts (from Centre Line to the end of arch) for every height of Embankment (above paving) up to 80 feet, assuming the Culverts to be on a level—that is to say—without any inclination between the Upper and Lower ends, and also at right angles to the Centre Line.

Height of Formation Level above paving.	Box Culverts.		Arch Culverts.					
	2.6 X 2.6	2.6 X 4 ft.	4 feet.	5 feet.	6 feet.	8 feet.	10 feet.	12 feet.
32 *feet.*	54.0	52.0	48.0	46.0	44.0	40.0	37.0	35.0
33	55.5	53.5	49.5	47.5	45.5	41.5	38.5	36.5
34	57.0	55.0	51.0	49.0	47.0	43.0	40.0	38.0
35	59.0	57.0	53.0	51.0	49.0	45.0	42.0	40.0
36	60.5	58.5	54.5	52.5	50.5	46.5	43.5	41.5
37	62.0	60.0	56.0	54.0	52.0	48.0	45.0	43.0
38	63.5	61.5	57.5	55.5	53.5	49.5	46.5	44.5
39	65.0	63.0	59.0	57.0	55.0	51.0	48.0	46.0
40	67.0	65.0	61.0	59.0	57.0	53.0	50.0	48.0
41	68.5	66.5	62.5	60.5	58.5	54.5	51.5	49.5
42	70.0	68.0	64.0	62.0	60.0	56 0	53.0	51.0
43	71.5	69.5	65.5	63.5	61.5	57.5	54.5	52.5
44	73.0	71.0	67.0	65.0	63.0	59.0	56.0	54.0
45	75.0	73.0	69.0	67.0	65.0	61.0	58.0	56.0
46	76.5	74.5	70.5	68.5	66.5	62.5	59.5	57.5
47	78.0	76.0	72.0	70.0	68.0	64.0	61.0	59.0
48	79.5	77.5	73.5	71.5	69.5	65.5	62.5	60.5
49	81 0	79.0	75.0	73.0	71.0	67 0	64.0	62.0
50	83.0	81.0	77.0	75.0	73.0	69.0	66.0	64.0
51	84.5	82.5	78.5	76.5	74.5	70.5	67.5	65.5
52	86.0	84.0	80.0	78.0	76.0	72.0	69.0	67.0
53	87.5	85.5	81.5	79.5	77.5	73.5	70.5	68.5
54	89.0	87.0	83.0	81.0	79.0	75.0	72.0	70.0
55	91.0	89.0	85.0	83.0	81.0	77.0	74 0	72.0
56	92.5	90.5	86.5	84·5	82.5	78.5	75.5	73.5
57	94.0	92.0	88.0	86.0	84.0	80.0	77.0	75.0
58	95.5	93.5	89.5	87.5	85.5	81.5	78.5	76.5

Table A—*Continued.*

Shewing the half lengths of Culverts (from Centre Line to the end of arch) for every height of Embankment (above paving) up to 80 feet, assuming the Culverts to be on a level—that is to say—without any inclination between the Upper and Lower ends, and also at right angles to the Centre Line.

Height of Formation Level above paving.	Box Culverts.		Arch Culverts.					
	2.6 X 2.6	2.6 X 4 ft.	4 feet.	5 feet.	6 feet.	8 feet.	10 feet.	12 feet.
59 *feet.*	97.0	95.0	91.0	89.0	87.0	83.0	80.0	78.0
60	99.0	97.0	93.0	91.0	89.0	85.0	82.0	80.0
61	100.5	98.5	94.5	92.5	90.5	86.5	83.5	81.5
62	102.0	100.0	96.0	94.0	92.0	88.0	85.0	83.0
63	103.5	101.5	97.5	95.5	93.5	89.5	86.5	84.5
64	105.0	103.0	99.0	97.0	95.0	91.0	88.0	86.0
65	107.0	105.0	101.0	99.0	97.0	93.0	90.0	88.0
66	108.5	106.5	102.5	100.5	98.5	84.5	91.5	89.5
67	110.0	108.0	104.0	102.0	100.0	96.0	93.0	91.0
68	111.5	109.5	105.5	103.5	101.5	97.5	94.5	92.5
69	113.0	111.0	107.0	105.0	103.0	99.0	96.0	94.0
70	115.0	113.0	109.0	107.0	105.0	101.0	98.0	96.0
71	116.5	114.5	110.5	108.5	106.5	102.5	99.5	97.5
72	118.0	116.0	112.0	110.0	108.0	104.0	101.0	99.0
73	119.5	117.5	113.5	111.5	109.5	105.5	102.5	100.5
74	121.0	119.0	115.0	113.0	111.0	107.0	104.0	102.0
75	123.0	121.0	117.0	115.0	113.0	109.0	106.0	104.0
76	124.5	122.5	118.5	116.5	114.5	110.5	107.5	105.5
77	126.0	124.0	120.0	118.0	116.0	112.0	109.0	107.0
78	127.5	125.5	121.5	119.5	117.5	113.5	110.5	108.5
79	129.0	127.0	123.0	121.0	119.0	115.0	112.0	110.0
80	131.0	129.0	125.0	123.0	121.0	117.0	114.0	112.0

Note.—The line of paving must always be a few inches at least under the lowest points in the natural bed of streams. See General Instructions (No. 3) in reference to this. The height of formation level above line of paving at the intersection of centre line being found in the first column, the half lengths of Arches or Box Culverts of each kind will be seen in the respective columns opposite. The wings of Arch Culverts, at least so much as extend beyond the ends of arch, are not included in the above half lengths.

Table B—FOR SETTING OUT

This Table gives the half lengths of Culverts for various inclinations, ranging from A, being given in the first column; the upper and lower half lengths will be tances given in this Table are to be set out on the ground horizontally (not

LEVEL. Half Lengths per Table A.	1 per 100.		2 per 100.		3 per 100.		4 per 100.		5 per 100.	
	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
10	9.9	10.1	9.7	10.3	9.6	10.5	9.4	10.6	9.3	10.8
11	10.9	11.1	10.7	11.3	10.5	11.5	10.3	11.7	10.2	11.9
12	11.9	12.1	11.6	12.4	11.5	12.6	11.3	12.7	11.2	13.0
13	12.8	13.2	12.6	13.4	12.4	13.6	12.3	13.8	12.1	14.0
14	13.8	14.2	13.6	14.4	13.4	14.7	13.2	14.9	13.1	15.1
15	14.8	15.2	14.6	15.5	14.3	15.7	14.1	15.9	14.0	16.2
16	15.8	16.2	15.5	16.5	15.2	16.7	15.6	17.0	14.9	17.3
17	16.7	17.2	16.5	17.5	16.2	17.8	16.0	18.0	15.9	18.4
18	17.7	18.2	17.5	18.6	17.2	18.8	17.0	19.1	16.8	19.4
19	18.7	19.3	18.5	19.6	18.1	19.9	17.9	20.2	17.7	20.5
20	19.7	20.3	19.4	20.6	19.1	20.9	18.9	21.3	18.7	21.6
21	20.6	21.3	20.4	21.7	20.0	22.9	19.8	22.3	19.6	22.7
22	21.6	22.3	21.4	22.7	21.0	23.1	20.8	23.4	20.5	23.8
23	22.6	23.4	22.4	23.7	22.0	24.1	21.7	24.5	21.4	24.8
24	23.6	24.4	23.3	24.7	22.9	25.2	22.7	25.5	22.4	25.9
25	24.6	25.4	24.3	25.8	23.9	26.2	23.6	26.6	23.3	27.0
26	25.6	26.4	25.3	26.8	24.8	27.2	24.6	27.6	24.2	28.1
27	26.6	27 4	26.2	27.8	25.8	28.2	25.5	28.7	25.1	29.2
28	27.6	28.4	27.2	28.9	26.8	29.3	26.4	29.8	26.1	30.2
29	28.6	29.4	28.2	29.9	27.7	30.3	27.4	30.8	27.0	31.4
30	29.5	30.5	29.1	31.0	28.7	31.4	28.3	31.9	27.9	32.4
31	30.5	31.5	30.1	32.0	29.6	32.4	29.2	33.0	28.9	33.5
32	31.5	32.5	31.1	33.0	30.6	33.5	30.2	34.0	29.8	34.5
33	32.5	33.5	32.0	34.0	31.6	34.5	31.1	35.1	30.7	35.6
34	33.5	34.5	33.0	35.0	32.5	35.6	32.0	36.1	31.7	36.7
35	34.5	35.5	34.0	36.1	33.5	36.6	33.0	37.2	32.6	37.8
[illegible]	35.5	36.5	34.9	37.1	34.4	37.7	33.9	38.3	33.5	38.8
[illegible]	36.5	37.5	36.0	38.1	35.4	38.7	34.9	39.4	34.5	40.0
38	37.4	38.6	36.9	39.2	36.4	39.8	35.8	40.4	35.4	41.1
39	38.4	39.6	37.9	40.2	37.3	40.8	36.8	41.5	36.3	42.2

CULVERTS ON SLOPING GROUND.

1 *per* 100 *to* 20 *per* 100. *The half lengths of Level Culverts, as found by Table found for each respective inclination on the line opposite. Observe that all dis- on the inclination.)*

6 per 100.		7 per 100.		8 per 100.		9 per 100.		10 per 100.	
Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
9.2	11.0	9.1	11.2	8.9	11.4	8.8	11.6	8.7	11.8
10.1	12.1	10.0	12.3	9.8	12.5	9.7	12.8	9.6	13.0
11.0	13.2	10.9	13.4	10.7	13.7	10.6	13.9	10.4	14.1
12.0	14.3	11.8	14.5	11.6	14.8	11.4	15.0	11.3	15.3
12.9	15.4	12.7	15.6	12.5	15.9	12.3	16.2	12.1	16.5
13.8	16.5	13.6	16.8	13.4	17.0	13.2	17.3	13.0	17.6
14.7	17.6	14.5	17.9	14.3	18.1	14.1	18.5	13.8	18.8
15.6	18.7	15.4	19.0	15.2	19.3	15.0	19.6	14.7	20.0
16.5	19.8	16.3	20.1	16.1	20.4	15.8	20.8	15.6	21.1
17.4	20.9	17.2	21.2	16.9	21.6	16.7	21.9	16.5	22.3
18.4	22.0	18.1	22.3	17.8	22.7	17.6	23.1	17.3	23.5
19.3	23.1	19.0	23.5	18.7	23.8	18.5	24.3	18.2	24.7
20.1	24.2	19.9	24.6	19.5	25.0	19.4	25.4	19.1	25.9
21.1	25.3	20.8	25.7	20.5	26.1	20.2	26.6	19.9	27.0
22.0	26.4	21.7	26.8	21.4	27.2	21.1	27.7	20.8	28.2
22.9	27.5	22.6	27.9	22.3	28.4	22.0	28.9	21.7	29.4
23.8	28.6	23.5	29.0	23.2	29.5	22.9	30.1	22.5	30.6
24.7	29.7	24.4	30.1	24.1	30.7	23.8	31.2	23.4	31.8
25.7	30.8	25.3	31.2	25.0	31.8	24.6	32.4	24.3	32.9
26.6	31.9	26.2	32.4	25.9	32.9	25.5	33.5	25.1	34.1
27.5	33.0	27.1	33.5	26.8	34.1	26.4	34.7	26.0	35.3
28.4	34.1	28.1	34.6	27.7	35.2	27.3	35.9	26.9	36.5
29.3	35.2	29.0	35.7	28.6	36.4	28.2	37.0	27.8	37.7
30.3	36.3	29.9	36.9	29.5	37.5	29.0	38.2	28.6	38.8
31.2	37.4	30.8	38.0	30.4	38.6	29.9	39.3	29.5	40.0
32.1	38.5	31.7	39.1	31.3	39.8	30.8	40.5	30.4	41.2
33.0	39.6	32.6	40.2	32.2	40.9	31.7	41.6	31.2	42.3
33.9	40.7	33.5	41.3	33.1	42.0	32.6	42.8	32.1	43.5
34.9	41.8	34.4	42.4	34.0	43.2	33.4	43.9	33.0	44.7
35.8	41.9	35.3	43.6	34.9	44.3	34.3	45.1	33.8	45.9

Table B—FOR SETTING OUT

This Table gives the half lengths of Culverts for various inclinations, ranging from A, being given in the first column; the upper and lower half lengths will be tances given in this Table are to be set out on the ground horizontally (not

LEVEL. — Half Lengths per Table A.	11 per 100.		12 per 100.		13 per 100.		14 per 100.		15 per 100.	
	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
10	8.6	12.0	8.5	12.2	8.4	12.4	8.3	12.7	8.2	12.9
11	9.5	13.2	9.4	13.4	9.2	13.6	9.1	14.0	9.0	14.2
12	10.3	14.4	10.2	14.6	10.1	14.9	10.0	15.2	9.8	15.5
13	11.2	15.6	11.0	15.9	10.9	16.2	10.8	16.5	10.6	16.8
14	12.0	16.8	11.9	17.1	11.7	17.4	11.6	17.7	11.4	18.1
15	12.9	18.0	12.7	18.3	12.5	18.6	12.4	19.0	12.2	19.4
16	13.8	19.2	13.6	19.5	13.3	19.9	13.2	20.3	13.0	20.7
17	14.6	20.4	14.4	20.7	14.2	21.1	14.1	21.5	13.8	22.0
18	15.4	21.6	15.3	22.0	15.0	22.4	14.9	22.8	14.7	23.2
19	16.3	22.7	16.1	23.2	15.9	23.6	15.7	24.0	15.5	24.5
20	17.2	23.9	17.0	24.4	16.7	24.9	16.6	25.3	16.3	25.8
21	18.1	25.2	17.8	25.6	17.5	26.1	17.4	26.6	17.1	27.1
22	18.9	26.3	18.7	26.8	18.4	27.4	18.2	27.8	17.9	28.4
23	19.8	27.5	19.5	28.1	19.2	28.6	19.0	29.1	18.7	29.6
24	20.6	28.7	20.3	29.3	20.1	29.9	19.9	30.3	19.6	30.9
25	21.5	29.9	21.2	30.5	20.9	31.1	20.7	31.6	20.4	32.2
26	22.3	31.1	22.0	31.7	21.7	32.3	21.5	32.9	21.2	33.5
27	23.2	32.3	22.9	32.9	22.6	33.6	22.3	34.1	22.0	34.8
28	24.1	33.5	23.8	34.2	23.4	34.8	23.2	35.4	22.9	36.1
29	24.9	34.7	24.6	35.4	24.3	36.1	24.0	36.7	23.7	37.4
30	25.7	35.9	25.4	36.6	25.1	37.3	24.8	37.9	24.5	38.7
31	26.6	37.1	26.3	37.8	25.9	38.5	25.6	39.2	25.3	40.0
32	27.4	38.3	27.2	39.0	26.8	39.8	26.4	40.5	26.1	41.3
33	28.4	39.5	28.0	40.3	27.6	41.0	27.3	41.8	26.9	42.6
34	29 1	40 7	28.9	41.5	28.5	42.3	28.1	43.0	27.8	43.9
35	30.0	41.9	29.7	42.7	29.3	43.5	28.9	44.3	28.6	45.2
36	30.8	43.1	30.5	44.0	30.1	44.7	29.7	45.6	29.4	46.5
37	31.7	44.3	31.4	45.1	31.0	46.0	30.6	46.8	30.2	47.8
38	32.7	45.5	32.2	46.4	31.8	47.2	31.4	48.1	31.0	49.0
39	33.4	46.7	33.1	47.6	32.6	48.5	32.3	49.3	31.8	50.3

CULVERTS ON SLOPING GROUND.—*Continued.*

1 *per* 100 *to* 20 *per* 100. *The half lengths of Level Culverts, as found by Table found for each respective inclination on the line opposite. Observe that all dis- on the inclination.)*

16 per 100.		17 per 100.		18 per 100.		19 per 100.		20 per 100.	
Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
8.1	13.2	8.0	13.4	7.9	13.7	7.8	14.0	7.7	14.3
8.9	14.5	8.8	14.7	8.7	15.1	8.6	15.4	8.5	15.7
9.7	15.8	9.6	16.1	9.5	16.4	9.4	16.8	9.2	17.1
10.5	17.1	10.4	17.5	10.3	17.8	10.1	18.2	10.0	18.6
11.3	18.4	11.2	18.8	11.1	19.2	10.9	19.6	10.7	20.0
12.1	19.7	12.0	20.1	11.8	20.5	11.7	21.0	11.5	21.4
12.9	21.0	12.8	21.5	12.6	21.9	12.5	22.4	12.3	22.8
13.7	22.3	13.6	22.8	13.4	23.2	13.3	23.8	13.0	24.2
14.5	23.7	14.4	24.2	14.2	24.6	14.0	25.2	13.8	25.6
15.3	25.0	15.2	25.5	15.0	26.0	14.8	26.6	14.6	27.1
16.2	26.3	16.0	26.9	15.8	27.4	15.6	28.0	15.3	28.5
17.0	27.6	16.7	28.2	16.5	28.7	16.4	29.4	16.1	29.9
17.8	28.9	17.5	29.6	17.3	30.1	17.2	30.8	16.9	31.3
18.6	30.3	18.3	30.9	18.1	31.5	17.9	32.2	17.6	32.8
19.4	31.6	19.1	32.3	18.9	32.8	18.7	33.6	18.4	34.3
20.2	32.9	19.9	33.6	19.7	34.2	19.5	35.0	19.2	35.7
21.0	34.2	20.7	34.9	20.5	35.6	20.3	36.4	20.0	37.1
21.8	35.5	21.5	36.3	21.3	36.9	21.0	37.7	20.7	38.6
22.6	36.8	22.3	37.6	22.1	38.3	21.8	39.2	21.5	40.0
23.4	38.1	23.1	39.0	22.9	39.7	22.6	40.6	22.3	41.4
24.2	39.5	23.9	40.3	23.7	41.1	23.3	41.9	23.0	42.9
25.0	40.8	24.7	41.6	24.4	42.4	24.1	43.3	23.8	44.3
25.8	42.1	25.5	43.0	25.2	43.8	24.9	44.7	24.5	45.7
26.6	43.4	26.3	44.3	26.0	45.1	25.7	46.1	25.3	47.1
27.4	44.7	27.1	45.7	26.8	46.5	26.4	47.5	26.1	48.6
28.2	46.0	27.9	47.0	27.6	47.9	27.2	48.9	26.9	50.0
29.0	47.3	28.7	48.3	28.4	49.3	28.0	50.3	27.7	51.4
29.8	48.6	29.5	49.7	29.2	50.6	28.8	51.7	28.4	52.9
30.6	50.0	30.3	51.0	30.0	52.0	29.5	53.1	29.2	54.3
31.4	51.3	31.1	52.4	30.7	53.4	30.3	54.5	30.0	55.7

Table B—FOR SETTING OUT

This Table gives the half lengths of Culverts for various inclinations, ranging from A, being given in the first column ; the upper and lower half lengths will be tances given in this Table are to be set out on the ground horizontally (not

LEVEL. — Half Lengths per Table A.	1 per 100.		2 per 100.		3 per 100.		4 per 100.		5 per 100.	
	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
40	39.4	40.6	38.8	41.2	38.3	41.9	37.7	42.6	37.2	43.2
41	40.4	41.6	39.8	42.3	39.3	42.9	38.6	43.6	38.2	44.3
42	41.4	42.6	40.8	43.3	40.2	44.0	39.6	44.7	39.1	45.4
43	42.3	43.7	41.7	44.3	41.2	45.0	40.5	45.8	40.0	46.5
44	43.2	44.7	42.7	45.4	42.1	46.1	41.5	46.8	41.0	47.5
45	44.3	45.7	43.7	46.4	43.1	47.1	42.4	47.8	41.9	48.6
46	45.3	46.7	44.6	47.4	44.1	48.2	43.4	49.0	42.8	49.7
47	46.3	47.7	45.6	48.4	45.0	49.2	41.3	50.0	43.8	50.8
48	47.3	48.7	46.6	49.5	45.9	50.3	45.3	51.1	44.7	51.9
49	48.3	49.7	47.6	50.5	46.9	51.3	46.2	52.2	45.6	53.0
50	49.2	50.7	48.5	51.5	47.9	52.4	47.2	53.2	46.5	54.0
51	50.2	51.8	49.5	52.6	48.8	53.4	48.1	54.3	47.5	55.1
52	51.2	52.8	50.5	53.6	49.7	54.5	49.1	55.3	48.4	56.2
53	52.2	53.8	51.4	54.6	50.7	55.5	50.0	56.4	49.3	57.3
54	53.2	54.8	52.4	55.7	51.7	56.6	51.0	57.5	50.3	58.4
55	54.2	55.8	53.4	56.7	52.6	57.6	51.9	58.5	51.2	59.4
56	55.2	56.8	54.3	57.7	53.5	58.7	52.8	59.6	52.1	60.5
57	56.2	57.8	55.3	58.8	54.5	59.7	53.8	60.6	53.0	61.6
58	57.1	58.8	56.3	59.8	55.5	60.8	54.7	61.7	54.0	62.7
59	58.1	59.8	57.3	60.8	56.4	61.8	55.6	62.8	54.9	63.8
60	59.1	60.8	58.2	61.8	57.4	62.9	56.6	63.8	55.8	64.8
61	60.1	61.8	59.2	62.9	58.4	63.9	57.5	64.9	56.7	65.9
62	61.1	62.9	60.2	63.9	59.3	65.0	58.5	65.9	57.7	67.0
63	62.0	63.9	61.1	65.0	60.3	66.0	59.4	67.0	58.6	68.1
64	63.0	64.9	62.1	66.0	61.2	67.0	60.4	68.0	59.6	69.2
65	64.0	66.0	63.1	67.0	62.2	68.1	61.3	69.1	60.5	70.3
66	65.0	67.0	64.0	68.0	63.1	69.1	62.3	70.2	61.4	71.3
67	66.0	68.0	65.0	69.0	64.1	70.2	63.2	71.2	62.4	72.4
68	67.0	69.0	66.0	70.1	65.1	71.2	64.2	72.3	63.3	73.5
69	67.9	70.0	67.0	71.1	66.0	72.3	65.1	73.4	64.2	74.6

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r.	Lower.
.2	43.2
.2	44.3
.1	45.4
.0	46.5
.0	47.5
.9	48.6
.8	49 7
.8	50.8
.7	51.9
.6	53.0
.5	54.0
.5	55.1
.4	56.2
.3	57.3
.3	58.4
.2	59.4
.1	60.5
.0	61.6
.0	62.7
.9	63.8
.8	64.8
.7	65.9
.7	67.0
.6	68.1
.6	69.2
.5	70.3
.4	71.3
.4	72.4
.3	73.5
.2	74.6

CULVERTS ON SLOPING GROUND.—*Continued.*

1 *per* 100 *to* 20 *per* 100. *The half lengths of Level Culverts, as found by Table found for each respective inclination on the line opposite. Observe that all dis- on the inclination.)*

6 per 100.		7 per 100.		8 per 100.		9 per 100.		10 per 100.	
Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
36.7	44.0	36.2	44.7	35.8	45.4	35.2	46.3	34.7	47.0
37.6	45.0	37.1	45.8	36.6	46.6	36.1	47.4	35.6	48.2
38.5	46.1	38.0	46.9	37.5	47.7	36.9	48.6	36.5	49.4
39.5	47.2	38.9	48.1	38.4	48.8	37.8	49.7	37.4	50.6
40.4	48.3	39.8	49.2	39.3	49.9	38.7	50.9	38.2	51.7
41.3	49.4	40.7	50.3	40.2	51.1	39.6	52.0	39.1	52.9
42.2	50.5	41.6	51.4	41.1	52.2	40.5	53.2	40.0	54.1
43.1	51.6	42.5	52.5	42.0	53.4	41.4	54.3	40.8	55.2
44.0	52.7	43.4	53.6	42.9	54.5	42.3	55.5	41.7	56.4
44.9	53.8	44.3	54.7	43.8	55.6	43.2	56.6	42.6	57.6
45.9	54.9	45.2	55.9	44.7	56.8	44.1	57.8	43.5	58.8
46.8	56.0	46.1	57.0	45.5	57.9	45.0	58.9	44.3	60.0
47.7	57.1	47.0	58.1	46.4	59.1	45.9	60.1	45.2	61.1
48.6	58.2	48.0	59.2	47.3	60.2	46.7	61.3	46.0	62.3
49.5	59.3	48.9	60.3	48.2	61.3	47.6	62.4	46.9	63.5
50.4	60.4	49.8	61.4	49.1	62.5	48.5	63.6	47.8	64.7
51.3	61.5	50.7	62.5	50.0	63.6	49.4	64.7	48.7	65.9
52.2	62.6	51.6	63.6	50.9	64.8	50.3	65.9	49.5	67.0
53.2	63.7	52.5	64.7	51.8	65.9	51.1	67.1	50.4	68.2
54.1	64.8	53.4	65.9	52.7	67.0	52.4	68.2	51.3	69.4
55.0	65.9	54.3	67.0	53.6	68.2	52.9	69.4	52.1	70.6
55.9	67.0	55.2	68.1	54.4	69.3	53.8	70.5	53.0	71.8
56.8	68.1	56.1	69.2	55.3	70.4	54.7	71.6	53.9	73.0
57.8	69.2	57.0	70.3	56.2	71.5	55.6	72.8	54.8	74.1
57.7	70.3	57.9	71.5	57.1	72 7	56.4	74.0	55.6	75.3
59.6	71.4	58.8	72.6	58.0	73.8	57.3	75.1	56.5	76.5
60.5	72.5	59.7	73.7	58.9	74.9	58.2	76.3	57.4	77.6
61.4	73.6	60.6	74.8	59.8	76.1	59.0	77.4	58.2	78.8
62.4	74.7	61.5	76.0	60.7	77.2	59.9	76.6	59.1	80.0
63.3	75.8	62.4	77.1	61.6	78.4	60.8	79.7	60.0	81.2

Table B—FOR SETTING OUT

This Table gives the half lengths of Culverts for various inclinations, ranging from A, being given in the first column; the upper and lower half lengths will be tances given in this Table are to be set out on the ground horizontally (not

LEVEL. — Half Lengths per Table A.	11 per 100.		12 per 100.		13 per 100.		14 per 100.		15 per 100.	
	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
40	34.3	47.9	33.9	48.8	33.5	49.7	33.1	50.6	32.7	51.6
41	35.1	49.1	34.7	50.0	34.2	50.9	33.9	51.9	32.5	52.9
42	36.0	50.3	35.6	51.2	35.2	52.2	34.7	53.1	34.3	54.1
43	36.9	51.5	36.4	52.5	36.2	53.4	35.5	54.4	35.1	55.4
44	37.7	52.7	37.2	53.7	36.9	54.7	36.4	55.6	35.9	56.7
45	38.6	53.9	38.1	54.9	37.7	55.9	37.2	56.9	36.7	58.0
46	39.4	55.1	39.0	56.1	38.5	57.1	38.0	58.2	37.5	59.3
47	40.3	56.3	39.8	57.3	39.4	58.4	38.9	59.4	38.3	60.6
48	41.2	57.5	40.6	58.6	40.2	59.6	39.7	60.7	39.2	61.9
49	42.0	58.7	41.5	59.8	41.0	60.9	40.5	62 0	40.0	63.2
50	42.9	59.8	42.4	61.0	41.9	62.1	41.4	63.3	40.8	64.5
51	43.7	61.0	43.2	62.2	42.7	63.3	42.2	64.5	41.6	65.8
52	44.6	62.2	44.1	63.4	43.5	64.6	43.0	65.8	42.4	67.1
53	45.5	63.4	44.9	64.7	44.3	65.8	43.8	67.1	43.3	68.4
54	46.3	64.6	45.7	65.9	45.2	67.1	44.7	68.3	44.0	69.7
55	47.2	65.8	46.6	67.1	46.0	68.3	45.5	69.6	44.9	71.0
56	48.1	67.0	47.5	68.3	46.8	69.5	46.3	70.9	45.7	72.3
57	48.9	68.2	48.3	69.5	47.7	70.8	47.1	72.1	46.5	73.6
58	49.8	69.4	49.2	70.7	48.5	72.0	48.0	73.4	47.4	74.9
59	50.6	70.6	50.0	71.9	49.4	73.3	48.7	74.7	48.2	76.1
60	51.5	71.8	50.9	73.2	50.2	74.5	49.6	76 0	49.0	77.5
61	52.3	73.0	51.7	74.4	51.0	75.7	50.4	77.2	49.8	78.7
62	53.2	74.2	52.6	75.6	51.9	77.0	51.2	78.5	50.6	80.0
63	54.1	75.4	53.4	76.8	52.7	78.2	52.0	79.7	51.5	81.3
64	54.9	76.6	54.3	78.0	53.6	79.5	52.9	81.0	52.3	82.6
65	55.8	77.8	55.1	79.2	54.4	80.7	53.7	82.3	53.1	83.9
66	56.7	79.0	55.9	80.4	55.2	81.9	54.5	83.6	53.9	85.2
67	57.5	80.2	56.8	81.6	56.1	83.2	55.4	84.8	54.7	86.5
68	58.3	81.4	57.6	82.9	56.9	84.5	56.2	86.0	55.5	87.7
69	59.2	82.6	58.5	84.1	57.8	85.7	57.0	87.3	56.3	89.0

CULVERTS ON SLOPING GROUND.—*Continued.*

1 *per* 100 *to* 20 *per* 100. *The half lengths of Level Culverts, as found by Table found for each respective inclination on the line opposite. Observe that all dis- on the inclination.)*

16 per 100.		17 per 100.		18 per 100.		19 per 100.		20 per 100.	
Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
32.3	52.6	31.9	53.7	31.5	54.8	31.1	55.9	30.7	57.1
33.1	53.9	32.6	55.0	32.3	56.1	31.9	57.3	31.5	58.6
33.9	55.2	33.4	56.4	33.1	57.5	32.7	58.7	32.3	60.0
34.7	56.6	34.2	57.7	33.9	58.9	33.4	60.1	33.1	61.4
35.5	57.9	35.0	59.1	34.7	60.2	34.2	61.5	33.8	62.9
36.3	59.2	35.8	60.4	35.4	61.6	35.0	62.9	34.6	64.3
37.1	60.5	36.6	61.7	36.2	62.9	35.8	64.3	35.3	65.7
37.9	61.8	37.4	63.1	37.0	64.3	36.6	65.7	36.1	67.2
38.7	63.2	38.2	64.4	37.8	65.7	37.3	67.1	36.9	68.6
39.5	64.5	39.0	65.8	38.6	67.1	38.1	68.5	37.6	70.0
40.3	65.8	39.8	67.1	39.4	68.5	38.9	69.9	38.4	71.4
41.1	67.1	40.6	68.4	40.1	69.8	39.7	71.3	39.1	72.9
41.9	68.4	41.4	69.8	40.9	71.2	40.5	72.7	39.9	74.3
42.7	69.8	42.2	71.1	41.7	72.6	41.2	74.1	40.6	75.7
43.5	71.1	43.0	72.5	42.5	73.9	42.0	75.5	41.3	77.2
44.3	72.4	43.8	73.8	43.3	75.3	42.8	76.9	42.3	78.6
45.1	73.7	44.6	75.1	44.1	76.7	43.6	78.3	43.0	80.0
45.9	75.0	45.4	76.5	44.9	78.0	44.4	79.7	43.8	81.4
46.7	76.3	46.2	77.8	45.7	79.0	45.1	81.1	44.6	82.9
47.5	77.6	47.0	79.2	46.5	80.8	45.9	82.5	45.4	84.3
48.4	79.0	47.8	80.5	47.2	82.2	46.7	83.9	46.2	85.7
49.2	80.3	48.5	81.8	48.0	83.5	47.5	85.3	46.9	87.1
49.9	81.6	49.3	83.2	48.8	84.9	48.3	86.7	47.7	88.5
50.8	82.9	50.1	84.5	49.6	86.3	49.0	88.1	48.5	89.9
51.6	84.2	50.9	85.9	50.4	87.6	49.8	89.5	49.2	91.3
52.4	85.5	51.7	87.2	51.2	89.0	50.6	90.9	50.0	92.8
53.2	86.8	52.5	88.6	52.0	90.4	51.4	92.3	50.8	94.2
54.0	88.1	53.3	89.9	52.8	91.7	52.2	93.7	51.5	95.6
54.8	89.5	54.1	91.3	53.5	93.1	52.9	95.1	52.3	97.1
55.6	90.8	54.9	92.6	54.3	94.5	53.7	96.5	53.1	98.5

Table B—FOR SETTING OUT

This Table gives the half lengths of Culverts for various inclinations, ranging from A, being given in the first column ; the upper and lower half lengths will be tances given in this Table are to be set out on the ground horizontally (not

LEVEL.	1 per 100.		2 per 100.		3 per 100.		4 per 100.		5 per 100.	
Half Lengths per Table A.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
70	68.9	71.0	67.9	72.1	67.0	73.3	66.1	74.4	65.1	75.7
71	69.9	72.0	68.9	73.2	67.9	74.3	67.0	75.5	66.0	76.8
72	70.9	73.1	69.9	74.2	68.8	75.4	68.0	76.5	67.0	77.8
73	71.9	74.1	70.8	75.2	69.8	76.4	69.0	77.6	67.9	78.9
74	72.9	75.1	71.8	76.3	70.7	77.5	69.9	78.7	68.9	80.0
75	73.9	76.1	72.8	77.3	71.7	78.5	70.8	79.8	69.8	81.1
76	74.9	77.0	73.7	78.3	72.7	79.6	71.8	80.9	70.7	82.2
77	75.9	78.0	74.7	79.3	73.6	80.6	72.8	81.9	71.6	83.2
78	76.8	79.1	75.7	80.4	74.6	81.7	73.6	83.0	72.5	84.3
79	77.8	80.2	76.7	81.4	75.5	82.7	74.6	84.0	73.5	85.4
80	78.8	81.2	77.6	82.5	76.5	83.8	75.5	85.1	74.4	86.5
81	79.8	82.2	78.6	83.5	77.5	84.8	76.5	86.2	75.3	87.6
82	80.8	83.2	79.6	84.5	78.4	85.9	77.4	87.2	76.3	88.7
83	81.7	84.3	80.5	85.5	79.4	86.9	78.4	88.3	77.2	89.7
84	82.7	85.3	81.5	86.6	80.3	88.0	79.3	89.3	78.1	90.8
85	83.7	86.3	82.5	87.6	81.3	89.0	80.2	90.4	79.1	91.9
86	84.7	87.3	83.5	88.6	82.3	90.0	81.2	91.5	80.3	93.0
87	85.7	88.3	84.4	89.6	83.2	91.1	82.1	92.5	81.0	94.1
88	86.7	89.3	85.4	90.7	84.2	92.2	83.0	93.6	81.9	95.1
89	87.7	90.3	86.4	91.7	85.1	93.2	84.0	94.7	82.8	96.2
90	88.7	91.3	87.4	92.7	86.1	94.3	85.0	95.7	83.7	97.3
91	89.7	92.3	88.3	93.8	87.1	95.3	85.9	96.8	84.7	98.4
92	90.6	93.3	89.3	94.8	88.0	96.4	86.8	97.9	85.6	99.5
93	91.6	94.3	90.3	95.8	89.0	97.4	87.8	99.0	86.5	100.5
94	92.6	95.4	91.2	96.8	89.9	98.5	88.7	100.0	87.5	101.6
95	93.6	96.4	92.3	97.9	90.9	99.5	89.6	101.1	88.4	102.7
96	94.5	97.4	93.2	98.9	91.9	100.6	90.6	102.1	89.3	103.8
97	95.5	98.4	94.2	99.9	92.8	101.6	91.5	103.2	90.2	104.8
98	96.5	99.4	95.2	100.9	93.8	102.7	92.5	104.3	91.2	105.9
99	97.5	100.5	96.2	102.1	94.7	103.7	93.4	105.4	92.1	107.0

CULVERTS ON SLOPING GROUND.—*Continued.*

1 *per* 100 *to* 20 *per* 100. *The half-lengths of Level Culverts, as found by Table found for each respective inclination on the line opposite. Observe that all dis- on the inclination.)*

6 per 100.		7 per 100.		8 per 100.		9 per 100.		10 per 100.	
Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
64.2	76.9	63.3	78.2	62.5	79.5	61.7	80.9	60.9	82.3
65.1	78.0	64.2	79.3	63.4	80.6	62.6	82.0	61.7	83.5
66.0	79.1	65.1	80.4	64.3	81.8	63.5	83.2	62.6	84.7
67.0	80.2	66.0	81.6	65.2	82.9	64.3	84.4	62.4	85.9
67.9	81.3	66.9	82.7	66.1	84.1	65.2	85.5	64.3	87.0
68.8	82.4	67.9	83.8	67.0	85.2	66.1	86.7	65.2	88.2
69.7	83.5	68.8	84.9	67.9	86.3	67.0	87.9	66.1	89.4
70.6	84.6	69.7	86.0	68.8	87.5	67.9	89.0	66.9	90.6
71.6	85.7	70.6	87.1	69.7	88.6	68.7	90.2	67.8	91.7
72.5	86.8	71.5	88.2	70.6	89.8	69.6	91.3	68.7	92.9
73.4	87.9	72.4	89.3	71.4	90.9	70.5	92.5	69.6	94.1
74.3	89.0	73.3	90.5	72.3	92.0	71.4	93.7	70.4	95.3
75.2	90.1	74.2	91.6	73.2	93.2	72.3	94.8	71.3	96.5
76.2	91.2	75.1	92.7	74.1	94.3	73.1	96.0	72.2	97.6
77.1	92.3	76.0	93.8	75.0	95.5	74.0	97.1	73.0	98.8
78.0	93.4	76.9	94.9	75.9	96.6	74.9	98.3	93.9	100.0
78.9	94.5	77.8	96.0	76.8	97.7	75.8	99.5	74.8	101.1
79.8	95.6	78.7	97.1	77.7	98.9	76.7	100.6	75.6	102.3
80.7	96.7	79.6	98.2	78.6	100.0	77.5	101.8	76.5	103.5
81.6	97.8	80.5	99.4	79.5	101.1	78.4	102.9	77.4	104.7
82.5	98.9	81.4	100.5	80.4	102.2	79.3	104.5	78.2	105.9
83.5	100.0	82.3	101.6	81.2	103.4	80.2	105.2	79.1	107.0
84.4	101.1	83.2	102.7	82.1	104.5	81.1	106.4	79.9	108.3
85.3	102.2	84.1	103.9	83.0	105.6	81.9	107.5	80.9	109.4
86.2	103.3	85.0	105.0	83.9	106.8	82.8	108.7	81.7	110.6
87.1	104.4	86.0	106.1	84.8	107.9	83.7	109.8	82.6	111.8
88.0	105.5	86.9	107.2	85.7	109.0	84.6	110.9	83.5	112.9
88.9	106.6	87.8	108.3	86.6	110.2	85.5	112.1	84.3	114.1
89.8	107.7	88.7	109.5	87.5	111.3	86.3	113.3	85.2	115.3
90.7	108.8	89.6	110.6	88.4	112.4	87.2	114.4	86.1	116.5

Table B—FOR SETTING OUT

This Table gives the half lengths of Culverts for various inclinations, ranging from A, being given in the first column; the upper and lower half lengths will be tances given in this Table are to be set out on the ground horizontally (not

LEVEL. — Half Lengths per Table A.	11 per 100.		12 per 100.		13 per 100.		14 per 100.		15 per 100.	
	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper	Lower.	Upper.	Lower.
70	60.1	83.8	59.3	85.3	58.6	86.9	57.9	88.6	57.2	90.3
71	60.9	85.0	60.1	86.5	59.4	88.2	58.7	89.9	58.0	91.6
72	61.8	86.2	61.0	87.7	60.3	89.5	59.5	91.1	58.8	92.9
73	62.6	87.4	61.8	89.0	60.1	90.7	60.3	72.4	59.6	94.1
74	63.4	88.6	62.6	90.2	61.9	92.0	61.2	93.6	60.4	95.4
75	64.3	89.8	63.5	91.4	62.8	93.2	62.0	94.9	61.2	86.7
76	65.2	91.0	64.4	92.6	63.6	94.4	62.8	96.2	62.0	98.0
77	66.0	92.2	65.2	93.8	64.5	95.7	63.6	97.4	62.8	99.3
78	66.9	93.4	66.1	95.1	65.3	96.9	64.5	98.7	63.7	100.6
79	67.7	94.6	66.9	96.3	66.1	98.2	65.3	100.0	64.5	101.9
80	68.6	95.8	67.8	97.5	66.9	99.4	66.1	101.3	65.3	103.2
81	69.5	97.0	68.6	98.7	67.8	100.6	66.9	102.5	66.1	104.5
82	70.3	98.2	69.5	99.9	68.6	101.9	67.7	103.8	66.9	105.8
83	71.2	99.4	70.3	101.2	69.4	103.1	68.6	105.1	67.7	107.1
84	72.0	100.6	71.1	102.4	70.3	104.4	69.4	106.3	68.6	108.4
85	72.9	101.8	72.0	103.6	71.1	105.6	70.2	107.6	69.4	109.7
86	73.8	103.0	72.9	104.8	71.9	106.8	71.0	108.9	70.2	111.0
87	74.6	104.2	73.7	106.0	72.8	108.0	71.9	110.1	71.0	112.3
88	75.5	105.4	74.6	107.3	73.6	109.3	72.7	111.4	71.9	113.5
89	76.3	106.6	75.4	108.5	74.5	110.6	73.5	112.6	72.7	114.8
90	77.2	107.8	76.3	109.7	75.3	111.8	74.4	113.9	73.5	116.1
91	78.1	109.0	77.1	110.9	76.1	113.0	75.2	115.2	74.3	117.4
92	78.9	110.2	78.0	112.1	77.0	114.3	76.0	116.4	75.1	118.7
93	79.8	111.4	78.8	113.4	77.8	115.5	76.8	117.7	76.0	119.9
94	80.6	112.6	79.6	114.6	78.7	116.8	77.7	118.9	76.8	121.2
95	81.5	113.8	80.5	115.8	79.5	118.0	78.5	120.2	77.6	122.5
96	82.4	115.0	81.3	117.0	80.3	119.2	79.3	121.5	78.4	123.8
97	83.2	116.2	82.2	118.3	81.2	120.5	80.1	122.8	79.2	125.1
98	84.1	117.4	83.0	119.5	82.0	121.7	81.0	124.1	80.0	126.4
99	84.9	118.6	83.9	120.8	82.9	123.0	81.8	125.4	80.8	127.7

1 *per* 100 *to* 20 *per* 100. *The half lengths of Level Culverts, as found by Table*
found for each respective inclination on the line opposite. Observe that all dis-
on the inclination.)

16 per 100.		17 per 100.		18 per 100.		19 per 100.		20 per 100.	
Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
56.5	92.1	55.7	94.0	55.1	95.9	54.5	97.9	53.8	99.9
57.3	93.4	56.5	95.3	55.9	97.2	55.3	99.3	54.6	101.4
58.1	94.7	57.3	96.7	56.7	98.6	56.1	100.7	55.3	102.8
58.9	96.1	58.1	98.0	57.4	100.0	56.8	102.1	56.1	104.2
59.7	97.4	58.9	99.4	58.2	101.3	57.6	103.5	56.8	105.7
60.5	98.7	59.7	100.7	59.0	102.7	58.4	104.9	57.7	107.1
61.3	100.0	60.5	102.0	59.8	104.1	59.2	106.3	58.4	108.5
62.1	101.3	61.3	103.4	60.6	105.4	60.0	107.7	59.3	109.9
62.9	102.6	62.1	104.7	61.4	106.8	60.7	109.1	60.0	111.4
63.7	103.9	62.9	106.1	62.2	108.2	61.5	110.5	60.8	112.8
64.6	105.3	63.7	107.4	63.0	109.6	62.3	111.9	61.6	114.2
65.4	106.6	64.5	108.7	63.7	110.9	63.1	113.3	62.4	115.6
66.2	107.9	65.3	110.1	64.5	112.3	63.9	114.7	63.1	117.1
67.0	109.2	66.1	111.4	65.3	113.6	64.6	116.1	63.9	118.4
67.8	110.5	66.9	112.8	66.1	115.0	65.4	117.5	64.7	119.9
68.6	111.8	67.7	114.1	66.9	116.4	66.2	118.9	65.4	121.4
69.4	113.1	68.5	115.4	67.7	117.8	67.0	120.3	66.2	122.8
70.2	114.4	69.3	116.8	68.5	119.1	67.7	121.7	66.9	124.3
71.0	115.8	70.1	118.1	69.3	120.5	68.5	123.1	67.8	125.6
71.8	117.1	70.9	119.5	70.1	121.9	69.3	124.5	68.5	127.1
72.6	118.4	71.7	120.8	70.9	123.3	70.0	125.9	69.3	128.6
73.4	119.7	72.4	122.1	71.6	124.6	70.8	127.2	70.0	130.0
74.2	121.0	73.2	123.5	72.4	126.0	71.6	128.6	70.8	131.4
75.0	122.4	74.0	124.8	73.2	127.4	72.4	130.0	71.6	132.8
75.8	123.7	74.8	126.2	74.0	128.7	73.1	131.4	72.3	134.3
76.6	125.0	75.6	127.5	74.8	130.1	73.9	132.8	73.1	135.7
77.4	126.3	76.4	128.8	75.6	131.5	74.7	134.2	73.9	137.1
78.2	127.6	77.2	130.2	76.4	132.8	75.5	135.6	74.8	138.6
79.0	129.0	78.0	131.5	77.2	134.2	76.2	137.0	75.5	140.0
79.8	130.3	78.8	132.9	77.9	135.6	77.0	138.4	76.2	141.4

Table B—FOR SETTING OUT

This Table gives the half lengths of Culverts for various inclinations, ranging from A, being given in the first column ; the upper and lower half lengths will be tances given in this Table are to be set out on the ground horizontally (not

LEVEL. — Half Lengths per Table A.	1 per 100.		2 per 100.		3 per 100.		4 per 100.		5 per 100.	
	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
100	98.5	101.5	97.1	103.1	95.7	104.7	94.3	106.4	93.0	108.1
101	99.5	102.5	98.1	104.1	96.7	105.8	95.2	107.5	93.9	109.2
102	100.5	103.5	99.0	105.2	97.6	106.8	96.2	108.5	95.0	110.2
103	101.5	104.6	100.0	106.2	98.6	107.8	97.1	109.6	95.9	111.3
104	102.5	105.6	101.0	107.2	99.5	108.9	98.1	110.6	96.8	112.4
105	103.5	106.6	101.9	108.3	100.5	109.9	99.0	111.7	97.7	113.5
106	104.4	107.6	102.9	109.3	101.5	111.0	99.9	112.8	98.7	114.6
107	105.4	108.6	103.9	110.3	102.4	112.1	100.9	113.8	99.6	115.6
108	106.4	109.7	104.9	111.3	103.4	113.1	101.8	114.9	100.5	116.7
109	107.4	110.7	105.8	112.4	104.3	114.2	102.8	115.9	101.4	117.8
110	108.4	111.7	106.8	113.4	105.3	115.2	103.7	117.0	102.3	118.9
111	109.4	112.7	107.8	114.4	106.3	116.2	104.6	118.1	103.3	120.0
112	110.4	113.7	108.7	115.5	107.2	117.3	105.6	119.1	104.3	121.1
113	111.4	114.8	109.7	116.5	108.2	118.3	106.5	120.2	105.2	122.1
114	112.4	115.8	110.7	117.5	109.1	119.4	107.5	121.2	106.1	123.2
115	113.3	116.8	111.7	118.5	110.1	120.4	108.4	122.3	107.0	124.3
116	114.3	117.8	112.6	119.6	111.1	121.5	109.3	123.4	107.9	125.4
117	115.3	118.8	113.6	120.6	112.0	122.6	110.3	124.4	108.9	126.4
118	116.3	119.9	114.6	121.6	113.0	123.6	111.2	125.5	109.8	127.5
119	117.3	120.9	115.5	122.7	113.9	124.7	112.2	126.5	110.7	128.6
120	118.3	121.9	116.5	123.7	114.9	125.7	113.2	127.7	111.6	129.7

CULVERTS ON SLOPING GROUND.—*Continued.*

1 *per* 100 *to* 20 *per* 100. *The half lengths of Level Culverts, as found by Table found for each respective inclination on the line opposite. Observe that all dis- on the inclination.)*

6 per 100.		7 per 100.		8 per 100.		9 per 100.		10 per 100.	
Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
91.7	109.9	90.5	111.7	89.3	113.6	88.1	115.6	86.9	117.6
92.6	111.0	91.4	112.8	90.2	114.7	88.9	116.7	87.7	118.7
93.5	112.1	92.3	113.9	91 1	115.8	89.8	117.8	88.6	119.9
94.5	113.2	93.2	115.1	92.0	117.0	90.7	118.9	89.5	121.1
95.4	114.3	94.1	116.2	92.8	118.1	91.6	120.0	90.4	122.3
96.3	115.4	95.0	117.3	93.7	119.3	92.5	121.2	91.2	123.4
97.2	116.5	96.0	118.4	94.6	120.4	93.4	122.3	92.1	124.6
98.1	117.6	96.8	119.5	95.5	121.5	94.3	123.5	93.0	125.8
99.0	118.7	97 8	120.6	96.4	122.7	95.1	124.6	93.8	126.9
100.0	119.8	98.7	121.7	97.3	123.8	96.0	125.7	94.7	128.1
100.9	120.9	99.6	122.9	98.2	124.9	96.9	126.8	95.6	129.3
101.8	122.0	100.5	124.0	99.1	126.0	97.8	127.9	96.5	130.4
102.7	123.1	101.4	125.1	100.0	127.2	98.7	129.1	97.3	131.6
103.6	124.2	102.3	126.2	100.9	128.3	99.5	130.2	98.2	132.8
104.5	125.3	103.2	127.4	101.8	129.5	100.4	131.3	99.0	134.0
105.5	126.4	104.1	128.5	102.7	130.6	101.3	132.4	99.9	135.1
106.4	127.5	105.0	129.6	103.6	131.7	102.2	133.5	100.8	136.3
107.3	128.6	105.9	130.7	104.5	132.8	103.0	134.7	101.7	137.5
108.2	129.7	106.8	131.8	105.4	134.0	103.9	135.8	102.5	138.6
109.2	130 8	107.7	133.0	106.3	135.2	104.8	136.9	103.4	139.8
110.1	131.9	108.6	134.1	107.2	136.3	105.7	138.0	104.3	141.1

Table B—FOR SETTING OUT

This Table gives the half lengths of Culverts for various inclinations, ranging from A, being given in the first column; the upper and lower half lengths will be tances given in this Table are to be set out on the ground horizontally (not

LEVEL. — Half Lengths per Table A.	11 per 100.		12 per 100.		13 per 100.		14 per 100.		15 per 100.	
	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
100	85.8	119.8	84.7	122.0	83.7	124.2	82.6	126.7	81.6	129.0
101	86 6	121.0	85.5	123.2	84 5	125.4	83.4	127.9	82.4	130.3
102	87.5	122.2	86.4	124.4	85.4	126.7	84.2	129.2	83.2	131.6
103	88.3	123.4	87.2	125.6	86.2	127.9	85.0	130.5	84.0	132.9
104	89.2	124.6	88.1	126.8	87.0	129.2	85.9	131.8	84.8	134.1
105	90.0	125.8	88.9	128.1	87.9	130.4	86.7	133.0	85.6	135.4
106	90.9	127.0	89.8	129.3	88 7	131.7	87.5	134.3	86.5	136.7
107	91.7	128.2	90.7	130.5	89.5	132.9	88.4	135.6	87.3	138.0
108	92.6	129.4	91.6	131.7	90.4	134.1	89.2	136.8	88.1	139.3
109	93.4	130.6	92.4	133.0	91.2	135.4	90.0	138.1	88.9	140.6
110	94.3	131.8	93.3	134.2	92.0	136.6	90.8	139.4	89.7	141.9
111	95.1	133.0	94.1	135.4	92.9	137.9	91.6	140.7	90.5	143.2
112	96 0	134.2	95.0	136.6	93.7	139.1	92.5	141.9	91.3	144.5
113	96.8	135.4	95.8	137.8	94.5	140.7	93.3	143.2	92.2	145.8
114	97.7	136.6	96.7	139.0	95.4	141.6	94.1	144.5	93.0	147.0
115	98.5	137.8	97.5	140.3	96.2	142.8	94.9	145.7	93.8	148.3
116	99.4	139.0	98.4	141.5	97.0	144.1	95.8	147.0	94.6	149.6
117	100.2	140.2	99.2	142.7	97.9	145.3	96.6	148.3	95.4	151.0
118	101.1	141.4	100.1	144.0	98.7	146.6	97.4	149.5	96.2	152.2
119	101.9	142.6	100.9	145.1	99.5	147.8	98.2	150.8	97.0	153.5
120	102.8	143.8	101.7	146.4	100.4	149.0	99.0	152.1	97.8	154.8

CULVERTS ON SLOPING GROUND.—*Continued.*

1 *per* 100 *to* 20 *per* 100. *The half lengths of Level Culverts, as found by Table found for each respective inclination on the line opposite. Observe that all dis- on the inclination.)*

16 per 100.		17 per 100.		18 per 100.		19 per 100.		20 per 100.	
Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
80.6	131.6	79.6	134.2	78.7	137.0	77.8	139.8	76.9	142.9
81.4	132.9	80.4	135.5	79.5	138.3	78.6	141.2	77.7	144.3
82.2	134.2	81.2	136.9	80.3	139.7	79.3	142.6	78.4	145.7
83.0	135.5	82.0	138.2	81.0	141.1	81.1	144.0	79.2	147.2
83.8	136.8	82.8	139.6	81.8	142.5	80.9	145.4	80.0	148.6
84.6	138.2	83.6	140.9	82.6	143.8	81.7	146.8	80.7	150.1
85.4	139.5	84.4	142.2	83.4	145.2	82.4	148.2	81.5	151.5
86.2	140.8	85.2	143.6	84.2	146.6	83.2	149.6	82.3	152.9
87.0	142.1	86.0	144.9	85.0	148.0	84.0	151.0	83.0	154.4
87.8	143.4	86.8	146.2	85.8	149.3	84.8	152.4	83.8	155.8
88.6	144.7	87.6	147.6	86.5	150.7	85.6	153.8	84.6	157.2
89.4	146.0	88.4	148.9	87.3	152.0	86.3	155.1	85.4	158.6
90.2	147.4	89.1	150.3	88.1	153.4	87.1	156.5	86.1	160.1
91.0	148.7	89.9	151.6	88.9	154.8	87.9	157.9	86.9	161.5
91.8	150.0	90.7	153.0	89.7	156.2	88.7	159.3	87.7	162.9
92.6	151.3	91.5	154.3	90.5	157.5	89.4	160.7	88.4	164.4
93.4	152.6	92.3	155.6	91.3	158.9	90.2	162.1	89.2	165.8
94.2	154.0	93.1	157.0	92.0	160.3	91.0	163.5	90.0	167.3
95.0	155.3	93.9	158.3	92.8	161.6	91.7	164.9	90.7	168.7
95.8	156.6	94.7	159.6	93.6	163.0	92.5	166.3	91.5	170.1
96.6	157.9	95.5	161.0	94.4	164.4	93.3	167.7	92.3	171.5

Table C—FOR

This is a Table of Multipliers *for ascertaining the half lengths of Culverts on Table A, will give the proper lengths of level Culverts* on the skew, *accord given in corresponding columns in Table B. will convert the latter into the inclination,* on the skew, *according to the angle of skew. By the angle of line of Railway.*

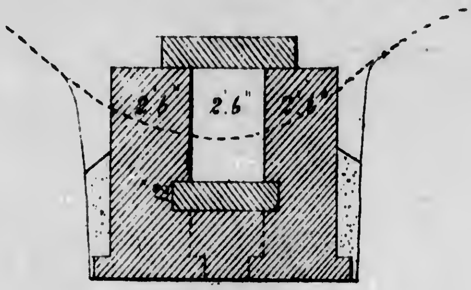
Angle of Skew.	Level. — Upper and lower half lengths alike.	2 per 100.		4 per 100.		6 per 100.		8 per 100.	
		Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
90°	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
87° 30′	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002
85°	1.004	1.004	1.004	1.004	1.005	1.004	1.005	1.004	1.005
82° 30′	1.009	1.010	1.010	1.010	1.010	1.009	1.009	1.009	1.009
80°	1.015	1.015	1.016	1.014	1.017	1.014	1 017	1.014	1.018
77° 30′	1.022	1.022	1.022	1.022	1.022	1.022	1.022	1.022	1.028
75°	1.035	1.034	1.037	1.033	1.038	1.031	1.039	1.032	1.041
72° 30′	1.047	1.049	1.049	1.050	1.050	1.047	1.051	1.044	1.055
70°	1.064	1.062	1.067	1.061	1.069	1.059	1.072	1.058	1.075
67° 30′	1.080	1.082	1.082	1.080	1.088	1.080	1.091	1.073	1.095
65°	1 103	1.101	1 107	1.097	1.112	1.094	1.116	1.093	1.120
62° 30′	1.127	1.125	1.130	1.119	1.138	1.118	1.142	1.120	1.150
60°	1.155	1.149	1.160	1.145	1.168	1.140	1.174	1.136	1.182
57° 30′	1.183	1.180	1.193	1.172	1.200	1.168	1.209	1.161	1.215
55°	1.221	1.213	1.230	1.206	1.240	1.198	1.249	1.193	1.259
52° 30′	1.260	1.250	1.270	1.242	1.282	1.232	1.292	1.228	1.304
50°	1.305	1.293	1.317	1.284	1.332	1.273	1.346	1.264	1.362
47° 30′	1.360	1.344	1.375	1.333	1.392	1.321	1.410	1.310	1.428
45°	1.414	1.398	1.433	1.383	1.456	1.368	1.477	1.355	1.501
42° 30′	1.480	1.460	1.505	1.444	1.531	1.425	1.555	1.409	1.588
40°	1.556	1.531	1.583	1.510	1.617	1.487	1.650	1.468	1.688
37° 30′	1.640	1.612	1.680	1.589	1.718	1.560	1.762	1.535	1.810
35°	1.743	1.709	1.788	1.676	1.839	1.644	1.892	1.616	1.950
32° 30′	1 855	1.812	1.916	1.782	1.975	1.742	2.046	1.706	2.120
30°	2.000	1.945	2.067	1.897	2.154	1.851	2.237	1.810	2.332

SKEW CULVERTS.

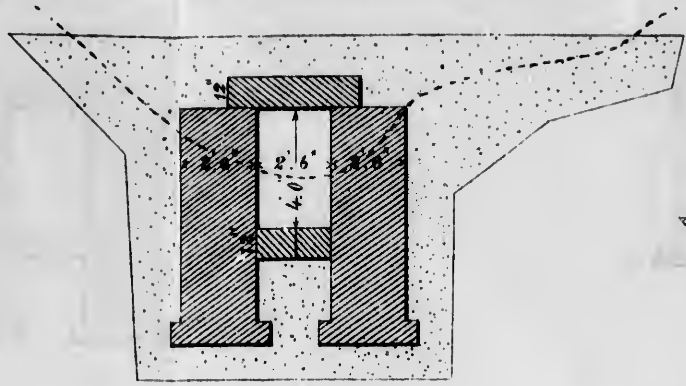
the skew: those found in the second column, multiplied into the lengths given in ing to the angle: those found in the other colmnns, multiplied into the lengths correct upper and lower half lengths, as the case may be, of Culverts with the same skew is meant the angle which the centre line of Culvert makes with the centre

10 per 100.		12 per 100.		14 per 100.		16 per 100.		18 per 100.		20 per 100.	
Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.
1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002
1.004	1.006	1.004	1.006	1.004	1.006	1.004	1.006	1.003	1.008	1.003	1.008
1.009	1.009	1.009	1.012	1.009	1.012	1.009	1.012	1.009	1.013	1.009	1.013
1.014	1.019	1.014	1.020	1.014	1.022	1.014	1.021	1.013	1.022	1.012	1.023
1.022	1.030	1.020	1.030	1.020	1.032	1.020	1.032	1.020	1.037	1.020	1.038
1.032	1.043	1.030	1.044	1.029	1.046	1.029	1.048	1.028	1.051	1.027	1.053
1.043	1.058	1.040	1.060	1.040	1.063	1.040	1.068	1.039	1.070	1.038	1.072
1.056	1.077	1.054	1.081	1.054	1.084	1.053	1.087	1.051	1.092	1.049	1.095
1.072	1.096	1.070	1.103	1.068	1.108	1.068	1.112	1.067	1.120	1.066	1.121
1.091	1.125	1.087	1.130	1.085	1.136	1.083	1.142	1.080	1.150	1.078	1.157
1.110	1.152	1.105	1.160	1.104	1.168	1.102	1.173	1.095	1.184	1.090	1.190
1.132	1.187	1.128	1.196	1.126	1.206	1.122	1.216	1.118	1.226	1.115	1.237
1.158	1.225	1.150	1.246	1.148	1.250	1.145	1.262	1.137	1.273	1.132	1.285
1.187	1.271	1.181	1.284	1.176	1.299	1.171	1.314	1.167	1.332	1.162	1.348
1.218	1.321	1.212	1.338	1.205	1.360	1.200	1.375	1.191	1.396	1.182	1.422
1.255	1.379	1.247	1.401	1.239	1.422	1.232	1.447	1.225	1.475	1.219	1.501
1.248	1.448	1.288	1.475	1.277	1.508	1.267	1.535	1.261	1.565	1.250	1.605
1.343	1.526	1.331	1.560	1.320	1.595	1.309	1.634	1.300	1.680	1.291	1.721
1.395	1.615	1.380	1.660	1.365	1.710	1.353	1.755	1.342	1.810	1.330	1.862
1.451	1.724	1.434	1.779	1.418	1.833	1.405	1.892	1.391	1.965	1.379	2.033
1.517	1.855	1.495	1.930	1.478	2.000	1.462	2.065	1.445	2.165	1.430	2.250
1.592	2.010	1.569	2.102	1.546	2.193	1.526	2.300	1.506	2.433	1.489	2.564
1.677	2.198	1.647	2.240	1.623	2.420	1.598	2.560	1.572	2.712	1.552	2.900
1.773	2.423	1.739	2.592	1.708	2.753	1.679	2.950	1.652	3.201	1.629	3.444

SECTION AB



SECTION THROUGH CONCRETE WALL, C. D.

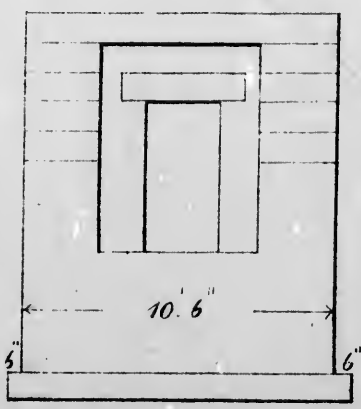


INTERCOLONIAL RAILWAY

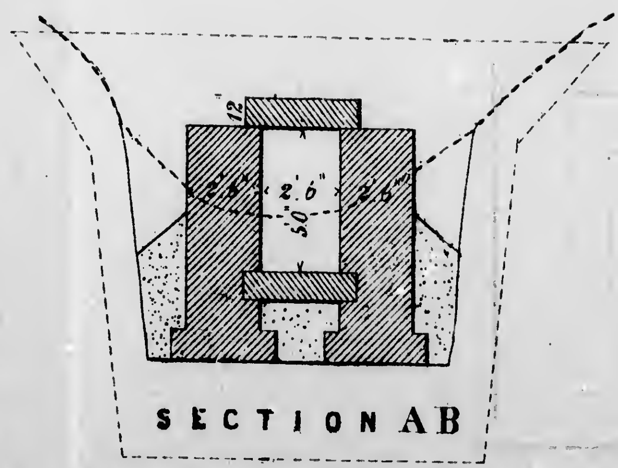
CULVERTS FOR SIDE HILL GROUND

Referred to in General Instructions No. 4.

Sandford Fleming
Chief Engineer

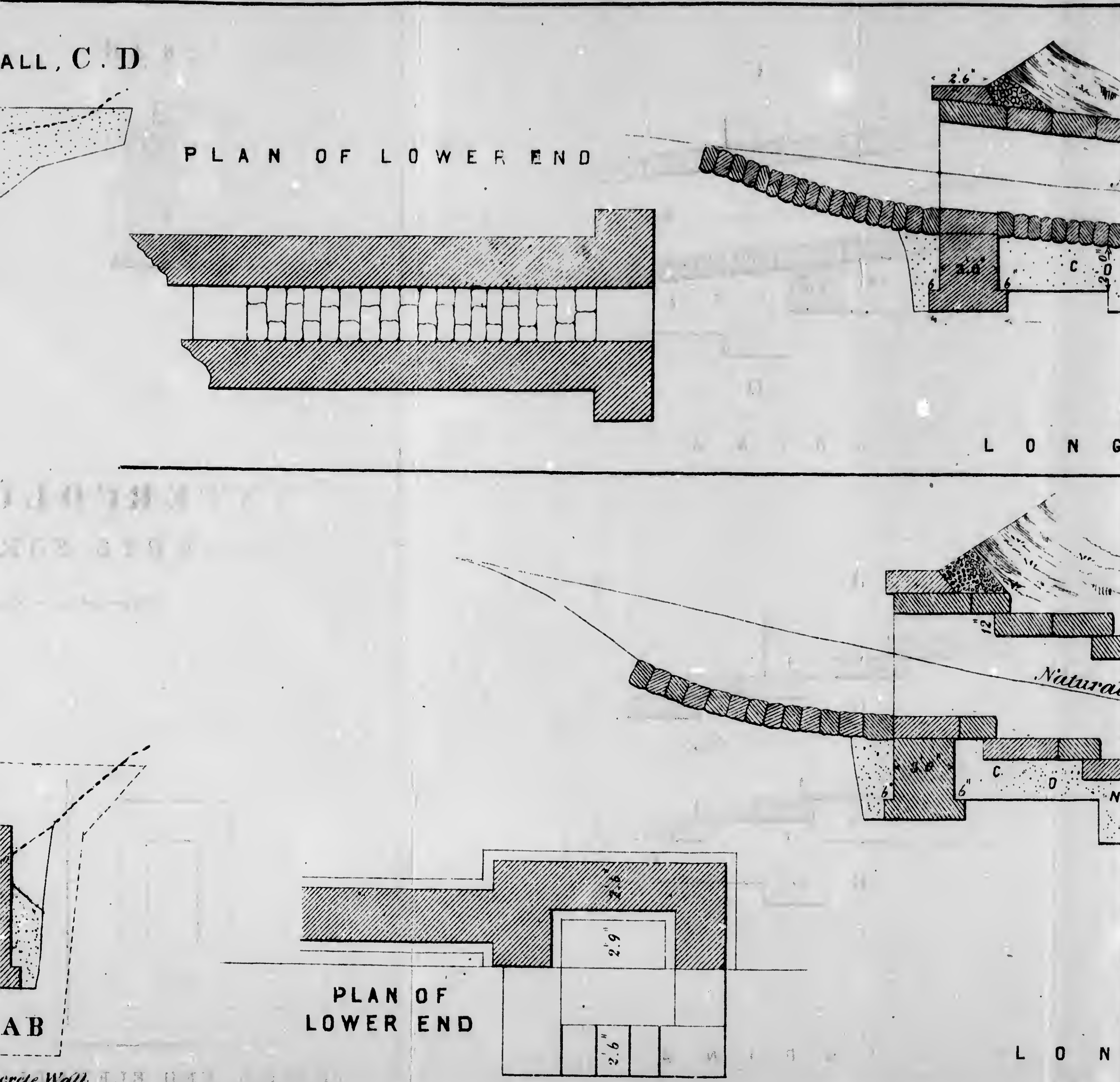


LOWER END ELEVATION

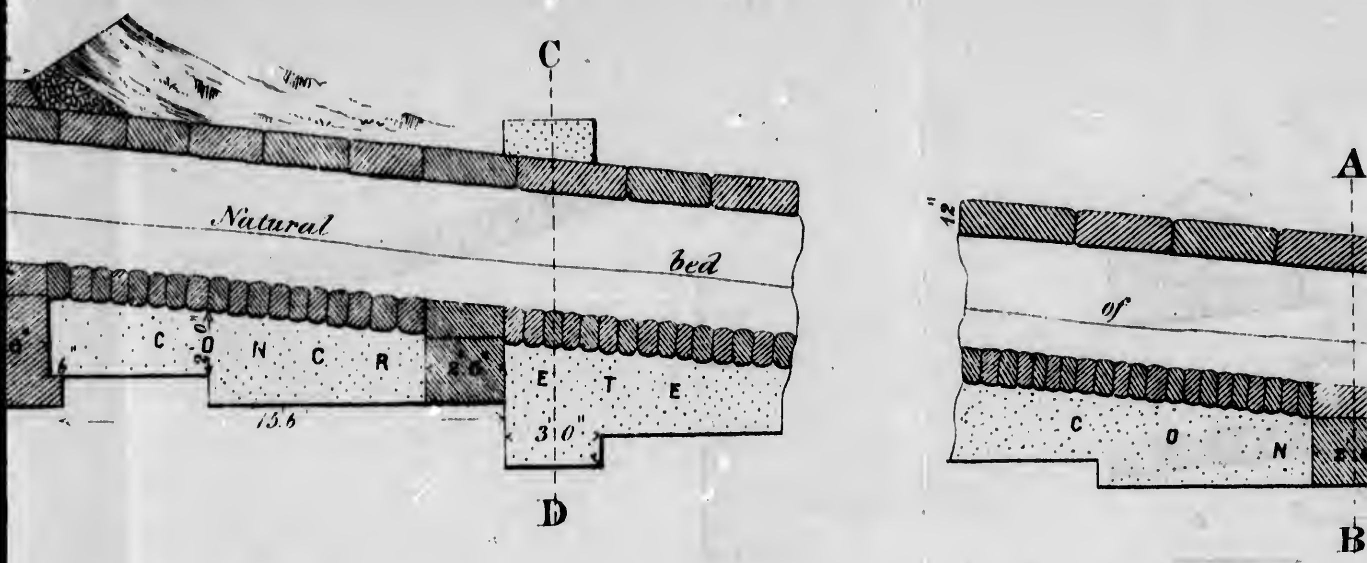


SECTION AB

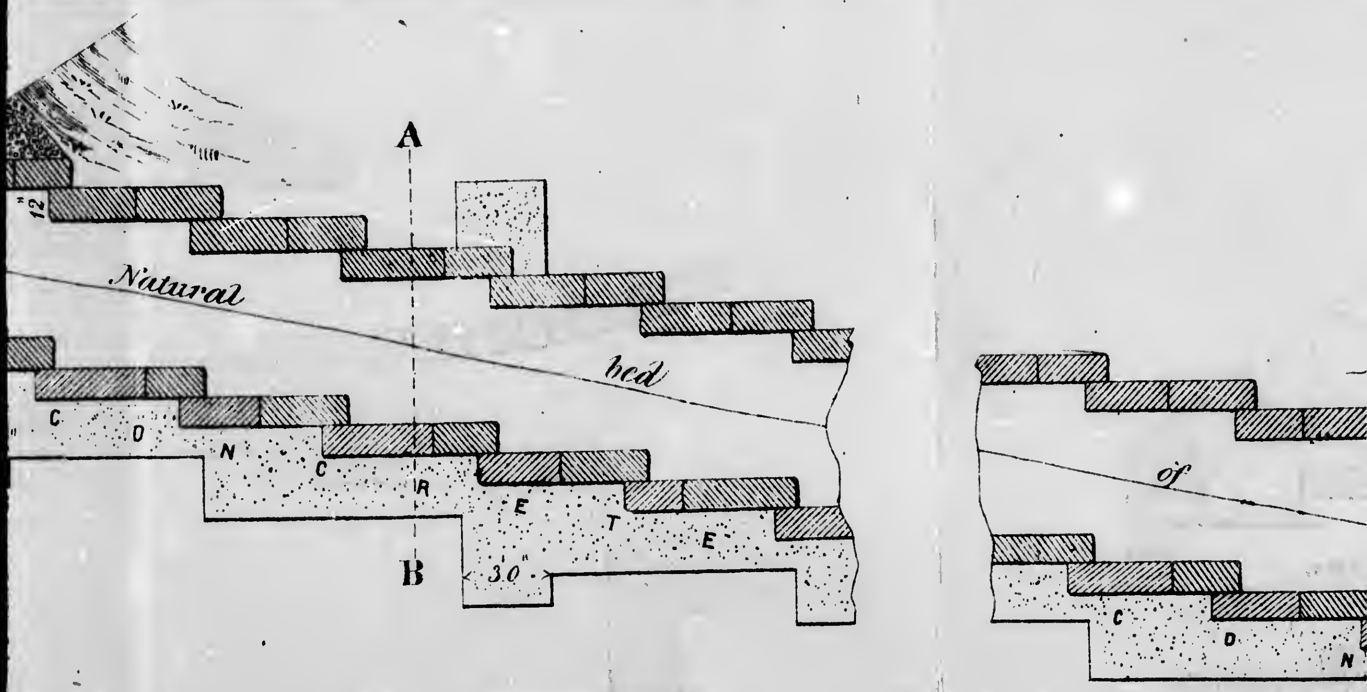
The dotted line shews Concrete Wall



Scale 8 feet to 1 inch

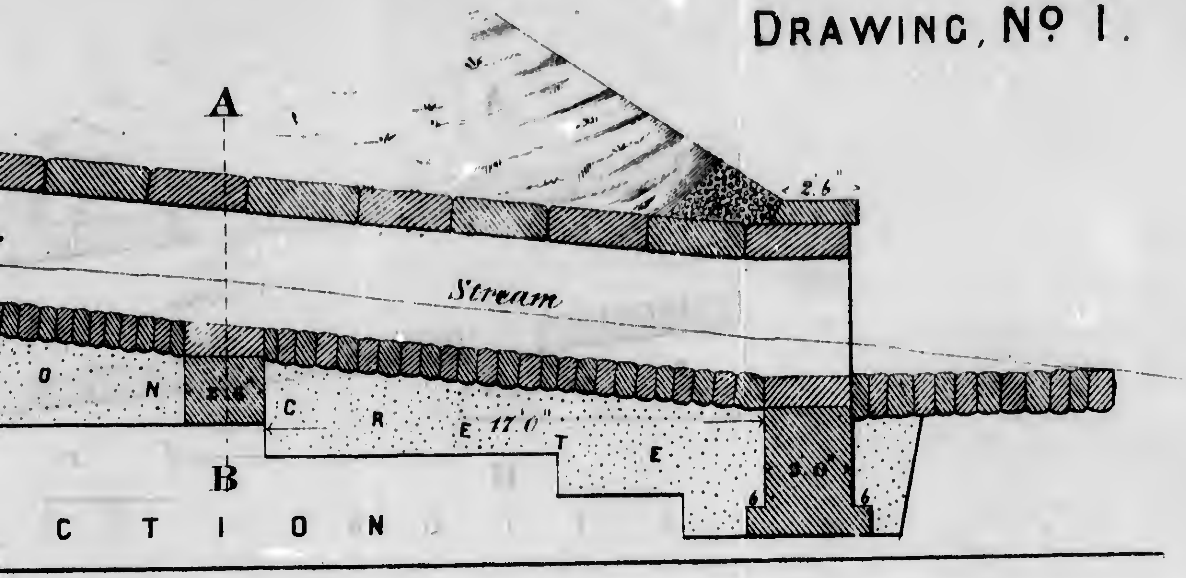


L O N G I T U D I N A L   S E C T I

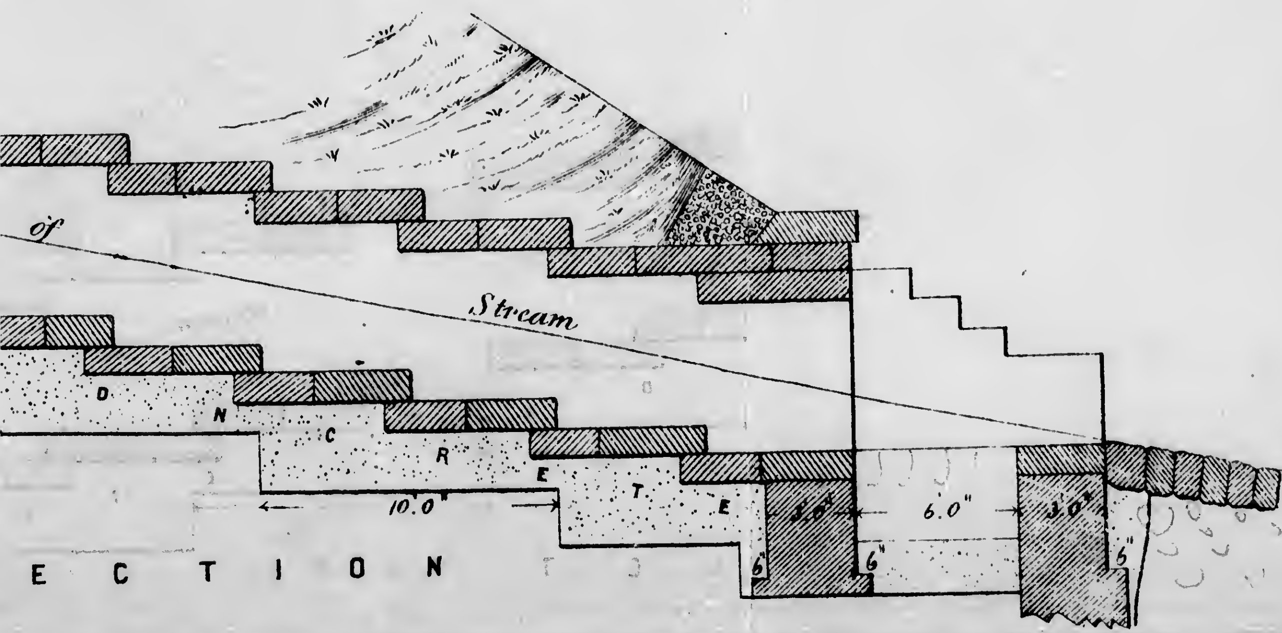


L O N G I T U D I N A L   S E C T

DRAWING, Nº 1.



DRAWING, Nº 2.



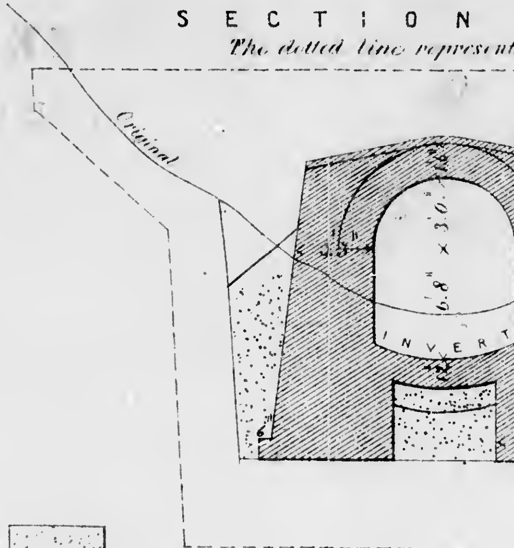
INTERCOLONIAL RAILWAY

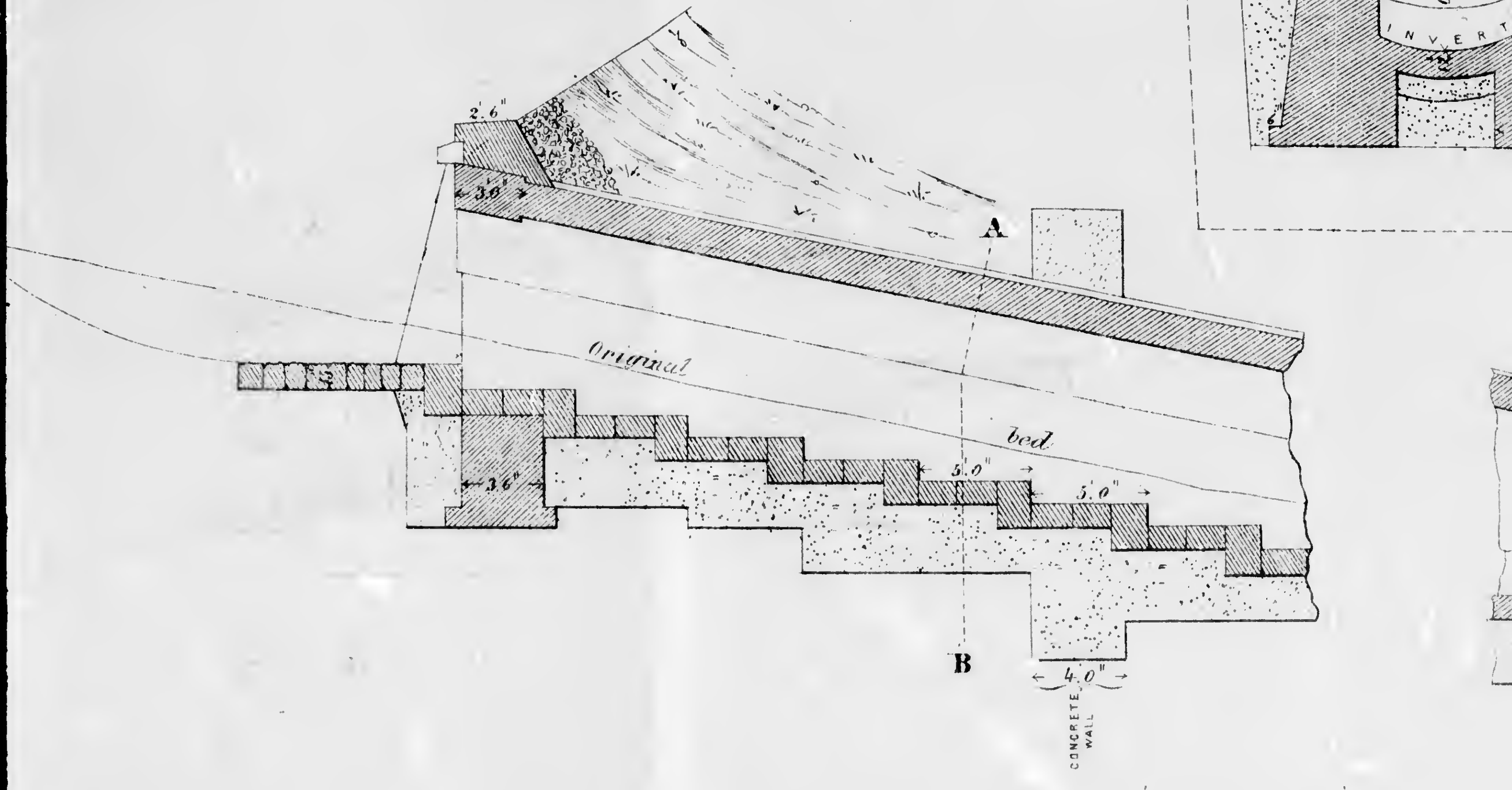
ARCH CULVERT ON SLOPING GROUND

Referred to in General Instructions No. 4.

Sandford Fleming
Chief Engineer

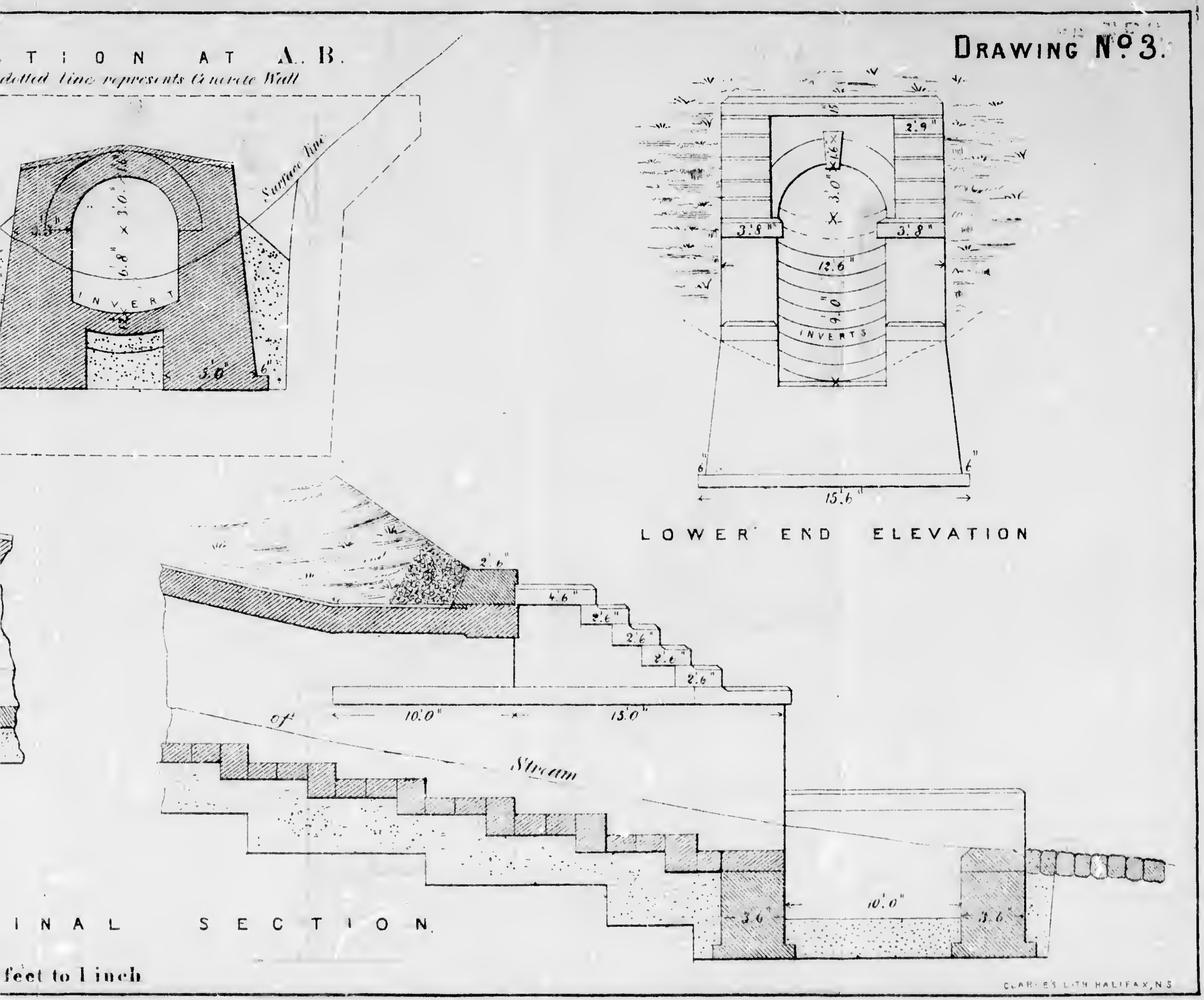
S E C T I O N
The dotted line represent.





L O N G I T U D I N A L

Scale 8 feet to 1 inch


DRAWING Nº 3.
TION AT A. B.
dotted line represents Concrete Wall
Surface line
3.3"
6.8" × 3.0" 1.6"
INVERT
5.0"
6"
2.9"
1.6"
3.0"
3.8"
3.8"
12.6"
9.0"
INVERTS
6"
6"
15.6"
LOWER END ELEVATION
2.6"
4.6"
2.6"
2.6"
2.6"
2.6"
10.0"
15.0"
of
Stream
10.0"
3.6"
3.6"
INAL SECTION.
feet to 1 inch
CLARKE'S LITH HALIFAX, N.S.