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THE following Report by Major Yorke, R.E., Board of Trade Inspector of Railways, upon the Extensions of the Line of Railway constructed by the West India Improvement Company, is published for general information.

By Command,

J, ALLWOOD,
Acting Colonial Secretary.

MAJOR YORKE'S REPORT.

Kingston, Jamaica,
May 27th, 1893.

SIR,

I have the honour to report for the information of His Excellency the Governor, that in accordance with the instructions contained in your letter of the 13th instant, I have carefully inspected the extensions of the Jamaica Railway, which have already been handed over by the West India Improvement Company, and also the further extension of the line so far as it has gone.

2. It will be convenient if I enumerate here the points named in your letter, on which His Excellency desired that I should report, viz. :—

(1.) Are the cuttings and embankments of the extensions between Porus and Appleton properly constructed to the width specified in the agreement forming Schedule A, of the Railway Law of 1889, and are the slopes of the same sufficient to ensure their stability ?

(2.) Are the curves and gradients in accordance with the agreement ?

(3.) Are the bridges, culverts, tunnels, retaining walls, fences, level crossings, occupation gates and drainage works, properly constructed and completed ?

(4.) Is the permanent way properly laid and sufficiently ballasted and maintained, and is the line in a condition to allow of trains running over it safely at the minimum speed prescribed by the Law of fifteen miles an hour ?

(5.) Do the Station buildings and platforms on the line afford adequate accommodation to passengers, and if not, in what respects do they fail ?

3. Dealing with these points seriatim, and confining my remarks for the present to the portion of the line between Porus and Appleton, I have the honour to report as follows :—

Cuttings and Embankments.

4. As regards the cuttings, they are now of the required width, viz., 18ft., but they have in most cases been left with vertical sides. Where they pass through rock or hard white marl, there can be no objection to the sides being vertical, but care should be taken that they do not overhang. But where, as is frequently the case, the cuttings pass through red marl, the question whether the sides may be left vertical, or whether they should be sloped back, and if so at what angle, depends upon the permanent stability of the soil. There appears to be some difference of opinion on this point, and arguments and facts are adduced in support of both slopes and vertical faces. There can be no doubt that in some places the red marl will stand for years with a vertical face, for there are cuttings on the road to Mandeville, the faces of which are as vertical now, as they were when first excavated years ago. It would therefore seem probable that the stability of the red marl varies in different localities, and I would suggest that it be left to the discretion of the Engineer of Way and Works to deal with the railway cuttings in the manner best suited to each individual case, sloping them back or leaving them vertical in accordance with the stability of the soil. In the meantime, I was unable to trace any signs of collapse in these cuttings, and I do not think that any danger is to be apprehended of slips taking place.

5. The drainage of the cuttings has not in all cases received the attention it deserves. Not only are drains sometimes omitted, but where they exist they are often blocked by heaps of ballast. The attention of the Engineer of Way and Works was called to this matter and he promised that it should be rectified without delay.

6. Though the majority of the embankments are now properly constructed of the full specified width, viz., 16 feet, at formation level, there are evidences in some cases of recent widening, and there still remain a few which, though apparently of full width, do not seem to comply in all strictness with the conditions laid down in Schedule A of the Railway Law of 1889. That Schedule says that the width at formation level of all embankments shall be not less than 16 feet, and I observed that in certain cases that width is only attained by the expedient of building up dwarf walls of dry rubble near the top edges of the side slopes, and that without these dwarf walls the width would be curtailed. Such an arrangement is, in my opinion, not in accordance with the meaning of Schedule A. To what extent, if any, the natural settlement of the embankments, stated by Rankine (Manual of Civil Engineering) to vary from 1-12th to 1-5th of the original height, and the action of the tropical rains, have contributed to the deficiency in the width of some of the embankments, it is, in my opinion, no longer possible to estimate with any degree of accuracy, nor does the matter appear to be one of great importance, except in so far as compliance with the specification is concerned. Although 16 ft. is the usual width adopted for embankments on single lines in England, it is not so all the world over. The width adopted on the Canadian Pacific Railway is only 14 ft. and any greater width than this is convenient rather than necessary. So far as I could judge, the embankments between Porus and Appleton are perfectly stable, and their stability would not be impaired if the dwarf walls referred to above were removed, though their width at formation level might be slightly reduced. In a few places the rails are not laid exactly in the centre of the cuttings and embankments. This is probably due to the slewing of the line during plate-laying operations, or in the ordinary course of maintenance, and under any circumstances, the fact is of small importance, so long as the divergence of the track from the centre line of the road bed is confined within moderate limits.

Curves and Gradients.

7. Several of the curves of the line (those selected being pointed out as the sharpest) were tested in my presence, in addition to those already checked by the Government Inspector of Railways, and it was found that they are practically in accordance with the condition in Schedule A. which lays down that no curve shall be of less radius than 330 feet. It is true that short lengths varying from 50 to 150 ft. were found in which the curvature was slightly in excess of that limit, but in these cases the average curvature of each complete curve conformed to the Law, and the increase of curvature in places, was probably due to the easing of the curves at their extremities, or to errors in plate-laying, or to those slight alterations which are constantly being introduced during the maintenance of the line. Slight changes of curvature are sure to occur after a line is opened for traffic, and there should be no difficulty in their being rectified if necessary by the permanent way gangs in the ordinary course of maintenance. I am of opinion therefore that the curves on the line have been properly laid out according to the Law, though this can only be ascertained with precision by a survey of the whole line.

8. Similarly with the gradients, there is no reason for assuming that they were not properly constructed in the first instance. The Law lays down that no gradient shall exceed 1 in 30 ($3\frac{1}{3}$ per cent.), but it is possible that, owing to the settlement of banks, or alterations in the level of the track during plate-laying or maintenance operations, some slight increase in the rate of inclination has been introduced over short lengths. For instance, near Comfort Hall Tunnel the gradient is 1 in 27.5 for a distance of 150 ft., but such isolated instances

prove nothing, and if it is considered necessary to check the general inclination of the whole line, a longitudinal section from end to end will have to be prepared. I understand from the Government Inspector that he proposes to have such a section made, when opportunity occurs.

Bridges.

9. There are no large bridges between Porus and Appleton, and only a few small ones of spans varying from 20 ft. to 8 ft. These are constructed of wrought iron girders on rolled I. joists, resting on concrete abutments. They are all standing well, are stiff under a load, shew little or no vibration, and appear to possess ample practical strength.

10. In the case of the Trinity Road bridge (near peg 135) which is situated on a curve, I noticed that the necessary super-elevation of the outer rail has been attained by giving an inclination to the top of the abutments, thereby raising one girder above the other, and causing both girders to tilt inwards towards the centre of the curve. This mode of construction is decidedly faulty. The webs of the girders are not vertical, and torsional stresses are set up, which the girders are not designed to withstand. The upper portion of this bridge should therefore be reconstructed without delay. The girders should be laid level transversely, and the necessary cant should be given to the rails by means of timbers resting on the girders, and not by the girders themselves.

11. The same remarks apply also to bridges at pegs Nos. 40 and 1207, but as the curvature of the track and therefore the super-elevation of the outer rail are less at those places, the tilting of the girders and the undue stresses consequent thereon are not so serious. It is very desirable that under-bridges should, as far as possible, be avoided in places of maximum curvature.

12. On all the under-bridges some simple method, such as iron straps or clips, is required for the purpose of securing the cross timbers to the girders, and more care is required in packing up the cross timbers, so as to give the rails a proper bearing upon the girders. At the bridge near Appleton (peg 1580) the packing pieces between the cross ties and girders are very insecure, and they are liable to be shaken out. Should this occur and one of the rails be thereby deprived of its proper support, a train might be thrown off the line.

13. It would also be an improvement, if on all bridges, but especially on those situated on curves, the rail joints were formed with angle fish-plates, so as to give increased lateral stiffness to the joints.

14. All the bridges are in need of scraping and painting.

Culverts, &c.

15. The culverts and drainage works are for the most part satisfactory, so far as construction goes, concrete being the material mostly used. As to the sufficiency of the waterway afforded by them, I am unable to express any opinion, depending as it does upon considerations which only intimate local knowledge can supply.

The public road on the northside of the Black River appears to be permanently under water for a short length close to the Railway level crossing. If this water is held up by the Railway embankments, it would seem necessary to build an additional culvert under the line close to the level crossing. There are two small open culverts, one on each side of Browns Town level crossing which require attention. At present they are liable to be choked with ballast, and rendered useless. I have already drawn attention (para. 5) to the necessity of improving the drainage of the cuttings.

Tunnels.

16. There are two tunnels between Appleton and Porus, viz.: Comfort Hall Tunnel, 243 yards long, and Balaclava Tunnel, 106 yards long. Both are cut through rock and white marl, the latter being apparently disintegrated rock. Comfort Hall Tunnel is unlined, and though it appears sound, there is a certain amount of scaling going on in the roof, principally at the east end, which seems to indicate the desirability of lining it, at any rate in places, if not throughout. I have no doubt that in England such a tunnel would not be allowed to remain unlined. In the meantime, the tunnel should be carefully watched, and a man should be stationed there in order to examine it before the passage of every train. It must not be imagined from this, that I regard the tunnel as dangerous, but there is a possibility of a fall of marl taking place from the roof of sufficient amount to cause a train to leave the rails.

17. Balaclava Tunnel is partly unlined, and partly lined with concrete, and seems to be in a satisfactory condition, though one cannot help regretting that the lining was not continued throughout its entire length. The sides of the cuttings at each end, and the faces of the rock above each entrance of this tunnel, require some cutting back at the top, as at present they overhang more than is desirable.

Retaining Walls.

18. The retaining walls call for no special remark. They are built of rubble masonry in Portland cement, and appear substantial and stable.

Fencing.

19. The fencing for the most part consists of 5 strands of wire (in some cases barbed) supported on wooden posts 12 ft. apart. Where stone is plentiful dry stone walls take the place of the wire fencing. The wires are in some places kept in position by angle-iron drop (or distance) pieces, which are suspended from, and attached to the wires midway between the posts, and I believe that this arrangement is to be provided along the whole line. There does not appear to be much to object to in this fence, considering the nature of the country through which the railway passes. But by the Law of 1889, it should equal in durability and stability the fencing on the old line. On the latter, I am informed the posts supporting the wires are 4½ ft. to 6 ft. apart, there being under such circumstances no drop pieces between the posts. I venture to suggest that the new fences constructed as described above may be regarded as sufficient to meet the requirements of the case, so long as it is erected in such a manner as to prevent sheep and cattle from getting under the wires straying upon the line. At the same time where the fence is on a curve, it may be desirable to erect a few more posts.

Level Crossings.

20. In some cases, e.g., at the level crossing over the parochial road to Devon, near 58th (railway) mile, at the public road level crossing near peg 846, and at level crossing near peg 960, the rails are rather too high above the level of the roads. At St. George's Church, at Comfort Hall, and at Williamsfield the crossings are in fair order. At level crossing near peg 960 the road of approach is too steep. In all cases of public or parochial road level crossings, I would recommend that guard

rails be fixed inside the main rails, and that the space between the rails should be planked. The planking might with advantage be extended some distance outside the rails on each side of the line, and at any rate the road metal should be kept at the proper height between the gates and the rails.

Gates.

21. The gates at the level crossings leave much to be desired in the matter of appearance and workmanship, and their unsightliness is enhanced by the slovenly manner in which they are hung, one half of a gate (where double) being often hung 1ft. or 1½ft. higher than the other half. Turnstiles have not been provided at the level crossings, but as the Company has received permission, under Clause 32, to keep the gates constantly open for the roads except when engines or trains are passing along the railway, turnstiles seem to be unnecessary.

22. The occupation gates provided at intervals along the line, are of the same type and appearance as those at the level crossings. Their appearance is not of so much importance, but they should in all cases be hung so as only to open outwards from the railway, the object being that when they are unlocked, cattle may not be able to open them by pressing against them. I noticed several of these gates standing open on each day of my inspection, from which it may be inferred that Clause 38 of the Railway Law is not very strictly enforced.

Permanent Way.

23. The Permanent Way consists of flat-bottomed (Vignoles) steel rails, weighing 60lbs to the yard, secured by 5 inch spikes to sleepers measuring 8″ x 8″ x 6″. The points are formed of fish plates of two different patterns, viz., Moss Bay steel bar fish plates, 25 inches long and weighing 21lbs. per pair, and angle steel plates, also 25 inches long, but weighing 32lbs per pair, the latter being chiefly used on the portion of the line between Green Vale and Balaclava Stations. The rails are notched on alternate sides 2 inches from the end, the notches being intended to receive the spikes nearest to the joints and so to prevent "creeping." Where angle fish plates are used, they are also notched in a similar manner to the rails.

24. In England it is customary with flat-bottomed rails to use fang bolts to secure the rails to the sleepers at each joint and at one or more intermediate places between the joints. This superior fastening is perhaps unnecessary on the Jamaica Railway, when the low rate of speed at which the trains travel is taken into account. Moreover the rails on all the curves on the line are supported on the outside by "knee braces" fixed to each alternate sleeper. These are very useful appliances, and in the absence of fang bolts, gauge ties and bearing plates are essential for the purpose of resisting the lateral pressure of the wheels on the rails, and from preventing the track from spreading. The disadvantage attached to them is, that they each require 3 spikes, which are somewhat liable to cause the sleepers to split.

25. Check rails are provided on nearly all the curves of the line, and they should invariably be used whenever the curvature exceeds 9°. The sleepers on curves are laid two feet apart from centre to centre, and on the tangents about 2′ 4″, and the number of sleepers thus provided affords sufficient bearing area between the rails and the sleepers and between the sleepers and the ballast.

26. There is an absence of uniformity in the manner in which the rails have been linked together. In some cases the joint between two rails rests upon a sleeper, forming what is known as a "supported joint" In other cases the joint occurs between two sleepers, forming a "suspended" joint. And sometimes the joint is partly supported and partly suspended. The provision of the notches already mentioned in the lower flanges of the rails makes it clear that the joints were intended to be supported, and as it is desirable to use any appliance in the manner for which it was designed, I recommend that all the joints with notched rails and bar fish plates should rest upon the sleepers. By observing this precaution the slight dimunition in the strength of the rails caused by the notches is neutralized. Where angle fish plates are used, it does not so much matter whether the joints are supported or suspended, as the extra strength of this type of plate more than counterbalances the effect of the notches. But uniformity of practice is desirable, and whichever form of joint, whether supported or suspended, is adopted for this pattern of fish plate, it should be adhered to.

The suggestions now made can easily be carried out by the maintenance gangs, who have merely to alter slightly the positions of the sleepers nearest to the joints. Doubtless the angle Fish plates make a stronger joint than the bar plates, but the latter are of the usual weight in proportion to the rails, and I consider them of sufficient strength, if used in the manner described. On bridges however, and especially on those on a curve the lateral stiffness afforded by the angle fish plates would be a decided advantage (see para. 13.)

27. The rail joints have not been placed opposite each other, as is usual on European railways, but have been allowed to overlap or break joint. A considerable saving of labour in cutting of rails, and of material has thereby been gained. I see no advantage in this method of construction, but on the contrary, I believe it to be an advantage on a line full of curves for the rails to break joint, as by this means the joint of one set of rails is supported laterally by the adjacent rail, and the curves are less liable to get out of shape.

28. The check rails referred to in paragraph 25, are of the same section as the main rails, and mostly fixed so that the space between the flanges of the two rails is 3 inches. This distance is somewhat greater than usual but taking into account the exceedingly sharp curves, and the length of the rigid wheel base of the engines, I am inclined to think that it is not greater than necessary on this Railway. Moreover this distance can hardly be avoided, unless the section of the guard rail is altered, for it is only just sufficient to permit of spikes being driven between the flanges of the two rails. But I found many places where the interval between the two rails is as much as 3½ inches and even 4 inches, and this is excessive. Steps should be taken to rectify this error, as the check rail becomes useless under such circumstances.

29. It must be admitted that the section of the check rail is not altogether satisfactory, as no sort of distance piece between it and the stock rail is or can well be provided. Barry recommends in his book on Railway appliances (p. 60) that the check rail for use with flat bottomed rails should consist of "a strong angle iron firmly bolted to the sleepers." But if the present pattern is adhered to (and

there are advantages in having one section of rail for all purposes) it would be a useful precaution if "knee braces" were used at moderate intervals to support the check rails.

Sleepers

30. The sleepers used on the line are of two kinds viz., Cypress wood, and creosoted pine—The former, which are practically confined to the first 20 miles of the extension, are of inferior quality, and have proved unsatisfactory so far as durability is concerned. A considerable number have decayed and have been or are being replaced by creosoted sleepers. Many more are shewing signs of decay and will have to be replaced ere long. These sleepers cannot be regarded as complying with the specification in Schedule A of the Railway Law, which lays down that "good and durable" sleepers are to be used. Much progress has, however, been made in replacing the cypress sleepers with creosoted ones, and so long as equal vigilance in removing and replacing the decayed sleepers is used in the future, no anxiety need be felt as to the safety of the line on account of the sleepers. It is satisfactory to know that in future creosoted sleepers alone will be used on the line.

Ballast.

31. The ballast consists of broken rock. It is excellent in quality, and is now ample in quantity, except in one or two places where owing to the sinking and subsequent lifting of the line some additional top ballast is required. A good deal of ballasting appears to have been recently carried out

Switches.

32. The switches and frogs, or as they are usually called in England, the points and crossings, are not altogether satisfactory. There are no distance pieces and studs between the switch rails and the stock rails, and slide chairs for the switch rails are either not provided at all, or are not provided in sufficient numbers. In many cases the switch rails either rest directly on the sleepers, or else on pieces of bar iron badly secured to the sleepers by single spikes, and frequently the switch rails have only one connecting rod between them, instead of two, as should be invariably the case.

33 The frogs are not well designed, being too short to obtain a good bearing on the sleepers. The distance pieces in them are for the most part broken, and though no danger need be apprehended, these fractures indicate too much movement and undue strains under a passing train. The guard rails opposite to the frogs are secured to the sleepers in a most haphazard fashion, and at distances varying from 1¼ to 2½ inches from the stock rail. No proper distance pieces have been provided between the guard and stock rails, the consequence being that in some places they are entirely absent, while in others they have been improvised out of bits of gas pipe. The bolts and nuts used with the guard rails are frequently of various shapes, lengths, and sizes.

34. These defects in the switches. etc., are most apparent at the east end of Porus Station, at the east and west ends of Williamsfield and Balaclava Stations. I pointed them out on the ground to the Engineer of Way and Works, and I would urge that early steps be taken to remedy them. At the west end of Kendal the points for the loop are situated on a sharpe curve at the foot of a gradient, and it would be desirable if possible, to place these points in a better position. In the absence of facing point bolts, which are obligatory on English Railways, the speed of all trains when passing over the points in the facing direction at the entrance to Stations should not exceed 8 miles an hour.

35. I did not detect any broken spring, washers nor nuts of irregular size, except at the loop switches referred to above) nor wide rail joints, (except on sidings where they are of little consequence, and with the exception of the defects pointed out in paragraph 32 and 33, I consider that the permanent way is at present well laid, maintained, and ballasted, and in such a condition as to allow of trains running safely over it at a speed of 15 miles an hour, except at the facing points close to the stations, where the speed should not exceed 8 miles an hour.

Stations.

36. The arrangement of the new Stations is somewhat unusual according to English ideas, inasmuch as the station buildings form a sort of island between the line and the sidings or loop. The rolling stock is of American type, and the platforms are therefore raised only a few inches off the ground, so that no large amount of inconvenience is experienced by having a line of rails between the road of approach and the station, but should English rolling stock be used upon the line, high platforms will become necessary, and the stations will require remodelling. The (so-called) platforms, at present provided, are of concrete, and are raised about 4 inches above the rails. This is all that is necessary with the American cars, and in fact, I think that high platforms would be a mistake. There is a want of uniformity in the lengths of the raised surfaces, and it seems desirable that some standard should be adopted. At important stations the platform should be equal in length to the longest train, but at roadside stations half this length would be sufficient, that is to say, assuming the regular trains to consist of two American cars, each 60 ft. long a platform 60 ft. long would be sufficient at small stations, and the trains should always be drawn up, so that the two center gangways of each train are opposite the platform. The surface of the platforms need not be concreted for the whole length. It is doubtless convenient to concrete the portions nearest the booking offices, but the extremities of the platforms might consist of gravel or ballast, held up by a dwarf wall.

37. The adequacy of the accommodation for passengers at each station depends so entirely on the amount of traffic to be expected, that I have some hesitation in expressing any opinion on it. But so far as I could judge all the stations, with the exception of Porus, appear to afford sufficient accommodation. At Porus, no new station buildings have been erected, although the old station has been abandoned in consequence of a diversion of the line, and the only accommodation provided as booking and waiting room is the corner of a goods shed. I think some improvement is needed here.

38. At Balaclava and Williamsfield Stations safety switches have been provided between the sidings and the main line, in consequence of the gradient. But at the former place the safety switch is too far, and in the latter case too near to the main line. Both switches should be moved, each of them being placed in that position in siding where the two tracks are six feet apart. Similar safety switches should in my opinion be provided on al sidings or at least on those which are on a steeper gradient than 1 in 260.

39. At Appleton my attention was called to two pairs of switches, one on the north side of the Stasion giving access to the Y for turning the Engine, and one on the South, leading to a goods siding. Neither of these pairs of switches are conveniently placed, but I am unable to regard them as a source of danger.

40. I venture to make the suggestion that all Stations where Passenger Trains may have to pass each other, the loop lines should be regarded and maintained as main lines and not as sidings, I draw attention to this, because it appeared to me during the course of my inspection, that this is hardly the case at present, but I may have been mistaken.

Appleton to end of Track.

41. It is my duty now to refer briefly to the Section from Appleton to the end of the track. The permanent way is similar to that already described, bar fish plates and creosoted sleepers being used. It is well laid and sufficiently ballasted, except across Union Plain, where owing to the swampy nature of the soil, the line has required constant lifting, and some additional top ballast is now required.

42. There are three fine bridges over the Black River, two of them having spans of 102 ft. and one of 87ft. They are of American design, and appear to possess ample strength and rigidity. They require scraping and painting.

43. After leaving the Black River Valley, the line ascends into the Cockpit country, where the difficulties of location and construction are great, and considerable skill in overcoming these difficulties has been required. The works throughout this section have every appearance of stability and strength, but these elements depend upon the nature of the foundations and the mode of construction adopted, as to which no inspection is now possible. It will be an advantage if the dry rubble retaining walls are finished off with a coping of masonry set in cement, and if the retaining walls are built up to at least the level of the top of the sleepers, the whole space between the rails and walls being filled with ballast up to the same level.

44. The curves are provided with check rails, and it is the intention, I am informed, of the West India Improvement Company to fix check rails on the tangents as well as on the curves on those portions of this section of the line which are carried upon high retaining walls or viaducts. This arrangement will form a very valuable additional precaution against the risk of accident.

45. This section of the line is, so far as the permanent way is concerned, in quite as good a condition as that from Porus to Appleton, and in the matter of sleepers its condition is even better, and therefore under ordinary circumstances, I consider that a speed of 15 miles an hour might be safely maintained over it. But having regard to the precipitous nature of the country and the disastrous result that might attend the derailment of a train, it will be prudent to limit the speed of trains through the Cockpit country to 12 miles an hour. This suggestion must not be regarded as implying any distrust of the stability of the works or permanent way. Trains are sometimes derailed through the breaking of an axle, or by some other cause entirely unconnected with the permanent way, and it is very desirable to leave no precaution neglected, which might minimise the effect of such an accident. I therefore would suggest that as far as the section of railway through the Cockpit Country is concerned, the clauses in the Law fixing the minimum speed at 15 miles an hour be not enforced, but rather that the Company be urged to limit the speed therein to 12 miles an hour.

46. In conclusion, I would remark that although the Railway does not come up to the standard laid down by the Board of Trade for English lines, it is generally speaking in a satisfactory condition, and suitable for a low rate of speed and moderate amount of traffic. It has been my duty to draw attention to certain defects, but these can nearly all be rectified without any difficulty, and with a small amount of expenditure.

47. My thanks are due to Mr. L. F. MacKinnon, General Manager of the Railway, for the facilities he cordially afford to me for getting over the line, and also to the following gentlemen, viz., Mr. V. G. Bell, Director of Public Works, Mr. P. A. Fraser, Surveyor General and Inspector of Railways, Mr. F. Hovil, Engineer of Way and Works, Mr. E. P. Nash, Assistant to the Government Inspector, and Mr. Elliot of the West India Improvement Company, for the valuable and willing assistance rendered to me during my inspection.

I have the honour to be,

Sir,

Your Obedient Servant

H. A. YORK, Major R.E.

Inspecting Officer of Railways, Board of Trade