

Construction of the Experimental line to Raneegunge

"Skill in engineering work implies the successful adaptation of the art of construction to varying circumstances."-- Lord Lawrence in his minutes on construction of Railroads in India

Construction of the experimental line started with a zeal and passion, unprecedented in history of India; the rush, the frenzy, and the enthusiasm to overcome the challenges, which the terrain of Bengal and nature never failed to provide in plenty, was simply astonishing.

It was truly an experimental line, an experiment intended to prove, whether the natives would avail themselves of the improved means of locomotion afforded by a Railway; whether in actual practice there were any serious obstacles to the construction of a Railroad in India; and *whether its financial results would be such as to justify the Government in granting a guarantee to further extensions.* — Edward Davidson (1868). *The Railways of India: With an Account of Their Rise, Progress, and Construction*

The contract for the experimental line from Calcutta to Raneegunge was signed in August, 1849. Mr. George Turnbull, the Chief Engineer of the Railway company, reached Calcutta in May, 1850; and immediately embarked on the survey of the entire Howrah - Raneegunge section in oppressive heat of May and June by riding and in palkees, to determine the best route, finding that *Probably there never was a country with people so rich and intelligent, in which roads were so few & travel so difficult.*

George Turnbull, chief engineer of East Indian Railway, reported various difficulties faced during construction of Railways:

" Besides the magnitude of the works, the construction of a Railway was a novelty in India and a practical knowledge of the country, the people, and their language had to be acquired. The native had to be trained to accomplish tasks entirely foreign to anything he had seen or heard of before and the wonderful adaptability which enabled him to carry out, under European guidance, the construction of a railroad was in itself an indication that he would afterwards be able to take charge of its stations and goods sheds, maintain its permanent way and buildings, construct its engines and rolling stock, work its telegraph and carry out, often under the most trying circumstances and contending against all manner of difficulties, every kind of duty that would be likely to be required of him."-- The History of the East Indian Railway by George Huddleston. Published 1906 by Tracker, Spins and Co

The visionary focus on training was truly remarkable and it outlined the need for training Indians for maintenance & operation of Railways and for manufacturing of Engines & Rolling stocks in future.

The expenditure of £1,000,000 (Rs One Crore) was sanctioned for the first section, viz., from Howrah, opposite Calcutta, to Raneegunge, via Pandooah and Burdwan.

The question of the construction of a double or single line of Railway was dealt with by Mr. Simms, the consulting engineer, in a very pragmatic manner; for the Court of Directors, while sanctioning a capital of one million only, had expressed an opinion that *"it would be unwise to make the experiment upon a single line."*

Mr. Simms did not agree with this. He made some calculation regarding the probable cost of constructing Railroads in India, and came to the following conclusions:—

That a double line would cost £10,237 per mile, while a single line would cost £ 6,673 per mile And, that as the money available for the construction of the experimental Railway was £ 950,000/., that sum would allow of the construction of 92 miles of double line or 142 miles of single line. Consequently, if a double line were made, the Railway would fall about twenty-three miles short of the proposed terminus in the coal-field ; and as such a plan would not be accepted.

He recommended the experimental line to be constructed with embankments and brickwork for a double line, but carrying only a single line of rails. This method of construction seemed to him applicable not only to the Railroad between Calcutta and Raneegunge, but also to all proposed extensions in India, and this advice has in practice been acted on.

Acquisition of land, that too in such a massive scale, running across villages, towns and regions, disrupting innumerable rural and urban settlements, upsetting their ways of life forever, was unprecedented. Considering the enormous difficulties faced in acquisition and lack of clear ownership records, it was decided that land would be acquired by Government and would be handed over free of cost to EIR. Company took possession of its first tract of land from valuation commissioner in January 1851.

Government paid 40 Rs per Bigha, at the rate of 2 Rs per Bigha for twenty years, in case of permanent settlement ; and 20 Rs per Bigha ,at the rate of 2 Rs per Bigha for 10 years, in case of temporary settlement. - *Land Acquisition for the Railways in Bengal, 1850–62: Probing a Contemporary Problem- Smritikumar Sarkar*

For a little over 1,633 bighas of land under permanent occupation, the total payment amounted to only Rs 65,320.50. The government did not distinguish between different types of land, their location or uses, as it made separate payment for the superstructure—houses, huts, walls, ponds or tanks and ghats. The government repeatedly urged upon the people to make a little sacrifice for a good cause. The Court of Directors was under the impression that in view of the immense benefits to be derived from the Railways passing through their localities; landowners would hand over their property on ‘moderate terms’.-Report by Charles Lushington, Selections from the Records of the Bengal Government, No. IV, Appendix M, p. xxviii

The construction of the first phase of the EIR line, 41 miles between Howrah and Pundooa, had dislocated about 2,639 houses. Out of these, only 97 were brick-built houses, including European dwellings at Howrah and those in the Shrirampur–Seoraphuli–Baidyabati route. *The natives, however, were ejected from their holdings in rather summary fashion, without any prospect of immediate compensation, till the ownership of land was established.* On the whole, the average cost of the properties taken over amounted to Rs 8,493 per mile, a paltry sum by any measure.

Besides an interval of 28 miles between Howrah and Pandooah, which was in the hands of the contractors, the Court of Directors had sanctioned the construction of the line from Pandooah to the Raneegunge Collieries -- a distance of 81¼ miles — and throughout this extent had been selected and marked out on the ground, and the land surveys of nearly 31 miles were complete”

In order to expedite construction activities, EIR decided to outsource the work, first time in country; and the line to Raneegunge was allotted to five separate contractors:

Messrs. Hunt, Bray, and Elmsley 26 miles Howrah to Hooghly.
Messrs. Burn and Co.	10 miles Hooghly to Pundooah.
Messrs. Remfrey (first let to Mr. Daniel, of Calcutta)	.
	5 miles Pundooah to Bainchee.

Mr- Damel	11miles Bainchee to Mundeepoohur.
Mr. Ryan	10 miles Mymaree.
Messrs. Burn and Co	22 miles to Burdwan.
Messrs. Bray and Emsley	36 miles Coolool to Raneegunge.

EIR had initially wanted to hire the British contractors, who had the prior experience in constructing Railways in UK. Offer of one such contractor, Mr. Jackson, was forwarded to Board of directors by Mr. Turnbull and Stephenson, but Board in its wisdom, did not approve the offer, suspecting huge profit margin and instead, advised to outsource the work to local firms headed by domiciled Europeans.

Directors of the Railway company, or rather their Managing Director, Mr. Macdonald Stephenson, had made in London great efforts to induce some of the great contractors of England to undertake the construction of Indian Railways ; but, excepting a Mr. Jackson, all held back ; thinking, apparently, that the profits to be obtained on contracts so strictly supervised by Government as those for Railways in India, would not be sufficiently large to warrant their entering upon the business. Mr. Jackson of London, in August, 1849, sent in a tender, however, for the first 70 miles out of Calcutta, at a rate between £8000/. and £9000/. Per mile ; agreeing to the condition that the distance should be opened for traffic within three years from the date of acceptance of the tender. Mr. Jackson's proposal was favourably received, and recommended by the Direc-

tors of the East Indian Railway Company; but after a consideration of three months by the Honourable Court, and the Board of Control, it was rejected without any reason being alleged for its being declined.

If Mr. Jackson's tender was unobjectionable in other respects, as it is understood to have been; the rate, instead of deterring the home authorities from accepting it, should have had an exactly opposite tendency: for £8000/. Per mile, for a completed line, is more moderate than the cost at which any Railway in India has been finished.

But, it was erroneously assumed, that Railways could be constructed in India for about £5000/. a-mile, and a great opportunity to deploy experienced contractors was missed.

The contracts in India were made, however, somewhat hastily, and on imperfect information, and though they were entered into with the sanction of the Government of India, yet the contracts did not receive their cordial approval. It was known to Colonel Baker, the Consulting Engineer to the Government, that the men who tendered had, in some instances, little capital; that the time stipulated was too short for the work to be completed ;he expected that there would be a partial failure, as proven subsequently.

Still, as the Managing Director, Mr. Stephenson, wished to give the contract system, as obtainable in India, a trial ; as the tenders were in themselves fair, and as the men said they had capital, and were anxious to proceed with their work, their offers were accepted. Excepting, however, Messrs. Hunt, Bray, and Elmsley, of London, Messrs. Burn and Co., of Calcutta, and Messrs. Norris and Co. subsequently, all failed to carry out their agreements; and one by one the lengths had to be taken out of their hands, and the works completed by the engineers of the railway company themselves.

Turnbull would closely monitor their progress and take monthly stock of bricks in hand with each contractor. In his report to the agent, he states that *Messrs. Burn and Hunt will in all probability finish their contracts by the end of 1853 ; that Mr. Ryan may possibly do so, but that Mr. Daniel certainly will not. Mr. Ryan, however , is reported as completely misunderstanding his position as a contractor, and as quite ignoring all orders and instructions given by the engineers of the Railway company.*

In consequence of this report, Mr. Daniel's contract was taken out of his hands, with the sanction of the Governor-General. Some small quantity of work was done by a firm which appears to have been Mr. Daniel's security — or rather Mr. Jackson's, Mr. Daniel's senior partner— but who was allowed to withdraw from the contract at an early stage; but the arrangement evidently proved unsatisfactory, for in October, 1853, Lord Dalhousie sanctioned the completion of that portion of the line by the Railway company under the supervision of their own Resident Engineer.

In one of the monthly report , he eloquently states that though the Company is not compelled to build magnificent viaducts over pathways “crossed by a single milkmaid once a year, as was done in Britain, ”*but we have still to contend with an alluvial soil, with a country pierced in every direction by creeks, ponds, and rivulets, and a deficiency of labour, particularly in the building department, which is said to have given some of the native sub-contractors an excuse for enlisting into their service, workmen who would be more in their places in the stable, than handling trowel and plumb-line.”*

How prophetic were his words, even now, 168 years later, we find untrained farm hand trying their skills in laying and maintenance of tracks, for want of trained and certified workers hired by contractors.

Still, notwithstanding these failures, 95 miles out of the 121 from Calcutta to Raneegunge were executed by contract, but the contracts included only excavation, earth work, masonry, ballast, and laying the rails. Messrs. Hunt, Bray, and Elmsley were able to complete their work earlier than the target and earned much appreciation for their professional conduct and quality of work.

The iron-work of the bridges was ordered by the Railway Company in England, was imported by them, and was erected under the supervision of their own engineers.

The embankments on this length were made with very flat slopes to resist the action of the floods, from which much danger was apprehended. A slope, of 5 to 1, was initially kept, and in a great portion of the length, this form was maintained. As there were no cuttings in the alluvial plains of the Ganges, all the earth needed for the banks had to be excavated from pits near the toe of the slope.

The section at first prepared required no less than thirty-four acres of land per mile ; but this section was subsequently modified at Colonel Kennedy's suggestion, so as to require 11.5 acres per mile for permanent occupation.

The average height of the banks in the delta of the Ganges was 6 feet, and the width of the embankment was 33 feet at top. The gradient was unexceptionably good throughout the 121 miles, and there was a slight descent from the coal-pits to Calcutta, which proved to be a decided advantage for peculiar nature of a mineral traffic in loaded direction.

The earthworks were exposed for two rainy seasons, before the ballasting was laid, to ensure stability of embankment and to preclude possibilities of accident from slipping of bank.

--Railways in Bengal; --By William Patrick Andrew

The gigantic amount of earthwork, more than 289 millions cubic feet of earth (258 millions of cubic feet of earthwork in bank, 7 millions of cubic feet of excavation in tanks, and 24 millions of cubic feet in foundation) at a total cost of 11,68,000 Rupees, had to be removed while constructing 121 miles of Rail lines between Howrah and Raneegunge.

The ballasting in those days consisted chiefly of burnt clay, laid on the top of the earthworks to the depth of about two feet, in which the wood or iron sleepers would be imbedded. The gross amount of this work, which was more expensive than the actual embankment, was about twenty-one and a quarter millions of cubic feet, at an aggregate cost of thirteen lakhs and seventy-five thousand Rupees.- --Railways in Bengal; --By William Patrick Andrew

EIR, in a pioneering move, introduced the concept of maintenance of line in construction contract and stipulated that line should be maintained for twelve months after completion, to keep a check over construction quality.

Bridges & Via ducts:

The country traversed by the Railroad being very low and subject to floods and inundation, a very large number of flood arches were provided. River Damoodah, The sorrow of Bengal, used to burst its banks nearly annually, and embankments on the right of the river were removed to control the bursting of banks and flash floods.

“Although the absurd restrictions in force in England have not been so peremptorily insisted upon in Bengal, the number of bridges and waterways appear sufficient to meet any possible contingency, and is perhaps a little in excess of the actual acquirements of the line.

There were about 212 culverts of dimensions not exceeding 12 feet, and many of course much smaller, in the first 26 miles from Calcutta ; and no less than 360 in the next 16 miles, many of the openings being as much as 15 feet each. In the Raneegunge district, 36 miles in length, there were 175 culverts varying from 12 feet in span downwards. In the Burdwan division of 43 miles in length, flood arches were provided in great numbers, but the reports on record are silent regarding them.

There were five large bridges in the 121 miles, over the Bailee Khal, the Sursuttee, the Mugra, and Bankah;

The bridge over the Mugra Khali, which was nearly the first, if not the first, iron bridge erected by a Railway company in India, consisted of three spans of four Warren's girders. There were two girders for each line, and in 1858, one set of girders rested on wooden and the other on brick piers. The length of the girders was 85 feet, and their depth was 6 ft. 3 in. The area of the cast-iron plates in top at centre of the span was 62-25 square inches, but the dimensions of the plates diminishing

from the centre of the span to the piers, the area of the cast-iron plates was there 52X19 square inches.

Girders were tested with a load of 58 tons, the deflection in motion was $\frac{9}{16}$ th of an inch, and when stationary, $\frac{1}{2}$ inch. The weight of the platform on one span was 15 tons. All the bridges proved to be quite sturdy and except for rattling sound & good deal of supervision, have borne a constant and very heavy mineral traffic.

Chief engineer Turnbull had wanted to construct wooden bridges in EIR for their cheapness; ease of construction like American Railroads, but consulting engineer Mr. Simms did not recommend the use of wood due to rapid rotting and advised to use Iron Bridge.

Some of the bridges, however, were in the first instance, constructed of wood for the purpose of hastening the opening of the line; but by the end of 1859, all the wooden structures had been replaced either by girders or brick arching.

Altogether between Howrah and Raneegunge, there were 1029 yards of bridging and 6690 yards of culverts and flood openings.

Mr. Turnbull, on 6th Aug 1850, submitted plan for box girder bridge, with three 80 feet spans, to cross the Bailee Khal, but consulting engineer Kendell advised him to use, recently patented, still to be proven for large scale Rail road application, Warren truss design instead; an example of using the latest technique in Rail road construction. -- History of Technology, Volume 11, edited by Norman Smith

Major J. P. Kennedy. Consulting Engineer to the Government of India, introduced the system of monthly reporting of the progress, ubiquitous MCDO, we find in all the Railway offices.

"I am persuaded that the most effectual mode of ensuring an efficient and economical application of funds in the construction of engineering operations is that of bringing under the frequent periodical revision of the controlling authority an abstract view of the total expenditure incurred, together with the corresponding progress effected in the work, and the consideration of all matters affecting its interests.

I am anxious therefore at once to establish this principle at monthly intervals, and accordingly I beg now to offer the first Monthly Progress Report of the operations under the East Indian Railway Company, consisting of an abstract of the outlay from the commencement, as furnished by the Accountant's Department, and an abstract of the work effected, as furnished by the Engineering Department, showing the whole of the expenditure and the corresponding work done from the commencement".

- Selections from the records of the Government of India(Home Department),-report on the proposed Railways in Bengal - Calcutta Carbery, Military Orphan Press 1853

First Railway Engineer of India:

If any pioneer of Railway construction deserves a memorial to his name, If one person, who can be credited with laying of Rail lines in India against all odds, and personally led the construction work from the front, he was George Turnbull , the Chief Engineer responsible for construction from 1851 to 1863 of the first Railway line from Calcutta (the then commercial capital of India): the 541-mile line to Benares en route to Delhi. He was rightly acclaimed in the Indian Government's Official Gazette of 7 February 1863 paragraph 5 as the "First Railway engineer of India".

One illustration, a trifling one compared with the unlooked for obstacles which confronted him during the mutiny, will suffice to show this. In England, the hostility to a Railway invading the rights of landowners is smoothed away by Act of Parliament. It was far otherwise in India in Mr. Turnbull's time, and as Government shrank from the necessary action the Engineer had to settle matters himself. In a particular instance Mr. Turnbull on his own authority cut a lane, 100 feet wide, through jungle and other impediments from Howrah up to Chandernagore and braved the consequences. As it happened, no litigious results followed, but the Chief Engineer was warned not to do the like any more.

Mr. John Marshman, the editor of "The Friend of India," and Mr. Turnbull's personal friend, on hearing of this exclaimed, "Well! there has not been such an act of audacity performed in these parts since the time Admiral Watson opened fire

upon the Dutch fleet in the Hooghly when we were at peace with Holland." .”-- **The History of the East Indian Railway by George Huddleston**

Mr. Turnbull received, a well deserved eulogy from Lord Elgin, for his outstanding contribution: *“His Excellency the Viceroy will not fail to bring to the favourable notice of Her Majesty's Government, the long and excellent services of Mr. Turnbull, who, having been the first Railway engineer employed in India, has now happily seen the portion of this great work on which he was more particularly engaged brought to a close after many years of arduous and persevering labour, under circumstances of unusual difficulty, with the most complete satisfaction to his employers and to the Government, and to the highest credit to himself.”*

He was a clever engineer, an able designer, and a courteous gentleman; and though somewhat defective in administrative power. - “Edward Davidson (1868:). *The Railways of India*”

Turnbull was offered a knighthood for his role in constructing Railways in India, but declined it as he felt that he did not have sufficient money to live to the standard he felt was needed.

The ironwork for the single line, one of the most expensive portions of the work, had to be imported and orders were placed for eighteen tons of Rails at a cost of eleven Lakhs of Rupees. Consulting engineer F.W.Simms in his report to F.J Halliday Secretary to the Government of India, showing remarkable foresight and vision, strongly recommended for adoption of 84 lbs Rails, the heaviest of any yet employed in England, for improved comfort and safety.

“but with respect to the weight of the rails, 84 lbs. to the yard, I would also most strongly recommend their adoption, as combining the greatest utility and ultimate economy.

By the adoption of lighter rails a saving might be effected in the first instance, but impressed as I am with the importance of having a substantial Permanent Way, I am inclined to disregard any such saving in comparison with the whole cost, and the solid advantages to be derived from having good upper works to the Railway, both as to ultimate outlay and comfort and safety in travelling.”

- Selections from the records of the Government of India(Home Department),-report on the proposed Railways in Bengal - Calcutta Carbery, Military Orphan Press 1853

Rails were of wrought iron, in lengths of 14 to 20 feet, with an allowance of one-tenth for sidings or passing places, and station rails. The weight of the chairs amounted to about 4,000 tons, one-eighth of which was supplied by the Porto Novo iron works at rupees 60 a ton, and the total cost was about rupees 1,90,000. The keys of compressed wood by which the chairs are fastened to the Rails, and the pins by which they are secured to the wooden sleepers, numbered about one million and a quarter, and cost some sixty thousand Rupees.

Mr. Macdonald Stephenson had wanted to use cast iron annealed Rails and sent the recommendations of Mr. R. Brunton, the engineer of Porto Novo Iron works, but, consulting engineer Mr. Simms did not approve of cast iron Rails and advised to use wrought iron Rails only.

The estimate gives further details about iron sleepers and chairs *“Moreover, in the Raneegunge district, there are twenty miles, which it is intended to lay entirely with iron sleepers and chairs combined, and for this work 2,750 tons of cast iron will be required at an expense of rupees 2,28,000 and 577 tons of wrought iron at an expense of rupees 60,000. The completion of the operation by laying the permanent way for 121 miles, with twelve of sidings, and the station rails, will cost about rupees 6,50,000, but this includes the transport of the materials from the ship's side by the contractor to any place at which they may be required.”*

Cast iron sleepers would face lot of teething troubles and frequent breakages were reported under higher speed or load: *“Cast iron sleepers, designed by Mr. Turnbull, bore the traffic of slow and steady trains well; but proved quite unable, with the ballast procurable in Bengal, to sustain the passage of ordinary trains at a rate of thirty miles an hour, or that of heavy coal-trains, weighing 313 tons. Mr. Turnbull therefore recommended that the use of cast-iron sleepers should be discontinued; and in support of his advice mentioned that during 1856 the breakage of cast-iron sleepers had been at the rate of 1.8 per mile per month, but that in the first half of 1857 the breakage rose to 4.35 per mile per month, and was constantly on the increase.*

However Greaves' cast iron pot sleepers were laid with great success later in Madras & GIPR, as fine sandy ballast, with which the pots could be readily filled, was there found ; but with the ballast of kunkur, gravel, and broken bricks or clay, usually met with in the northern provinces of India, the pots could not well and satisfactorily be filled."

--- Edward Davidson (1868). *The Railways of India: With an Account of Their Rise, Progress, and Construction*

"The cost of clearing away jungle, and excavating the roots of trees was about Rupees 82,000, an expense which is to be attributed to the necessity of effectually preventing the roots of Peepul and other trees from dislocating the brickwork, or disturbing the embankment, an evil which will be estimated at once, by any Indian resident, who has ever enjoyed the luxury of seeing a Peepul spread itself through the wall of his house, with the certainty that it must ultimately bring it down."

Finally, the stations, together with such apparatus as "turn-tables," "water cranes," "switches," &c., will cost about six lakhs of rupees, there are about 140,000 cubic feet of teak, Saul, and other timber, costing rupees 3,85,000, about rupees 25,000 of miscellaneous ironwork, rupees 32,000 for metalling ordinary roads, and Rupees 23,000 for gates at level crossings.

The Electric Telegraph, moreover, for the use of the line, will cost about rupees 6,000, and the expense of fencing, which has been allowed to stand over for the present, is estimated at three lakhs of rupees. Entire track was fenced to prevent trespassing, though the fencing would be repeatedly stolen.

House of commons enquiry report ,dt.14 th May 1861, stated :

*"The attention of the Government having been drawn to the condition of the fences along the line of the East Indian Railway in Bengal, inquiries were made on the subject, when it was ascertained that the fences were incomplete in many places, and that the Railway chief engineer, with whom the responsibility of keeping them in efficient condition rested, had long been aware of the fact. The wooden fences required almost entire renewal, and there was apparently an unwillingness to incur the expense because of the difficulty of protecting them from the natives, who carried off portions whenever they had an opportunity of doing so unperceived .----*East India [Progress and Condition] Statement Exhibiting the Moral and material progress of India— India office 14 may 1861-house of commons report

Magnitude of the work, planning and accuracy can be gauged from the summary sheet of estimate:

Distance 121 miles.	Rupees.
Earthworks, 289 millions of cubic feet . .	11,68,000
Ballasting, 21.25 millions of cubic feet . .	13,75,000
Brickwork, 73 millions of cubic feet .	16,00,000
Rails, 18,000 tons	11,00,000
Chairs, 4,000 tons	1,90,000
Keys, 1,20,000 .	60,000
Cast-iron rails for Rameegunge district, 2,750 tons.	2,28,000
Wrought iron for ditto, 577 tons .	60,000
Laying down rails	6,50,000
Clearing jungle .	82,000
Station and station apparatus .	6,00,000
Timber .	3,85,000
Miscellaneous iron-work	25,000
Metalling roads and gates .	58,000
Fencing of track .	3,00,000

Total **78,81,000**

--Railways in Bengal; pages45-46) --By William Patrick Andrew

Enormous increase in the price of iron was observed later caused chiefly by a sudden expansion of the American demand, and the rise in freight since the discovery of gold in Australia.

It was estimated that the cost of the first section will not exceed rupees 73,000 a mile, which, with the addition of rupees 16,000 for surveying, engineering and management, makes a total expenditure of rupees 90,000, £9,000 a mile. This includes locomotive engines, carriages, wagons, and other rolling stock, sufficient for one opening of the line, and certainly represents a result as gratifying as it was unexpected, and one which will go far to secure the early extension of Railway communication throughout the east.

As per East Indian Railway Report, No. 6 dt. 19th March 1853, From George Turnbull, Esq., to the Chairman and Directors of the East Indian Railway, estimated expenditure for construction of 121 Miles from Howrah to Raneegunge, including Howrah and other stations, was shown Rs 88,04,087, 13 Anna 5 Paise , translating to Rs 72,761 per mile.

Laying the Brickworks:

Bricks proved to be a major challenge for EIR engineers, as millions of high quality bricks were required for construction of viaducts, flood water arches and masonry bridges apart from various Railway buildings. Rails, iron sleepers and Rolling stocks would be imported but importing millions of bricks was not a practical proposition.

Indian brick laying skill was quite primitive: *bricks made by natives are so badly manufactured, that they cannot be relied on. A native takes any clay that happens to be near at hand, digs it up, wets it, kneads it with his feet for a short time, and then moulds the bricks on the ground, and leaves them to dry in the hot sun and wind. Bricks so made are badly tempered, badly shaped, and are, besides, usually cracked and badly burnt.*

The EIR Co. had to spend £ 1,500 per mile of the line for viaducts and bridges alone. The construction of 84.5 miles of the EIR line, between Howrah and Bardhaman , involved the use of 40.5 million bricks.

Seventy three millions of bricks were required for constructing bridges and viaducts in the experimental line to Raneegunge; and manufacturing bricks in such large quantities, that too within a set timeframe soon emerged as a major bottleneck.

Mere numbers was not the only problem; under the terms of the contract, construction companies had to locate brick kilns far away from human habitation. Then, again, good earth for bricks could be had only at a few places; moreover, only a thin layer at the surface was workable. Turnbull complained to the chairman of the EIR Co. that 'Little or no progress has been made in brick-making for want of land'. This vexed problem continued to haunt the companies in charge of the construction of different railway sections.

Brick kilns were set at a few locations, where superior bricks in flame kilns as per American plan, as stipulated in the contract, would be manufactured.

Some of the brick fields were located 'at a considerable distance from the line', thus adding to the 'cost of carting the bricks to the working site'. Further, the construction companies always tried to locate brick kilns as close as possible to their working sites and thus inconvenienced the local people.

It was construction against all odds, Mr. Rendel in his speech to shareholders had said :” *that the shareholders would be glad to learn that already forty-five miles of their line had been completed from Calcutta. There were engineering difficulties to contend with in India, which people at home could not possibly conceive. Yet he was bound to say that the works executed on their Indian lines were equal to any of the kind done in this country; several large bridges had been built over nul-*

lahs and rivers near Hooghly, and on exceedingly treacherous, sinking and shifting ground. Yet no failures had happened nor had any accidents taken place, though since the planning of their Railway, heavier floods had risen in Bengal than had been witnessed since the days of Clive.” – The history of the East Indian Railway by George Huddleston-Chapter 1

Though, a great proportion of the Engineers, who commenced the Railway works did not live to see them completed; they succumbed to hard work in a climate then often deadly; still with steadfast resolve and passionate dedication, they pursued the objective against all the odds, which had always been cited against the construction of Railways in India: frequent floods & inundations, violent winds & scorching heat, the ravages of insects & vermin, destructive effects of spontaneous growth of vegetation, the unenclosed and unprotected tracts of country and lack of skilled manpower.

The construction of experimental line to Raneegunge was a great undertaking and its completion was a great morale booster for EIR in view of the fact *there was scarcely a single line longer in Great Britain than the one from Howrah to Raneegunge.*

Railways in Bengal; being the substance of a report addressed to the chairman of East India Company By William Patrick ANDREW (Sir.)

The first foot of land was made over to the contractors on the 25th of January, 1851, and by the 25th of January, 1855, the entire line from Howrah to the Collieries will be open for traffic. 120 miles have been completed in four years. It had taken more than six years to complete The London and Bristol line, which is of the same length.—Allen's Indian mail July 3 1855

It proved that it was as easy to make a Railroad in India as in England, and that the natives appreciated the Railroad keenly and used it largely. These circumstances encouraged Lord Dalhousie to recommend, and the Court of Directors to adopt, the enlarged scheme of Railways for India, paving the way for rapid growth of Railways in the country.

It would fundamentally change the country which was practically stationary, where generation after generation had passed away, leaving the habits and the customs of the people more unchanged than those of any other race of which history bears record.

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