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REMARKS

On the cost and plan of construction of the *South Carolina Rail Road*, compared with other roads, showing the advantages which the South possesses over the North in establishing this system of improvement. By A. A. Dexter, Civil Engineer and Resident Engineer of the 6th and 7th Divisions of the South Carolina Rail Road.

To the Friends of Internal Improvement of the Southern States.

In many sections of the South, the spirit of Internal Improvement appears to manifest itself: and a lively agitation of the important subject of an improved system of inter-communication is daily becoming more general. The success which has attended the establishment of Rail Ways, with the application of steam as a motive power, has created a new era in the history of mechanical science: promising in the novelty and vast utility of its results, to effect a great change in the physical and social condition of the country.

Rapidly as this plan of improvement has advanced in public favor, in the short space of five years, enlisting capital to the amount of fifty millions of dollars, on this side of the Atlantic, we yet behold the infancy of a system, the gigantic extent, and remote tendencies of which, we can but imperfectly appreciate.

Believing as we do, that the South possesses local advantages, which peculiarly favor the economical construction of Rail Roads, and render the system eminently applicable to herself, we presume that no apology will be deemed requisite in offering to the public a few practical remarks, on a subject of so much general interest, and particularly as relating to a work which is the great pioneer of the South, in the establisment of these enterprises.

Without further preliminary observation, therefore, we will proceed to a discription of the South Carolina Rail Road, with a general detail of the cost and plan of construction—following with a sketch of the most prominent Northern Roads, and after instituting a comparison of the plans and cost, draw our conclusions, in which we hope to be, unbiased by any feelings of prejudice or sectional partiality.

GENERAL DESCRIPTION.

We will preface our description with the remark, that in the establishment of a Rail Road through a well timbered country like that through which this road passes, there can be no doubt of the judicious economy of the general plan of pile construction, which has been adopted in preference to the expensive system of embankments which prevails at the North. Besides the increase in the first cost, the expense of keeping the embankments in repair, owing to the injuries sustained from settlings, washes, slides, derangment of culverts, &c. is unquestionably greater than that attending the occasional renewal of decayed timbers.

The profile of the South Carolina Rail Road, embracing, generally, a remarkably uniform surface of country, may be compared to that of a continued bridge, sometimes resting on the earth, but generally elevated above the soil about five or six feet.

The Road extending from the city of Charleston to Hamburg, is 135 miles in length; and the rails were laid in continued line complete, about the 1st of June, 26 months from the period when the whole line was located and put under contract. A few miles of the road, near Charleston, were made, and in use with Hand Cars, about two years prior to this period.

The road crosses the Edisto river, about 400 yards below the junction of the North and South fork, 65 miles from Charleston, after passing over, in that distance, six difficult streams, and depressions, the Saw Mill Creek, Cypress Swamp, Four Hole River, Indian Fields, Poke Swamp and Cattle Creek. The road continues its course on the dividing ridge between the Edisto and the branches of the Savannah, passing nine miles to the north of Barnwell village, until it reaches the head of the valley of Wises Creek, a branch of Big Horse Creek.

At this point, which is only 21 miles south of Edgefield Court House, the road attains its highest altitude of 510 feet above the level at Charleston, and 360 feet above the Augusta bridge, 15 miles distant. One hundred and eighty feet of this descent to the valley of the Savannah, is conquered at this point by an Inclined Plane, 3800 feet long, having 3 grades of ascent, the steepest of which is 1 in 18.

From the foot of the Plane the remainder of the descent is overcome in 10 miles, having an average inclination of 18 feet in a mile.

At Hamburg two spacious depositories are in course of construction of brick, with zinc roofs, on a commodious lot of six acres, gratuitously bestowed on the Company by Henry Shultz, Esq.

There is only one bridge of importance on the whole route, that crossing the Edisto River, which is 400 feet long, has a single arch over the main stream of 66 feet.

The road is a single track except at the Inclined Plane, where there is one mile of double road, and at the turn outs and depositories, about three miles more.

Two stationary Steam Engines, which work on the same crank, of about 25 horse power each, now erected at the head of the Inclined Plane, and nearly in readiness for operation, will effect the passage of the loaded trains and passenger cars over the Plane at the rate of about ten miles an hour.

The 7th Residency, embracing the distance of 15 miles from the foot of the Inclined Plane to Hamburg, was much the most difficult and expensive part of the road—a more costly plan of construction being frequently necessary, owing to the badness of the foundation and the height of the work. The excavation of this road cost nearly 1000 dollars per mile, while that of the rest of the road will not average 300 dollars per mile. The high price of materials was one great cause of the increased expense of this section.

The profile of the South Carolina Rail Road is remarkably favorable, as the entire length of inclination, as great as 1 in 150, or 35 feet in a mile, is but 1 5-8 miles, the occasional ascents not exceeding 1 in 200 or 26 feet in a mile.

The straight lines, with the exception of the 7th Residency, are generally uncommonly long, and the curves easy. There is one straight line 25 miles in length, and several courses of from 6 to 10 miles. The first 65 miles from Charleston varies in length but ½ mile from a uniformly straight line.

The road is now ironed a distance of 100 miles from Charleston, to which point the Steam Engines have frequently passed. All the iron would have been on, and the road in complete operation, but for unexpected delay in the arrival of the Locomotive Engines, three of which contracted to be delivered in Charleston by the 1st of March last have not yet arrived. The Engines in use do not afford sufficient power to transport the iron for the road, and at the same time comply with their mail and passenger arrangements, and the public convenience in the constant carriage of freight.

Two of the Engines now in use are built on an entirely novel plan, according to the instructions of H. Allen, Esq. Chief Engineer of this road.—They are supported upon eight wheels, by which means the weight is diffused, and a more powerful Engine is obtained with the same stress upon the road.

This Engine, however, is more complicated in its construction, and more liable to derangement than a four wheeled Engine, and therefore at present less generally approved—but it is to be hoped that the few practical difficulties which attend the use of an Engine, so well adapted to powerful transportation, in this and other roads, which may be built on a similar plan, may vanish before superior skill and experience.

When in order, these Engines, for a few miles, detached from their train, have frequently attained a speed of 40 miles, and in one or two instances of more than 50 miles per hour. These Engines will carry 30 tons of freight, besides passengers, with ease 15 miles an hour, at a cost of about 20 dollars per day, including all expenses of fuel, attendance, and wear and tear of Engine. The Phoenix, a light Engine on four wheels, has twice run from Charleston, a distance of 72 miles, to Midway and back, in the day, a distance of 144 miles, placing it, therefore, beyond a doubt, that the travel from Augusta to Charleston can be effected in 10 and 12 hours.

If the Engines which have so long disappointed us, should arrive in the course of this month, the whole road can be in use by the fifteenth day of September. The 15 miles from Hamburg to the foot of the Inclined Plane, is ironed, and used with Hand Cars.—The mail is now carried 105 miles on the road.

DETAILS OF CONSTRUCTION.

There are four different plans of construction made use of on this road, the adoption of which was determined by the character of the soil and the height of the line of grade:—these are, the Sleeper plan No. 1 the Sleeper plan No. 2—the Pile construction, and the Truss work.

Sleeper Plan No. 1.—The Sleeper plan No. 1, which is a very cheap construction, answers well on a good clay or gravel foundation. In this construction, the rails, 6 by 10, are supported on transverse sills, 10 by 12, laid six and a half feet apart: these sills are ten feet long, of good lightwood or heart pine, well hewed. In trimming up the excavations and bermes, and preparing the side drains, enough earth is obtained to cover the transverse sills entirely, and afford a solid bearing to the whole length of the rail. Most of our road on this plan has been built by contract, for $1450 per mile—the excavation, draining and filling is not included. We have about 5 miles of this road.

Sleeper Plan No. 2.—This plan likewise is used in excavation, and forms an admirable structure, preferable to the other in being less liable to settling and lateral derangement. In this case, the size of the rail and distance apart of the supports, remain the same. The caps, into which the rails are let a depth of 3 inches, and secured by wedges, as before, are 6 by nine, and nine feet long, fastened down at each end by a two inch trenail, to a longitudinal sill, which is firmly bedded to nearly its full depth in the ground.

These longitudinal sills are put three feet from the centre of the road each way, which bring them nearly on a line, under the rails. The size never was allowed to be less than 9 by 9, generally well hewed in the upper and lower surfaces, and blocked off on the edges. It is better to jog the caps into the sills by a gain in the latter, and use a wedge in preference to the trenail, as the pin hole admits water and engenders decay.

On this plan the Inclined Plane is built, but the lower sills are 12 by 12—all heart of the best pitch pine, well hewed on all sides and the ends lapped.

The average cost of work on this construction, is about the same with that of piling on the same grade—from 1800 to 2200 dollars per mile. There are about 18 miles built on this plan in the whole road.

One considerable advantage attending this plan of construction is the facility of repairing it, and renewing the decayed supports. Another important consideration is, that timber will last longer horizontally placed than vertically—as in the Pile Construction.

Pile Construction.—In this construction the posts are generally of light wood or of the heart of the pine tree, round—with the butt end in the earth, and from 10 to 15 inches in diameter. The posts are in no case allowed to be less than 4 feet in the ground—6 feet apart transversely, by 6½ feet longitudinally. Where the ground is soft the piles are sometimes driven to a depth of 25 feet—the distance in earth being entirely governed by the descent, under a given weight, at the last blow of the hammer.

The weight of the hammer used varied from 600 to 1000 lbs. The best piling machines were 35 feet in height on large wooden rollers, with moveable cars of disconnecting the ram block, at different heights, secured by bolts and nuts to the uprights. Under a hammer of 900 lbs. with a clear fall of 20 feet at the last blow, the pile was allowed to sink two inches. As the success of the road in a great measure depended on the stability of the piles, competent testers, under the pay of the company, compelled by their presence the faithful execution of this important part of the work.

Holes were generally dug about 3½ feet deep into the soil before the pile was introduced, by means of *tongs*—a kind of double spade, made for the purpose. In hard soil this previous digging is a great saving in expense, and by allowing the pile to be introduced with nearly its full size at the end, is a material aid to its permanency.

The piles, being sawed off and tenanted on the true and even line of graduation established by the levels of the Engineer, are connected transversely by caps 9 feet long, 6 by 9. These mortised and drawbored on to the piles.

The rails, 6 by 10, and never less than three stretches or 19½ feet in length, are let into the caps 3 inches and secured by wedges, driven on the inside of the rail in each cap. About ¾ of an inch is taken off the inner sides of the rails by a chamfer 4 inches deep, to a line, on which the edges of the iron plates are laid precisely 5 feet apart across the road, in the clear. Great care is necessary that the top surface of the rail be perfectly smooth and uniform, so as to afford the iron a solid bearing.

The confidence which the projectors and advocates of the Pile Construction felt in predicting the economy and stability of the plan, is entirely justified by the result. So far, the settling of the road even in parts which have been in use four years, is confined to a few points,—and then the introduction of a few additional supports, remedies the evil. Not the slightest yield is observable in any part of the road where the driving was properly attended to.

The cost of our Pile Construction has been from 1900 to 3000 dollars per mile, averaging about 2300 dollars, the bracing being extra. The piling machines, with blocks and gearing, are furnished to the contractors by the company, at an expense of about 100 dollars for each complete.

We have some Pile Construction 15 feet in height—strengthened by outside braces, supported against short piles driven about 8 feet from the road on each side of the main track.

No bracing is requisite where the height is under 7 feet, if the soil be firm. From 7 to 10 feet, one brace of 4 by 5 scantling between each pair of posts, is sufficient. Above 10 feet, two braces between each pair of posts placed somewhat in the shape of a letter X, are introduced.

One mile of single bracing, average height, costs about 150 dollars: of double bracing, 400 dollars.

Truss Construction.—Where the bottom is bad and the work over 12 feet in height the Truss Construction is advisable.

A foundation must first be made of piles, well driven, supporting a large bottom sill, 12 by 12, which may be embanked on the top, or a foundation of transverse and longitudinal sills, firmly imbedded in a solid sand embankment, may be used. This last plan we have frequently had occasion to adopt in the 7th residency. Four posts, 8 by 10, making something the shape of an inverted W, connected at the top by a cap 10 by 12, are mortised into the bottom still 12 by 12. The trusses or bents may be put 12 or 13 feet apart, when the size of the rail should be 12 by 12. Ten feet apart with rails 9 by 12, is a convenient distance. The cost of this construction, the solidity and strength of which has given great satisfaction, is very variable, depending on the difficulty of the foundation, the price of materials, and the height of the work. It varies from 6 000 to 10 000 dollars per mile.—There is one connected piece of road on this plan, almost half a mile in length, the height of which is from 18 to 25 feet. There is altogether about 5 miles of the Truss Construction.

The Iron.—The iron plates used on this road are 2½ inches wide, ¼ inch thick, and in length from 10 to 15 feet, secured to the rails by spikes 5 inches long, the heads of which fall into a countersink below the level of the surface. A mile of road requires 17 tons of this iron, costing something like 45 dollars per ton landed in Charleston.—Spikes cost about 9 cents per lb. or 90 dollars to the mile.

17 tons of iron at 45 dollars,	$765
1000 lbs. of spikes at 9 cents,	90
Transportation from Charleston along the line, on an average, including steam boat freight of 20 miles to Augusta,	100
	955

After the top surface is prepared, the iron can be laid on the road and spiked down at 25 dollars per mile. Iron ¾ of an inch thick, having a rectangular flange on one side to project down on the inner edge of the rail, about ½ inch, would have been greatly preferable to that used, in preserving a rigid uniformity of top surface, and lessening lateral friction on the wheel of the locomotive. The use of iron of this description was strongly recommended by the chief engineer, but was not adopted from considerations of economy. The increased cost of using iron ¾ of an inch thick, with a flange of 3-8 of an inch in thickness, would not exceed 200 dollars per mile, while it would be of incalculable benefit in promoting the successful running of the engines.

Turn outs or passing places.—A turn out or passing place, about 660 feet in length, the centre of which is 30 feet distant from the main track, into which it curves easily at each end, is placed at every 7 miles along the road. Here is the well and wood station supplying the engine with fuel and water. We seldom have to dig more than 15 feet for water, and wood is obtained in abundance at from $1 25 to $1 50 per cord. Our turn outs leave the main track in a curve of 772 feet radius.

At each end of the turn out about 20 feet of the rail way is detached and made to run at pleasure on vertical hinges, from the general track into the sideling; and the old plan of switches, always liable to derangement, is entirely dispensed with.

The transportation may hereafter require intervening turn outs between those already established, but by this means the necessity of a double road may be entirely obviated.

Turn outs are built complete at 50 cents per lineal foot—iron work not included.

A revolving platform is generally placed in the centre of the turn out, by which means a loaded car can be taken in a few minutes off the main track or a rectangular road, into the depository.

EXCAVATION.

The greater part of the excavation on the South Carolina Rail Road has been shallow—the deepest cut not exceeding 25 feet. In proportion to the depth the excavation has been expensive—the soil, though a loose sand on the top, generally changed, at from one to two feet in depth, to a very solid red and yellow clay. Most of this excavation was done by contract, at 10 cents per cubic yard, although the actual cost to the contractors was perhaps 14 cents per yard.

The section of the cutting is 16 feet wide on the bottom, with slopes forming an angle of 45 degrees with the horizon.

Where the soil is very solid, and the cutting under 10 feet, the slopes will stand very well at as great an angle as 67½ degrees with the horizon.

About one fifth part of the whole line is constructed in excavation.

In the 16 feet on the bottom of the excavation, there is room left each side of the road, which occupies but 9 feet, for lateral drains, which are important auxiliaries in carrying off the water and maintaining solidity of foundation.

There is about 500,000 cubic yards of excavation and about 20,000 cubic yards of embankment in the whole line. The entire road could not have been embanked, in the general plan of the Northern roads, short of 400,000 dollars, full 75 per cent. of which would have been *extra, over the cost of the present road*, as the sleeper construction, which is necessary where the embankments are made, costs nearly as much per mile as the average pile construction.

ESTIMATE OF THE COST.

We have no correct data before us on which to base an accurate statement of the cost; but the following will be an approximate estimate:

135 miles of road, including all expense of preliminary surveys, of locomotive engines, cars, depositories, inclined plane and stationary engine, expense of engineer department, general superintendence, land purchases, negroes, &c. all complete, at 6,700 dollars—904,500 dollars.	
Of this sum, we will say, for the repository in Charleston and land purchased with view to future use of timber, and increased value,	$12,000
For negro labor and mechanics,	6,600
For the inclined plane with double road, truss work, and 25,000 yards of embankment and excavation, and half a mile extra double road,	20,000
Stationary engine at inclined plane, and all fixtures complete,	10,000
Seven locomotive engines delivered on the road, 6,000 dollars each,	42,000
Ten freight cars at 120 dollars each, and four passenger cars at 425 dollars each, to an engine, equals 2900 × 7,	20,300
Pile gearing, and ram block, and tools, and machinery on hand,	5,000
Surveying, superintendence, engineer department, &c.	53,000
Iron and spikes 152,850 dollars—transportation of the same 13,500 dollars,	116,350
Expense of workshops in Charleston, deducting worth of cars and carriages made,	16,000
Excavation 45,000 dollars, embankments 1,800 dollars, Edisto bridge 1,800 dollars,	48,600
Crossing of Horse creek 500 dollars, culverts 100 dollars, road and plantation bridges 2,000 dollars,	2,600
Ditches under the road at entrance into fields,	1,000
Expense of pitching 70 miles of road with tar and turpentine,	4,900
Extra expenditure in making a more substantial road than contemplated in the original plan, by truss work in high grades and bad foundations,	35,000
Bracing and other extra work,	25,000
Damage sustained by Avalanche from a side hill near Hamburg,	500
Draining and filling, in excavations,	3,000
Opening the tracks 200 feet wide thro' the locust, and burning undergrowth,	6,000
Twenty turn outs with water stations, revolving platforms, &c. 500 dollars each,	10,000
Depositories with rectangular tracks, work shops, offices, &c.	11,000
Repairs on the part of the road in use equal to 40 miles for one year at 75 dollars,	3,000
Police on do. and expense of running locomotives, &c.	8,000
Wood construction of 134 miles, and other expenses at 3,057 8, 100 miles,	409,649
Total cost,	$904,499

General view of some of the Northern Roads, showing the immense expense which has attended their construction.

CAMDEN AND AMBOY RAIL ROAD.

This road, across New Jersey, is the thoroughfare of travel between the cities of New York and Philadelphia. The length of the Road is 61 miles, and the profile of the country highly favourable. The Road is built with a Double Track—The Rail of solid Iron 16 feet long—2½ inches wide on the top—3½ inches at the bottom, and 3½ inches deep.

The rails are supported on Stone Blocks; but to prevent the effects of concussion and derangement of surface, pieces of locust, about three inches thick, are introduced between the Iron Rails and the stone supports. The total cost of this road was estimated at 1,120,322, or 18,366 dollars per mile—exclusive of Engines, Cars, Wharves, Depositories, &c., which would swell to amount to 1,300,000 or 21,311 dollars per mile. We learn that the Company have lately advertised for a loan of 800,000, which, if expended on the Road in addition to the estimate, will make the cost 2,100 000, or 34,400 dollars per mile. In this road, as is the custom in all the Northern Roads, the Stone Blocks which support the rails are bedded in broken stone, in order to secure the foundations against frosts. The interest on 34,400 dollars (the cost of a mile,) at 7 per cent. is 2 408, dollars, amply sufficient to build a mile of the wood construction of the South-Carolina Rail Road. The Camden and Amboy Rail Road is probably the most perfectly constructed road in the world for Locomotive use, reflecting great credit on the Engineer, R. S. Stevens, Esq of New York, famed for the improvements which he has introduced in Steam Navigation on the Hudson.

The Stock of the Company is quoted at 153 to 160.

NEW-CASTLE AND FRENCH-TOWN RAIL ROAD.

This road across the Isthmus of Delaware, is the great highway of trade between Baltimore and Philadelphia.

The road formation is wide enough for a double track—a single track is now laid, the length a little less than 16 miles. This Road differs materially from the former in construction. The rails are of Georgia pitch pine, 6 by 6, supporting an iron plate of 5 8 of an inch in thickness.

For nine miles the Road is supported in granite blocks—set 3 feet into the earth, resting on a well packed gravel foundation, and rammed round with the same material. The other 7 miles of the road on embankment, are built entirely of wood.

The rails are supported in white oak caps, 7½ feet long, 8 by 10, under the ends of which are longitudinal sleepers of hemlock 4 by 10, bedded in gravel.

This plan of construction is not in any respect superior to our sleeper plan No. 2, used in excavations, and owing to the danger of settlings in the embankments, is far less likely to prove permanent. This single track cost the enormous sum of 400,000, or 25,000 dollars per mile; to which is to be added the sum of 40,000 for a complete supply of engines, freight and passenger cars. This Rail Road is almost equally liable to decay with