In the first method a set of 4 x 6-in stringers was placed at the bottom of the machine-dug trench, 2 x 6-in. stringer being placed next to the bank and separated from the 4 x 6-in. stringer by a 2-in. block, much care being taken to have them set plumb, otherwise the sheeting would drive crooked. A similar set was placed about 3 ft. below the surface of the ground and the sheeting driven between the 2 x 6-in. and the 4 x 6-in. sets. A timber frame 16 ft. high was constructed on a platform wide enough to span the trench, and the hammer suspended on a trolley running on a 7-in. I-beam set transversely to the trench at the top of the frame. The platform was build on skids parallel with the trench, so that it could be easily moved forward as the driving progressed. The hammer was operated between two pairs of guide rods made of galvanized iron pipe, a gasoline engine and hoist being used. With this method and equipment an average of about 60 pieces of 2 x 12-in. timber, 18 ft. long, could be driven per day at a cost for labor of 50 cents per lineal foot of trench and a total cost for sheeting of about $3.20 per lineal foot. It was hard to keep the outfit upright and steady, and this reduced considerably the driving power. Only one plank could be set on each side of the trench at a time, making it necessary to move every foot, which was impracticable and too expensive.

In the second method blocks were set between the 4 x 6-in. stringers and the 2 x 6-in. stringers omitted. The steam hammer was handled by a derrick with a 20-ft. boom, the guide rods in this case being made fast to the hammer, and sliding through iron loops fastened to the end of the boom. The derrick was erected on a platform similar to the one described above, and in such a way that the foot of the derrick was over the centre of the trench. In this way about 34 pieces of sheeting could be driven from one position. The derrick was then moved forward and the driving continued. Laborers set up the sheeting ready for the driver as soon as the stringers were in place, so that the hammer could be kept constantly at work. With this method the number of pieces driven per day was increased about 30 per cent., with a corresponding decrease in cost.

Removing Material.—The quicksand was taken out in buckets of ¼-cu. yd. capacity. To handle the buckets, two derricks made of 6 x 6-in. timbers, with 20-ft. booms, were erected on opposite ends of a platform made to span the trench. A four-post frame made of 6 x 6-in. timbers properly braced held the derricks in place. On the platform within the frame a 4-h.p. gasoline engine furnished power for the hoists, which were so arranged that one man could operate both derricks. This apparatus was employed to handle the steam hammer, and when hitched to a scraper was also used for backfilling. The blocks were so arranged that in raising a full bucket from the trench its weight pulled the boom around to the side of the trench where the bucket was to be emptied. Seven men were ordinarily sufficient to operate this device, doing more and better work than 14 formerly accomplished by hand. Without it or something similar it would have been almost impossible in the worst places to make any progress against the quicksand; for in spite of tight sheeting, carefully driven, the sand ran in through the smallest cracks and boiled up from the bottom. Occasionally after half a day's work there were no results apparent in the trench.

Preparing Bottom.—With the sheeting in place, and the trench excavated, special methods had to be devised to prepare for pipe laying. Cinders, straw, brickbats, piling and concrete were experimented with, and at last concrete was chosen—first, to keep the sheeting from pressing in and crushing or disturbing the pipe, and, second, to obtain a pipe bed. The concrete placed one day was not used to lay pipe on until the next. Half of the diameter of the pipe was buried in concrete to distribute the weight and prevent crushing.

In some places where concrete was being placed for foundation the sand boiled up through the concrete before it had time to set and rendered it useless. To overcome this, inch boards were laid lengthwise in the bottom of the trench the full width and nailed together. They were then worked down through the sand and water as far as they would go, sufficient excavating having been done to permit the boards to be worked down to a point 6 or 8 in. below grade. The sand and water were then cleaned off the boards and the concrete placed. The time saved in this way more than paid for the boards, and a much better foundation was obtained.

Of all the equipment which the contractor had on the work the steam hammer and the derrick device for handling wet excavation gave him the best returns on the investment for plant.

Occasionally there would be an oasis in this sea of antediluvian mud where a good bottom could be secured by mixing cinders with it. This seemed to work where it was sticky, with clay predominating. It would fill up and bind, but if fine sand predominated, cinders were useless.

All pipe was eventually covered with dry earth and the fill was compacted by tamping to a depth of several feet.

Railroad.—Where the 15-in. main crossed the Chicago, Rock Island and Pacific right-of-way an attempt was made to tunnel the main tracks; but the sand was so bad that it was finally found necessary to drive a temporary bridge of 15-ft. span under each of the two main tracks and make the excavation in open cut. Under the stringers of the bridges for a space of several feet horizontal sheeting was set, and below this 2 x 8-in. sheeting was driven down below grade by hand. Outside the main tracks steel sheeting was driven and later pulled, using a 6-ton Triplex block. Cast-iron pipe was used across the right-of-way, and it was not thought necessary to leave sheeting in the trench. As the sand offered no foundation for the cast-iron pipe, brickbats and concrete were placed under the joints. The excavation was carried down below grade, a wagon load of brickbats dumped at the place where the joint would come, and about one-half or three-fourths of a cubic yard of concrete dumped from large buckets on the brick. So much sand was taken out at this place that the banks settled considerably, more than 1 ft. at one point. This line of sewer, however, showed up well on final inspection.

The contract, which ordinarily would take six months, was completed in November, 1912, and much credit is due to the contractor for the gameness with which he stuck and finished the work.

ROAD GRANTS IN ENGLAND.

Considerable dissatisfaction exists among highway authorities in London, England, at the manner in which the Road Board is dispensing financial assistance for the repair of roads damaged, chiefly by heavy motor traffic. The board hinted at the outset that it was prepared to make grants and loans to the authorities in the metropolitan police area up to the amount of £250,000. But it seems that no authority can get a grant unless it is itself prepared to spend three or four times as much as the grant, and is considered that this policy is a direct incitement to local bodies to spend more money than the circumstances of the case demand. Road board grants, it is claimed, should be unconditional, and that local authorities should not be forced to spend large sums out of the rates for the special benefit of motor traffic. So strong is the resentment of the authorities on this policy that the subject is to be raised in parliament at the first favorable opportunity.