

THE INSTITUTION OF CIVIL ENGINEERS

CORRESPONDENCE

ON PAPERS SUBMITTED FOR DISCUSSION AT
MEETINGS OF THE ENGINEERING DIVISIONS
DURING THE SECOND HALF OF SESSION, 1946-47.

ROAD ENGINEERING DIVISION.

Road Paper No. 23.†

"Some Defects in Concrete Roads: Causes and Remedies."

By FRANK NELSON SPARKES, M.Sc., M.I.C.E.

Correspondence.

Mr. T. Whitley Moran observed that the Author's views on the spacing of joints were particularly interesting. It was becoming clear that the mix temperature had an important bearing on joint spacing. Mr. Moran had seen a number of cases in recent years where concrete roads, aerodrome runways, and other concrete structures had developed defects due to hot-weather expansion of concrete laid during the winter and from winter-time contraction of concrete laid in the summer. The adoption of the Author's recommendations on joint spacing (p. 8) would be an immediate step forward.

Some confusion might arise between mud pumping and mud jacking; but that could be obviated if mud pumping were described as "pumping at joints" and mud jacking as "road jacking," each term being a clear description. Mr. Moran had used road jacking on several occasions, one of which was on the road described on p. 12. In that case the jacking was carried out with neat cement grout, as the maximum lift did not exceed 2 inches and the average lift was less than $\frac{1}{2}$ inch. The length of road dealt with was 750 yards, and approximately two-thirds of the slabs, or about 4,500 square yards, required jacking up to level. The total cost of the work, including drilling, jacking, traffic control, watching and lighting, and the sealing of joints, amounted to approximately 6s. 2d. per square yard of the net area treated. The cost of sealing the joints was likely to amount to between one quarter and one third of the total cost of

† Discussed at Meeting on 4 March, 1947.

such an operation, but it was an essential part of the work, and its omission might nullify the success of the repairs.

Mr. Moran had made a close study of some of the published descriptions of road jacking work carried out in America, and he had some hesitation in accepting the cost figures given therein. Some of the summaries given appeared to make no allowance for supervision, traffic control, fencing, and lighting, nor for the sealing of joints, but such costs could not, as a rule, be disregarded when undertaking similar work in Great Britain.

The fully-mechanized plant used in America hardly appeared to be suitable for levelling slabs up to fine limits in order to provide the standard of riding surface customary on British roads. In fact, accurate levelling was inconsistent with a high rate of progress, and Mr. Moran considered that a different type of plant was required to suit the British conditions. He had made some experiments with equipment, all of which was manually operated, including pumps, agitating-tanks, flushing-tanks, mixing-tubs, and conical rubber injection-pipes designed for quick insertion and quick withdrawal. The whole set of equipment was much simpler to operate and move about than the fully-mechanized American equipment and was much less costly. The great advantage of manually operated pumps was that the operator could exercise much closer control over the actual lifting of a slab than with a mechanical pump.

Mr. Moran would welcome the Author's views on the relative merits of injecting mud and a cement/sand mixture. No self-respecting highway engineer would wish to build a new road on a mud mixture. Why, therefore, should mud be pumped under a road where subgrade failure had already occurred? His experience was that a neat cement mixture could be injected with ease and a suitable cement/sand mixture could be used in many cases. The cost of materials in a neat cement or cement/sand mixture amounted to only about 7 per cent. or 8 per cent. of the gross cost of the repairs, so that the saving in cost by using mud instead of cement would be very small and the results obtained inferior. Therefore, it would seem that the accurate levelling and the durable results looked for in Great Britain could both be obtained more easily by injecting cement instead of mud.

A number of grading curves had been published from time to time, showing various gradings of mud which had been successfully used in mud jacking, and it would be appreciated that at the time of injection, the moisture-content would be well above the liquid limit.

It would be interesting to know whether any of those materials would pass muster as sub-base materials if subjected to routine soil mechanics tests in a laboratory.

Mr. J. H. Payne observed that the Paper was of considerable topical interest, particularly because so many concrete roads constructed before the war had had little or no maintenance since and had been subjected

to the rigorous conditions of severe winters in 1940, 1942, and 1947. The Author's suggestion that considerable scope existed for the use of mud-jacking as a routine maintenance operation deserved attention.

Concrete roads founded on clay subgrades were more liable to failure due to rain water reaching the subgrade through joints and cracks ; the clay was thus softened and would pump up through the joints. That loss of material meant that a void was left under the road slab and the unsupported area would deflect. Often the settlement was more pronounced on the leading edge of a slab, which received the impact load of heavy traffic. Once differential settlement of slabs had started, a danger existed of corner cracking, later map cracking, and finally disintegration of parts of the slabs. The later faults might be postponed or prevented altogether by filling the voids under the slab, consolidating the subgrade, and sealing joints and cracks. In the early stages the settlement might be only from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch and Mr. Payne considered that a good case could be established for using a cement/sand mix rather than a mud mixture. The quantity of material to be injected was very small and a cement mortar had the advantage over a mud mix that it would fill voids in any concrete that was honeycombed at the underside of a slab and would increase the durability of the concrete.

In levelling sunken slabs, it was important to bring adjacent slabs to the same level, or as nearly level as possible. One disadvantage in the American mud-jack was the difficulty in achieving that levelling of adjacent slabs. That might be explained by the fact that a good volume of material was injected at each stroke of the pump. With a hand-operated pump, where the quantity of material per stroke was much smaller, it was possible to level adjacent slabs to a much closer tolerance—plus or minus $\frac{1}{8}$ inch.

The importance of maintaining a good seal at all joints and cracks could not be too strongly emphasized. Change in the moisture-content of the subgrade was a primary cause of road failure and moisture-change could often be prevented by efficient sealing.

The Author, in reply, observed that he agreed with Mr. Moran on the confusion likely to arise between the terms " mud pumping " and " mud jacking " and he concurred in the terms suggested. Both Mr. Moran and Mr. Payne regarded a cement or a cement/sand mixture as preferable to mud for sub-sealing and jacking, and the Author entirely agreed. The misconception had arisen from the use of the word *mud-jacking*, which had become the common term used to describe the operation of pumping a grout of cement or bituminous mixture under the slab. The Author knew of no case where mud, as such, had been used as the jacking medium and he considered that such a material would never be accepted, by any responsible engineer, as a suitable base for a concrete road.

With regard to Mr. Moran's expressed hesitation in accepting the cost

figures for road jacking published in the American literature, the Author agreed that it was difficult to know exactly what the costs quoted really meant. Nevertheless they were valuable in indicating the order of cost of road jacking to engineers who had had no experience with the method and, provided they were taken as a guide only, they were admissible.

In the case cited on p. 29, the final cost was influenced considerably by the fact that ultimately a greater area of road was repaired than was allowed for in the estimate. The large difference between estimated and actual cost was therefore not typical and a much closer estimate could normally be made, even if some uncertainty were always bound to exist as to the size of the cavities to be filled and consequently as to the quantity of cement or bitumen required that could only be determined while the work was being done.

The practical information supplied by Mr. Moran and by Mr. Payne would be of great value to other engineers dealing with the problem of road jacking.

ROAD ENGINEERING DIVISION.

Road Paper No. 24.†

“The Use of Plant in Soil Stabilization.”

By CHRISTOPHER FRANCIS ARMSTRONG, A.M.I.C.E.

Correspondence.

Mr. R. L. Mitchell observed that the method of road construction outlined by the Author had been developed in England and America, but it had its greatest potential future in the Colonies, and particularly in Africa, where certain minor modifications to technique appeared to be necessary.

In dealing with soil mixers the Author had made no observations on the use of a motor grader in fulfilling that function. Certain compaction had been carried out by that means without the aid of a plough or roto-tiller and it would seem to have been quite successful. Again, since the intimate mixing of a large quantity of water was so essential, did the Author consider one of the latest American machines, comprising in effect two roto-tillers in one unit with a spray-bar in between, the spray-bar being fed by mobile water-tankers, to be particularly advantageous?

The Author had emphasized the importance of unity in width of equipment and had suggested a width of 6 feet. So narrow a width meant that overlapping of lanes was likely to be increased, which was particularly important where water spraying was concerned. Surely it would be advisable to standardize a width of say 10-12 feet to reduce the occurrence

† Discussed at Meeting on 6 May, 1947.