evidence of decay from corrosion it was difficult to imagine just what the failures could be due to, but he thought that most engineers would have tackled the problem by reinforcing the belt with hoops or bands, but the engineer who had to deal with the proposition must have been very interested in reinforced concrete construction, for he decided to enclose the tank in a complete reinforced concrete jacket, the walls being made of sufficient strength to withstand the hydraulic pressure with an ample factor of safety. With a simple, yet aesthetic, treatment of the concrete jacket, it was stated in the report that "the unsightly black steel tank had now been replaced with one commanding in appearance." There was no doubt, of course, that with such tanks as these, where appearance was a consideration, if such tanks had to be built, concrete would now be the most desirable construction.

THE AUTHOR'S REPLY.

The author, in reply, said that he was very much obliged to Mr. Vicars for the very kind remarks he had made when proposing a vote of thanks to him.

In regard to the formulæ which Mr. Vicars so kindly furnished, and which he imagined he must have deduced from his own practice, he must confess that he was not aware of it before, and it had deeply interested him. He had not known before that there was any formulæ by which they could approximate crushing strengths for concrete made with varying proportions of cement; although it was now perfectly obvious that such a formula could be simply deduced.

In regard to the question as to whether the metal was graded, he might mention that the metal usually obtained in Sydney was screened, by a screen passing all sizes

between ¾in. and 3/16in., and so it was graded in that manner.

He quite agreed that the grading of sand was a very important matter, and that was the sole objection he had found with the Nepean sand up to the present time. It seemed excellent material, and the only trouble in connection with it was that all the grains were of the same size. It was, of course, quite possible to obtain very good concrete with it, but when working up finished surfaces without rendering, Nepean sand was not very suitable, as it did not give the desired smoothness. Of course, the effect of having a proportion of smooth sand was to fill, to some extent, the voids which existed in the coarser grains of Nepean, and that again, as Mr. Vicars had pointed out, simply reduced the quantity of cement required for any particular purpose.

With regard to grinding the cement, he thought it was very generally accepted that the finer it was ground the better would be the results obtained.

He could not say that he had made a practise of testing for residues on sieves, because, very often, one had to take what one could get, but most of the well-known cements supplied to-day were very finely ground, and as he remarked in the paper, if the cement came up to what was now accepted as the ordinary commercial standard, he thought it was good enough for ordinary purposes.

In regard to the use of plaster of Paris or gypsum in Portland cement for cooling it, he would like to refer to a very fine paper read before the Institute of Civil Engineers at home some two years ago. It was written by the chief chemist of the Associated Portland Cement Manufacturers, who were, probably, the biggest makers of cement in the world. In that paper reference was made to the deleterious results of the use of plaster of Paris for cooling cement. Of course, as they

were no doubt aware, all the cement manufactured by the Associated Portland Cement Company was of the steam blown type referred to by Mr. Vicars, and was looked upon as being absolutely the finest cement obtainable by users of that commodity at home.

There had been several references made to clinker concrete that evening, and he should very much like to call their attention to the sample of destructor clinker now lying upon the table. In it they would find bits of old tea-cups, nails, condensed milk tins, and tobacco tins. In regard to the latter they could imagine the effect of a shut tobacco tin with nothing but air inside.

He was not quite clear as to whether Mr. Power referred to clinker or to ash concrete.

Mr. Power: Ash concrete.

The Author: Mr. Nangle, who had helped him that evening, had given him the results of some tests he had made after crushing some ash concrete cubes at the age of five or six weeks, and he understood that they crushed at 940lbs. per square inch. It would be seen from the table that clinker concrete 5 : 1 mix crushed at 1450lbs. sq in. He might say that he did not like ash concrete at all. Clinker concrete was in his opinion a long way better, but his objection to it was that, whereas with Nepean or any recognised sand and blue metal, which, of course, was a perfectly defined thing, they were able to ascertain exactly what they were getting, whereas in the case of ashes and clinker they never knew when one load was going to be different to the previous one. That, to his way of thinking, was the primary objection to its use.

The second objection was the risk of finding sulphur in the clinker or ash. Of course, if there was any marked trace of sulphur in the clinker or ashes it would attack

the steel reinforcement, and he had seen cases where the steel had been very badly corroded.

On the other hand, he had never seen steel corroded when taken out of blue-metal concrete.

In regard to its use in floors and staircases, where the stresses to which it was subjected were comparatively small, he thought it was quite suitable, but he did not like it for columns or beams. He did not like it for columns because the size of a column would be unduly enlarged, and in the case of beams, because at the bottom of the beams there was usually a whole mass of steel, where the stress was very great, and they would readily see that only the best quality of concrete should be used in such a position. The practical result of using such material in the case of beams was to increase the bulk of the beam.

He was very pleased to hear Mr. Vicars corroborate his remarks in regard to water-proofing tanks. They would remember that he mentioned the case of a tar tank with five-inch walls, and which was absolutely tight; and as he mentioned, the mineral oils, such as were to be found in tar, proved far more penetrating than water.

In regard to the method of mixing concrete raised by Mr. Grieve, and the comparison between the continuous and batch mixing, he thought it worked out in this manner. Hand mixing bore the same relation to continuous mixing as continuous mixing bore to batch mixing. Very often in hand mixing there were portions of the batch which would not be turned over at all. In the case of a continuous mixture the materials were tipped into hoppers, and were measured by means of little regulating gates, which were pulled down to admit certain amounts of stone, sand and cement into a trough, where it worked through. It was, after all, only a sort of conveyer, and simply churning the things down

a trough was not, in his opinion, to be compared with being tossed to and fro and up and down in a batch machine mixer.

In regard to the remarks made by Mr. Nangle, he, of course, was well known to them all as one who had had a very wide experience in the matter of testing building materials. He raised the question of the Building Act, the much-discussed Sydney Building Act, and said that when it was revised they would go right ahead and construct a whole concrete building. Well, why should they not avail themselves of the provisions of the present Act as it existed at the present time? It was even now quite possible to do the whole interior of any building in Sydney in concrete, and yet, as far as he was aware, it was only instances that this had been done.

He thought they should use the privileges extended by the present provisions, and so make their call for its revision more insistent.

In reference to the cost of centering for concrete work, he might mention that steel centering was often used. A large sewer job which had all been centered with timber could probably have been more cheaply constructed with a collapsible steel centre.

Mr. Nangle referred them to the photograph of the Drummoyne Reservoir, and said it should demonstrate, absolutely beyond dispute, that there should be no trouble in getting thin concrete sections perfectly water-tight. That had been his argument all along. Work of all kinds had now been performed in regard to concrete construction, where the concrete had had to retain liquids of all sorts with absolutely satisfactory results, and he agreed with Mr. Nangle that there should not be any trouble, and that the whole question lay in getting the material properly mixed and graded.

Mr. Nangle also referred to the necessity of mixing the concrete wet, and again he thoroughly agreed with him. In reference to his remarks in connection with the sewer channel, where it was pointed out that it was very essential that the concrete should be mixed in a dry state, he did not know what the object was, but he did know that in concrete work generally the wetter it was mixed the more it shrunk in setting. Now, if the sewer job referred to was constructed in mass concrete, he should say it would be very likely to be non-waterproof if not poured in a proper way.

Mr. H. Thompson had referred to a description of a bridge in the construction of which old tramway cables had been used, and he asked what would be the effect of the grease common to cables. He thought the effect would be to kill the concrete and, in all probability, the cement immediately surrounding the cable would be absolutely friable. If the cable were perfectly smooth then he thought the bridge would be open to suspicion, but as the cable was, of course, twisted and had a very much corrugated surface, its shape prevented it from pulling through, although the cement immediately surrounding it might be considerably weakened, if not destroyed, and therefore unable to fulfil the function for which it was employed. He thought it furnished a very fine illustration of what could be done by a resourceful man with the material which he had at hand. It was quite probable, of course, that the cables were made perfectly clean before they were used.

In reply to Mr. McEwin's query as to why the reinforcement was shown nearer the inside than the outside wall of the tank at Randwick, if it so appeared they might safely attribute it to a draftsman's error. The reinforcement had to stand a bursting stress, precisely similar to that in a boiler, and was placed in the centre of the

wall because it was easier to so place it than any other way. He did not think it would matter a bit if it came an inch nearer the inside or the outside from the centre of the wall on account of the fact that the wall was so thin in relation to the diameter of the tank.

He was much interested to learn from Mr. Budden that there was in existence in Adelaide a Building Act even more antiquated than their own, and he trusted that it would not be long before these two Acts were remodelled.

Mr. Buchanan referred to the blue metal he had used, and asked him if he thought the mixture would be increased in strength if ¾in. were mixed with the 1½in. Yes, he thought it would be, but when they had only ¾in. or ½in. covering their bars they had to obtain small stuff so as to get in around it, and if they used big stuff they could not employ thin sections. If they would look at the sample which was upon the table they would see it was not all ¾in. but went down to ¼in.

Mr. Power said that, in his experience, ash concrete was better than blue-metal concrete every time. Well, as far as floors and that sort of thing were concerned, and taking the cost, and also considering the increased thickness required, he thought that view was perhaps correct. At the same time, he had his old objections to ash concrete, because it was so variable, and the risk of corrosion was always present.

In reference to water-proofing mixtures, he was glad to hear that Mr. Power agreed with him. He thought Mr. Power said he had tried water-proofing concrete by mixing soft soap with the water. The effect of all grease on cement was to kill it, and to prevent it from setting. And the effect was just what Mr. Power experienced. He had apparently mixed the soft soap with the water and then the water with the cement. He had never heard

of that method of procedure being adopted before, but he had heard of and had used a wash of soap and water, and alum, alternately after the concrete was well covered over. In that way brick walls had been made watertight under a head of water of nearly 40ft.

Mr. Harricks made some very kind remarks, and followed them up by a very interesting description of some work performed in Fiji, and the sinking of a tank to the extent of 2ft. from its original level. He had never heard of a tank sinking to such an extent before. He inferred from his remarks that the foundation was of reinforced concrete, and it did not crack in any way, but that the whole went down and was still in a satisfactory condition. Mr. Harricks suggested that if they had had a reinforced concrete tank, with concrete walls, top and bottom, they would have had trouble. He thought quite the opposite. The foundation had gone down some 2ft.; it had sufficient elasticity to overcome all troubles in so doing; and he certainly thought that reinforced concrete, wall which was absolutely monolithic, would have precisely the same elasticity as the floor, and that, in the event of the tank tilting it would be less likely to give trouble. If they imagined the tank going down 2ft. into the mud they could understand that it might go down more on one side than another. If the whole thing went down as one monolithic whole he could not see how trouble would arise.

He thought he had replied to most of the remarks made by those who had spoken in the discussion, except those of Mr. Reeks, and as he had been good enough to dispose of his paper with a few kindly remarks all that was left for him to do was to thank all for the privilege accorded him in allowing him to appear before them that evening.