USE OF CEMENT AT COLLIERIES.*

By John Gregory.

CONCRETE by itself is much more capable of withstanding compressive than tensile stresses, the ratio being approximately 10 to 1, and in reinforced concrete the object of the designer is to increase the strength of those parts subject to tension by adding steel of suitable section. The size and disposition of the reinforcement are matters of calculation equiring considerable technical skill, as the various stresses have to be worked out and the several members of a structure proportioned accordingly. For important surface works this is somewhat out of the province of mining engineering, and it will be found an advantage to get designs from engineers or architects who have specialized in concrete work.

Underground Roadways.—With regard to the support of underground roadways, however, other conditions prevail. The crushing effect of the strata in deep mines is an unknown quantity, and as the stresses are chiefly in compression the writer has preferred to put in a thick concrete lining combined with heavy steel girders, rather than a correctly designed thinner lining dependent for its success upon an elaborate system of reinforcement. He is not prepared to justify this from a purely scientific standpoint, but it has the merit of being more easily put in by the ordinary colliery labor, and if the necessity should arise, it lends itself more readily to repair or renewal.

The first application at Sneyd Collieries was in 1908 when, owing to the failure of a brickwork barrel arch, 4 ft. in thickness, it was necessary to reconstruct the insets in a pit 1,860 ft. deep. Steel girders, 12 in. by 6 in. by 56 lbs. per ft., were obtained, bent to a circle having an internal diameter of 14 ft., each ring being composed of three segments, secured at the joints by fishplates and bolts. On the eastern side of the pit, the ground was very bad owing to the roadway intersecting a large fault having a downthrow of 100 yards, and here the girder rings were spaced 18 in., centre to centre. Where the ground was more settled, this distance was increased to 3-ft. centres. Sufficient ground was taken out to allow of at least 18 in. of concrete being put in, measuring from the inside face of the finished arch, and the concrete was well rammed in between and at the back of the girders, making a smooth finished barrel arch of 14 ft. diameter.

The girder rings were taken down the pit in sections and erected in position, a special portable standard being designed for raising the top segments. Temporary laggings laid on the top of the girder rings served to support the roof whilst the concrete was being put in, being removed as the work progressed, and although three parallel lines of rails were in use during the time the work was in progress, no interruption of coal-drawing was occasioned.

When cross-cuts joined the main road, the spacing of the girder rings was increased to allow of smaller rings having an internal diameter of 7 ft. 6 in. or 6 ft., to be inserted, their axis being at right-angles to the main tunnel. In these instances old rails were used to bridge the space between the large girders, resting on the inner flanges. The concrete lining at the junction was properly groined, and when finished had an exceedingly neat appearance.

The results achieved were so satisfactory that it was decided to adopt a similar method of securing a crut, 200 yards long, at a depth of 2,610 ft. This was also driven through the large fault already mentioned, and with the original timber supports the cost of upkeep of the road was very heavy. Girder rings of the same section but 10 ft. internal diameter were put in, the spacing again being dependent on the nature of the ground. Where it was necessary to provide manholes, two rings of 12 ft. diameter were placed eccentrically to the axis of the main tunnel. This work was also commenced in 1908, and so far as appearances go, it will be unnecessary to spend a single penny in maintenance during the life of the colliery.

Since the completion of the above, many of the main roads, airways, and water lodges have been lined in a similar manner. In very few instances have signs of crushing been observed, and in no case has it been necessary to renew the concrete, though this would be a much less expensive operation than renewing brickwork arches. The slight crushing which has taken place has invariably occurred where the roof had fallen to a considerable height, and the space intervening between the top of the concrete arch and the solid ground had been made good with chocks and loose débris, making the crush on the arch unequal. Now this is filled up solid with concrete or brickwork, or if this is not practicable, the concrete lining at the weak spot is considerably strengthened.

Other Colliery Purposes.—Stables and motor houses have been constructed in concrete, and although their initial cost is somewhat high, the saving in upkeep will soon repay for the first charge. In good ground a modified cross-section has been adopted, and the steel formers made from old pit rails bent to a shape resembling a square with rounded corners. The sides are smooth and dust is easily removed, and the entire absence of combustible material commends itself where electrical apparatus is installed.

In one or two instances, girder rings, 12 in. by 6 in. section, embedded in concrete in a similar manner to that described for the roadways, have been used with conspicuous success for pit-shaft repairs. Where the shafts cut the 100 yards fault already mentioned, brickwork lining, 4 ft. 6 in. thick, has been crushed, but where this has been replaced by concrete, no sign of weakness has yet been observed. Many other instances in which the use of concrete is a distinct advantage suggest themselves, and there seems no limit to its useful application. Straight steel girders, with concrete rammed in between, have been used in air-crossings, floors for double landings, foundations for machinery, etc. In several instances, main airways have been lined with concrete without the use of girders, the smooth surface of the finished work reducing the friction of the air and presenting no ledges for the deposit of dust.

On the surface the most important use to which concrete has been applied up to the present is in the construction of a bunker to hold 300 tons of pit dirt, and a gantry carrying a creeper and tram rails for conveying the loaded tubs to a tippler on the top. This work was designed and executed by reinforced-concrete specialists. The cost was approximately equal to that of a steel structure, and the advantages gained are an increased life and the saving of the expense of painting every few years.

Engine-room floors, stillages for oil stores, etc., on the surface have been put in by the colliery staff. For

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