tangent. The telescope is then transited and an angle turned off, which must be calculated from the distance of the face from the B.C. This point should be checked by again sighting on the back tangent with the telescope turned through an angle of 180° from its original position and then reversing and setting out the same angle as before, the mean of the two observations being the correct point on the curve. This process is continued as far as can be seen, when the transit is moved forward to an intermediate station and the usual procedure followed. When the curve is completed and the E.C. established, the transit is set over it, a sight is then taken on one of the intermediate points and an angle turned which will give the direction of the forward tangent. This should be very carefully checked as soon as the tunnel has proceeded far enough to give a good working base line for the new direction.

It frequently happens that the B.C. is so near the working face that a point on the curve cannot be focused. In such a case a line fastened to one of the back points on the tangent and passing vertically over the B.C. is stretched into the heading and a cord measurement taken from the B.C. to the approximate centre. The deflection angle is then calculated for this cord and the natural sine of this angle multiplied by cord length will give the length of an offset from the produced tangent, at right angles to it, that will pass through the centre, at the end of the cord.

Grade elevations are established as follows: The grade at the shaft being determined, a stout nail is driven in one of the top braces of the shaft and the elevation of the head noted. A steel tape is then lowered vertically down the shaft and another nail fixed about invert level. The difference between the heads of the two nails is then measured and the measurement subtracted from the elevation of the upper nail, will give the elevation of the head of the lower one. This can now be used as a turning point from which bench marks can be established through the tunnel. These are sometimes placed in the roof so as to be clear of interference from traffic, the rod being inverted when a reading is taken and the reading added to the H.I.

Engineers who have to deal with tunnel work will find many conditions arise that do not occur in ordinary practice but a little ingenuity will generally overcome all difficulties.

The methods outlined will be found sufficient to cover most of the problems that occur in ordinary practice, such as sewer, water or other tunnels, and will also form a basis for more intricate cases that may occur requiring special methods to determine the alignment.

SUBMARINE OIL PIPE-LINES.

Owing to the unfavorable nature of the comparatively shallow water close in to the coast, the Mexican Eagle Oil Company originated the idea of laying submarine pipe-lines to points where the largest tankers could be conveniently moored for loading purposes at any state of the tide and weather. They have three deep-sea loading berths at Tuxpam Bar with duplicate pipe-lines to each berth; the Penn Mexican Fuel Company also has two loading berths equipped with pipe-lines in duplicate. The lines terminate in 43 feet of water, which is below wave-action, and at the point where the pipe ends 120 feet of armored flexible hose is attached. The free end of the hose is closed by a blank flange and allowed to lie on the sea-bottom when not in use, its position being marked by a buoy with a chain sufficiently strong to lift it.

The rise and fall of the tide is approximately two feet, so that the depth of water, 43 feet, is sufficient for the largest tank steamers to load at any time. Tankers of 15,000 tons dead weight, drawing 28 feet, are regularly loaded.—Journal of the Royal Society of Arts.

ENGINEERS' CLUB, TORONTO.

The annual meeting of the Engineers' Club of Toronto was held last Thursday night, February 3rd, at the Club headquarters, about forty members being present.

The chair was occupied by Mr. C. H. Heys, president of the club, who, in presenting the annual report, made reference to the disturbed conditions of the country and their effect upon the membership.

A very healthy feature of the report is the present membership of the club as compared with that of a year ago. At the close of 1914 the total membership of the club was 455, whereas at the end of December, 1915, the total membership was 493. Furthermore, since then 49 new members have been accepted, making the present membership 542.

In the course of his address, the president paid a fitting tribute to those members of the club who are serving overseas. Of these, there are 28, and included in that number there is one on whom has been conferred the title of "C.M.G." and another, a member of the general staff, has won the D.S.O.

In view of the important engineering works that are being carried out and proposed in and around the city, the hope was expressed that with the large number of men who must necessarily be engaged on these works, together with the present membership, the year 1916 should prove a very successful one for the club in every respect.

Votes of thanks to the retiring president for his painstaking and able administration in 1915 and also to the secretary and the staff were proposed and most heartily supported.

The five new directors elected at the meeting to take the place of those retiring were: Messrs. H. G. Acres, Alfred Burton, J. B. Carswell, T. H. Stevens and M. P. White.

The full Board of Directors for the year will be as follows: Messrs. H. G. Acres, J. R. W. Ambrose, W. A. Bucke, Alfred Burton, J. B. Carswell, E. L. Cousins, A. G. Cumming, D. A. Dunlap, Arthur Hewitt, Chas. H. Heys, Chas. W. Power, L. V. Rorke, T. H. Stevens, M. P. White, T. S. Young.

Altogether the meeting was a very encouraging one and augurs well for a very successful year's work. After the meeting refreshments were served.

STEEL BILLETS FOR GREAT BRITAIN.

Mr. J. E. Ray, Trade Commissioner, Birmingham, has cabled the Department of Trade and Commerce, Ottawa, asking for quotations from Canadian manufacturers in connection with five hundred tons steel billets, three inches square, eighteen feet long, carbon point ten point fifteen; and same quality four square, two feet eight inches, carbon point three point thirty-five, earliest delivery c.i.f. Liverpool. Quotations are also asked c.i.f. Liverpool, earliest delivery for square steel billets, 200 tons each, size 2 inches, 2½ inches, 3 inches, 3½ inches, 4 inches, lengths 16 to 18 feet, carbon point 1 to point 15. It should be stated whether process is acid or basic. Firms interested are invited to cable Mr. Ray quotations forthwith.

The Department of Highways, Ontario, will be pleased to receive current catalogues and literature from manufacturers of and dealers in roadmaking material and equipment. Geo. Hogarth, Chief Engineer of Highways, Parliament Buildings, Toronto, Ont.

The 1916-17 estimates tabled in the House of Commons by the Minister of Finance recently provide for the organization and equipment of an Explosives Division of the Mines Branch, Department of Mines, Ottawa, for investigative work in connection with the manufacture and storage of explosives.