The chainmen then proceed setting stakes on this curve and establish a hub with a tack at the P. T.

The field draftsman plots the alignment notes and section line ties, and makes the right-of-way map. He also prepares and finishes all profiles and estimates of quantities, including the quantity and direction of hauled material, keeping his work up as fast as the notes are turned in from the field. No estimate is placed on the profile until it is approved by the locating engineer. Any piece of location which does not balance up well in excavation and embankment, within the limits of economic haul, after the estimate on it has been prepared, is relocated.

In country where shale or rock comes close to the surface, a testing party is put on. In cases where the rock is so close to the surface that the economic cut would necessitate the excavation of some rock, the location is made so that there will be a minimum of rock excavation, it being cheaper to borrow the material for embankments than to make the rock excavation.

At points where it is necessary to have structures, such as drops, culverts, siphons, and highway or railway bridges, the locating engineer should choose the most economical location under the circumstances. He also draws detailed sketches in his notebook of the kind of structure best fitted for that location. In addition, topography is taken, showing accurately the lay of the surrounding country within the possible limits of changes in location.

Profile.—The level party takes the final profile, showing all the breaks in the ground, also the slope of the ground at right angles to the located line. The final profile and alignment notes are turned over to the field draftsman, and the notes and estimates of quantities are worked up.

Curvature.—The maximum curvatures allowed for canals of different sizes in earth are as follows: For canals with a carrying capacity of less than 400 sec-ft. the minimum radius permissible is six times the bottom width; for canals carrying from 900 to 400 sec-ft. the minimum radius is ten times the bottom width; and for capacities from 900 to 1,500 sec-ft. the minimum radius is twelve times the bottom width.

Curves of moderately long radius are not detrimental in the operation of any canal, and they should be used as far as possible to lighten the expense of construction. In locating around sharp rocky points, where the radius of curvature used is less than the allowable, the water slopes of the canal must be paved or rip-rapped for an adequate distance, in order to preclude the possibility of erosion.

In open country, where there is no timber to contend with, location by the above method costs from $45 to $65 per mile. This covers engineering salaries and expenses.

When the location on any particular canal has been finished and the estimates and profiles have been worked up, the data are sufficient to let the contracts. Until the line is cross-sectioned and the final quantities are worked up, the contractors are paid for work completed from the location quantities. The difference between the two estimates is balanced when the final measurements are made.

ENCASTRE BEAMS.

Mr. Arthur Morley is the author of the following, which appeared recently in "Engineering":

The following method of dealing with beams which are firmly clamped at their ends appears in its applications to be simpler than any other. It consists of treating the "encastré" beam as a particular case of the cantilever, of which the otherwise "free" end is subjected to (1) a supporting force, and (2) a couple, such as will together make the beam comply with the required end conditions.

Let A B = l be the span of a horizontal beam, R be the reaction at B, and M be the fixing couple at B. If the beam were simply clamped at A, and otherwise entirely free, let i be the slope and δ be the deflection which the loads would produce at the free end B. Let E be Young's modulus, and I be the moment of inertia of cross-section for the beam. Then, if A and B are to be at the same level, and the beam is to have zero slope at these two points, considering the joint effects of R, M, and the loads in producing first slope, and second deflection at B,

$$\frac{R l^2}{2 E I} - \frac{M l}{E I} - i = 0 \quad . \quad . \quad (1)$$

$$\frac{R l^3}{3 E I} - \frac{M l^2}{2 E I} - \delta = 0 \quad . \quad . \quad (2)$$

and from these two simple equations

$$R = \frac{6 E I}{l^3} (2\delta - l i) \quad . \quad . \quad (3)$$

$$M = \frac{2 E I}{l^2} (3\delta - 2 l i) \quad . \quad . \quad (4)$$

The shearing force, bending moment, slope, and deflection anywhere may now be found, as for a cantilever, by superposing the effects of R, M and the loads, or the supporting force and fixing couple at A may be found by the ordinary rules of statics, and any method used to complete the problem.

If the ends are fixed at any slopes other than zero, it is only necessary to add to the left-hand side of equation (1) the increase of slope from A to B. And if the two ends are not at the same level, it is only necessary to add the increase of deflection from A to B to the left side of equation (2).

The results (3) and (4) may also be stated for a general form of loading thus:—

$$R = \frac{6 A (2x - l)}{l} \quad . \quad . \quad . \quad (5)$$

$$M = \frac{2 A (3x - 2l)}{l} \quad . \quad . \quad . \quad (6)$$

where A is the area of the bending-moment diagram for the loads with the end B quite free, and x is the distance of the centroid of this area from A (horizontally).

Similar methods are applicable to other kinds of beams; for example, the beam freely supported at its ends may be regarded as a cantilever fixed horizontally at one end A, propped at the other end B with such a supporting force as will reduce the bending moment at A to zero, and then rotated about A through such an angle as will bring down to the level of A—viz., the angle

$$\frac{R l^3}{3 E I} - \delta \div l.$$

This angle added to the slope of the propped cantilever gives that of the freely supported beam; the deflection at a distance x from A is found by adding x times this angle to the deflection of the propped cantilever.

Example.—A beam of clear span l built in at both ends and carrying a load W at a distance n l from one end (A).

For the cantilever,

$$i = \frac{W (n l)^2}{2 E I} \qquad \delta = \frac{W l^3 n^2 (3 - n)}{6 E I},$$

and, substituting these in (3) and (4),

$$R = W n^2 (3 - 2n), \qquad M = W l n^2 (1 - n).$$