The design of the plan depends upon so many features over which the surveyor has no control, that a very broad field is open to one's ingenuity. Generally, it can be recommended to design the difficult portions first. The level land is easily looked after and depends largely on the layout of the more difficult sections.

It is very desirable to leave sufficient land between the roadway and the crest of a hill for the site of a dwelling, and of course the higher the building restriction the more distant must be the street line. It might be said here, that it is on this very point that more annoyance and trouble has arisen than over any other. The general practice has been to let the plus or minus distance work to the crest of the hill, and should there be any error in the preliminary survey or the design, the most valuable lots on the subdivision are very seriously impaired.

Upon undertaking to stake out a subdivision with curved roadways, the very first act should be to replot, or at least check over, the submitted plan of the proposed subdivision. I am firmly convinced that the larger part of the difficulties that surveyors in Toronto had with curved layouts some years ago were almost entirely due to the faulty design of the proposed plan. A surveyor, or the designer's assistants, would make a preliminary survey of a certain parcel, and the designer laying out his curves paid no attention to the necessity of having them laid off from a tangent already located, but left the surveyor an impossible task, and in other cases inserting curves with a radius much less than required. It can readily be seen how hopeless the results of such plans must be. Unfortunately, there is no satisfactory way of making adjustments to suit plans. If the plan radius is used, the error is carried all through the subsequent work. Whereas it is sometimes possible to adopt a new radius, yet the solution rarely can fulfil the intention of the plan.

Cases have occurred in Toronto, where the only way to correct the plan was to have certain sections re-subdivided and new registered plans prepared. In another case, more lots were on the plan than could be located on the ground. With registered plans prepared, it is rather difficult to amend such conditions and as a matter of fact, the worst cases were the result of having registered plans filed, and then attempting to stake out the lots on the ground.

It is unfortunate that the designer of so many of the large subdivision plans around Toronto some years ago did not more fully appreciate the necessity of mathematical accuracy in his productions. It would have materially lessened our troubles of the past, and for many years to come. Otherwise his work had a lot to commend it.

The foregoing are a few of the serious results that have followed the attempt to stake out subdivisions from faulty designs.

Many methods have been attempted in the endeavor to find a satisfactory method of laying out curves, that they may be readily reproduced and will answer all the required conditions of a re-survey.

The following are a few of the methods tried, and have certain features to commend them:—

(*a*) Right-angled offsets from an established base line.

(*b*) Location of regular curves by means of deflection angles.

(*c*) Location of regular curves by offsets from chord.

(*d*) Random location of corners accompanied by traverse.

(*e*) Right-angled offsets from an established base line.

On small blocks of a few acres in extent over rough land, this method can hardly be improved upon. A plan is prepared on as large a scale as possible, and the distances from the offset line to the lot corners are scaled off. It would be most difficult to imagine a condition, on such a plan, where the base line could not be re-established. It has also the advantage that the intermediate points on the curve may be established with the same degree of accuracy as the corners of the lots.

Location of Regular Curves by Deflection Angles

This system is about the best for general purposes. It has many disadvantages, but for large areas seems to be the only practicable method that covers the many points involved.

The first essential is an absolutely definite tangent, and having this, it should be possible to reproduce the whole of any subdivision. The location of the side and rear lines has no greater obstacles than other methods, and where the side lines are laid out as radial lines, the conditions are ideal—but unfortunately this is rarely the case. I remember one subdivision I made, where street lines and rear lines were all concentric circles, and the side lines all radial lines. With a picket at the centre of the subdivision, it was possible to run the side lines to locate the rear lot corners into the most inaccessible places.

One great disadvantage of this method is, that it does not lend itself to the laying out of lots with a uniform perpendicular distance, say, 50 feet, between parallel side lines. The necessary calculations are quite prohibitive until some one can devise a table for us, giving the deflection angles for chords of various degree curves. For cases like the above, I have been using a graphical amendment that I will describe shortly. One great improvement that might be used with great advantage would be a rule to have stakes planted at intervals of not more than 25 feet. It is very difficult to determine the location of lot corners where the only stakes planted are at intervals of from 50 feet to 100 feet, and these subject to all the vicissitudes of corner stakes. Something that would add greatly to the usefulness of this method would be a traverse run over the subdivision connecting the E. C. and B. C. of curves in such a way as to confine the courses of the traverse, within the limits of the highway. A method of tying I have used is to take points on the curves as far apart as convenient, anywhere from 400 to 600 feet more or less, each end being a lot corner. The bearing of the tie line is taken and at intervals of 50 tie in each stake on either side of the street. This method has the advantage of being more rapid than the right-angled offset ties and is probably as satisfactory.

Graphic Method of Laying Out Curves

The formula I have used for laying out curves by this method is

$$r = \frac{c^2}{8m} + \frac{m}{2} = \frac{c^2}{8m} + \frac{m}{2}$$

which can be abbreviated where m is small to

$$m = \frac{c^2}{8r} \quad \frac{c^2}{8r}$$

m for any curve depending on $m = \frac{c}{2}$ and an $\frac{\Delta}{4}$

where r = radius of curve.
c = length of chord.
m = middle ordinate.
Δ = exterior angle.

The chord is divided into the required number of divisions. Usually a division of the half chord into eight