

A SURVEYOR'S VIEW OF A CO-ORDINATE SYSTEM*by John Pope**

The object of this account is to explain how the practicing surveyor can use a co-ordinate system - especially to say what he is given to work with and to what extent he must employ mathematics.

Any co-ordinate system brought into use over a large area (say a province) is designed by the geodesist who must consider among other things:

- a) The size and shape of the area, and
- b) the relative precision of the work to be done within the system.

The geodesist is faced with the problem of representing the curved surface of the earth by a plane. Distortion is inevitable. However, the land surveyor does not ordinarily work to a precision better than one part in ten thousand parts. Hence if the distortion in the system is not greater than this the user cannot detect it. The result will be that FOR THE LAND SURVEYOR A KNOWLEDGE OF LATITUDES AND DEPARTURES IS ALL THAT IS NECESSARY TO USE SUCH A CO-ORDINATE SYSTEM.

Once the geodesist knows the limiting factor he designs the system and culminates the work by calculating the rectangular co-ordinates of those existing control points in the province for which positions have been determined with an accuracy equal to or greater than that desired. These co-ordinate values are given to the provincial government and it makes them available to anyone who wishes them.

It usually happens that the existing control is not sufficiently dense to be of immediate use to the land surveyor and the provincial government must establish more monumented control points.

Assuming that this had been done in an area in which a land surveyor wishes to work, what does the surveyor encounter on the ground? He finds two intervisible monuments for which a variety of positional data is available. Let it be assumed that there is available only the minimum information, namely the rectangular co-ordinates of the individual stations. For example: (1)

From this it is evident that both monuments are located east and north of a common beginning point. The location of the beginning point is of no immediate interest. THE SURVEYOR IS INTERESTED IN THE RELATIONS BETWEEN THESE MONUMENTS, for the line between the monuments will serve him as a baseline. The relations wanted are the length of the line between the monuments and its direction with respect to other similar lines in the system. These are obtained as follows: (2)

The surveyor thus is in possession of a baseline with the following characteristics: (3)

It is obvious that this calculation can be done at the provincial government level and the results given to the user in the form of a card giving bearing and distance from each monument in the system to all other visible monuments in the system.

From here on the surveyor can use the baseline to do one of two things:

- a) Either he can record points or objects on the ground in terms of his baseline by determining their rectangular co-ordinates.
- b) or he can find a point or an object on the ground if he has been given the rectangular co-ordinates of it.

As an illustration of the second situation suppose the building is later demolished and it is desired to establish the location of the corner armed only with its co-ordinates, that is the surveyor must solve the problem "where is point E. 944.3, N. 289.9?"

He has only to go back to 7 and run an open traverse to a point which in relation to 7 has a departure of +319.3 and a latitude of -37.5. He may equally well choose to work from 8 in which case he runs a traverse to a point which in relation to 8 has a departure of 791.0 and a latitude of -202.8.

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Obviously, this whole argument can apply to any base line whatsoever and in itself is a most elementary proposition in surveying. The benefit of the co-ordinate system established province-wide is that any thing located with respect to the given base line is located with respect to every other possible base line in the system. Should the two monuments first employed disappear in course of time, every other monument in the system stands as a witness to this baseline and to any measurements referred to it. In practice monuments do disappear or become displaced. A system of inspection and replacement is necessary in order to maintain the desired density of monumentation in any particular area.

Two of the arguments advanced against the establishment of a co-ordinate system invariably are the mathematical complexity of such a system and the cost of monumentation. The only difficult mathematics involve the geodesist, not the surveyor. The monumentation can be carried out a section at a time where the need is greatest and monumentation is a capital expenditure which has returned dividends wherever used. A case in point is New Brunswick which began such a system in 1959 and is making extensive use of it to their benefit.

Some of the immediate benefits to the users of such a system in Nova Scotia would be:

- a) positional control by municipal survey departments in high density building areas,
- b) systematic preservation of the mathematical description of lot boundaries referred to the system,
- c) municipal tax and assessment problems over "lost" and "shifting" lots could be solved permanently,
- d) detailed planning for highways and for city fringe areas could be carried out in sections which will later fit together with certainty,
- e) mineral land boundaries could be located with greater certainty and less computation than is now possible,
- f) existing and future surveys can be integrated and duplication avoided.

A word of warning is necessary lest the user become overconfident. One can only get out of the system what one puts in. If points are referenced to the co-ordinate monuments with a relative precision of 1 in 10,000. Its the old story; given two decimal places in the answer you can always round off to one place, but with one place only, you can't tell what the second might be.

(1) Example not available: (2), (3) Sketches not available. - The Editor.

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SERVICES OF ONTARIO LAND SURVEYORS REQUIRED BY DEPARTMENT OF LANDS AND FORESTS

The Department of Lands and Forests, Lands and Surveys Branch, occasionally requires at Toronto, temporary in-office services of Ontario Land Surveyors with approximately 10 years experience. Periods of service may extend from one to six months. Assignments to include such services as examination of returns of surveys, descriptions, research and special studies.

Offers of Services are to be made in writing to the Surveyor General outlining experience and stating periods services are available.