

# Control Survey Stations

*The following is the text of a memorandum from R. A. Smith, O.L.S., Metropolitan Toronto's mapping manager, to the legal survey section of Metro's Department of Roads and Traffic.*

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WHEN PERFORMING coordinated legal surveys, it is necessary to take into consideration the amount, if any, a control marker is off the original position of the control station. The method to be followed is analogous to the method followed when a legal survey monument (iron bar) is off the original position of a legal corner.

Control survey reference sheets and coordinate listings show the coordinate values assigned to the position of each control station and the date the values were assigned. Each control station acts as a local datum point and is therefore positively related to the grid. The original position of each control station is physically maintained by reference ties to nearby stable physical features, as per Ontario Specification (OS 79).

To facilitate surveying and engineering applications, a control marker is placed at or near most control stations. A control marker is often placed before the stations coordinates are ascertained. This marker in its original position marks the control station. As with legal survey corners, it is not the original monument that governs but the original position of the monument that governs. Legal survey monuments move and so do control markers. When retracing the original position of a control station, the control marker is presumed to be correct until proven otherwise. From time to time, Central Mapping ascertains that a marker is off the station and shows the delta X and delta Y along with the appropriate date on the reference sheet. These measurements indicate the amount the centre of the marker (not various cut marks thereon) is off the station. It is therefore a simple exercise to calculate the coordinate location of a control marker.

When using control stations, the most recent information should be obtained from the Central Mapping Office. In the past, copies of all reference sheets were forwarded from CMA for the surveys files. This practice has been discontinued. The reference sheets in the survey files may be out of date and should not be used.

Coordinates on a legal survey corner

are a way of expressing the position of the legal corner relative to the control stations on either side. Even if the coordinate value for one or both of the control stations change, the relative proportional relationships remain constant. Therefore, it is necessary to note on legal survey plans both the coordinates of the control stations, at the time of the survey, and the coordinates of the legal corners. The control station then acts as a witness post (or bearing tree) for nearby legal corners.

Legal surveys plan should show the amount the legal monuments were found to be off the legal corners and the amount the control markers were found off the control stations. It is permissible to note on a plan that another surveyor called a legal monument off (i.e. cutcross 0.015E OLS 1). Similarly, a control marker can be called off as per the Central Mapping's reference sheet (i.e. brass cap 0.005N, 0.008E, Metro).

Various approaches may be taken when conducting coordinated legal surveys. The following may serve as a guide.

1. Obtain from CMA the coordinate values for the control stations and the delta X, delta Y for the markers.
2. As most control markers are very stable (i.e. brass plugs in side walks) the coordinate values for the control markers may be calculated directly from the above data and used.
3. If the marker location has not been reviewed by CMA (i.e. no date is shown and the delta X, delta Y are shown as 0.0) or if the marker may be unstable (i.e. an iron bar) then follow CMA's instruction for marker maintenance.
4. In the field, measure as directly as possible from the control markers to the legal survey monuments. The more irregular the connection between the markers and the legal survey monuments the weaker the coordinate locations assigned to the legal points. A distant control station or one of its reference tie points may be used as a backsight.
5. For staking out legal corners, precalculate the dimensions from the control markers, or from your traverse points.
6. On the plan, show the coordinate values for the control stations, the amount the control markers are off and the coordinates for the legal corners and the amount legal monuments are off.
7. When retracing a previously coordinated legal corner, measure directly from the control markers, on either side of the legal corners, to the legal monument. Then proportion to find the measured coordinate values for the monument.
8. Differences between the measured coordinate values for the monument and the original coordinate values for the corner may exist as a result of:
  - (a) expected minor differences in legal survey measurements (tolerance for plan dimensions 2 cm + 1:5,000);
  - (b) the legal monument having moved from its original position as per the coordinate difference;
  - (c) using an irregular traverse or low accuracy measurements to coordinate the legal monument resulting in inaccurately measured coordinate values;
  - (d) the previous legal surveyor's methods and/or procedures not resulting in accurate original coordinate values;
  - (e) the delta X, delta Y of the control markers not being taken into consideration during either the original or the retracement survey; or
  - (f) the values for one or both the control stations were revised.
9. Once the coordinate differences have been reconciled it is necessary to evaluate the legal survey evidence. If you agree with the method used by the previous surveyor when he located the legal corner, then it is relatively easy to reconstruct the original position of the legal corner and ascertain its coordinates.



10. If your opinion is consistent with that of the previous surveyor and the values only differ by the expected minor differences in legal survey measurements, then hold the previous coordinate values. This is similar to holding the original registered plan frontage for a lot even though your measurement is slightly different.
11. If in your opinion incorrect coordinate values had been assigned to the corner, either because the previous surveyor had not correctly retraced the original position of the original corner or had improperly coordinated it, then assign your own new coordinate values to the corner. In either cases, the onus is on you to prove the originally assigned coordinate values are incorrect.
12. There are two other circumstances where new coordinate values must be assigned to a corner. Subsequent to the previous survey, the coordinate values for the control stations may have changed. (See 9F.) Then the old coordinate values for the station and the legal corner must be converted, by proportioning, to the new values. The revised old values and the mea-





sured values can then be compared and evaluated. The final values for the legal corner must in this case be consistent with the new values for the station.

13. The second case is where the control network has been densified and a new station has been set much closer to the legal corner. The original coordinates for the legal corner were based on a traverse considerably longer than the new traverse. The coordinates for the new station should not be used to ascertain an improved opinion of the coordinate values for the legal corner.
14. Because the coordinate values for control stations can change due to readjustment, the stations' coordinate values as used are shown on legal survey plans. Similarly, because control networks may be densified, it is necessary to indicate the accuracy or tolerance (circle of error) for coordinated legal corners.

In urban areas where there is a mature network (i.e. stations about 250 m apart), the tolerance for coordinates of legal corners is understood to be within allowable limits (0.03 m

MAE), unless stated otherwise, and is not shown on the plan. In all other cases the surveyor's opinion of the tolerance (radius of the circle of error) should be shown. The coordinate values for the starting stations are always shown. ●

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-  persistent pain and stiffness on arising.
-  pain, tenderness or swelling in one or more joints.
-  recurrence of these symptoms, especially when they involve more than one joint.
-  persistent pain and stiffness in the neck, lower back or knees.

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