

GULF SURVEYORS GROUP INC.

PROFESSIONAL SURVEYORS AND MAPPERS

POBOX 3306, APOLLO BEACH, FL 33572

TEL: (813) 641-1051 FAX: (813) 645-3797

info@gulfsurveyors.com - www.gulfsurveyors.com

Design Control and Dependant Construction Control

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The use of the term error in construction staking is often misused. The real issue is more often an imprecision in the stakeout work. This paper will address one of the single largest issues that contributes to a true error in the establishment of dependant control.

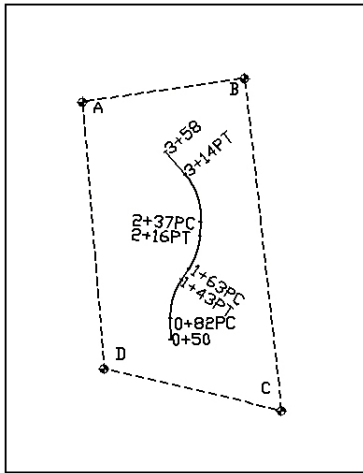
THE CHARACTERISTICS OF CONTROL SURVEYS

Each control survey is a separate and unique entity and has the following characteristics:

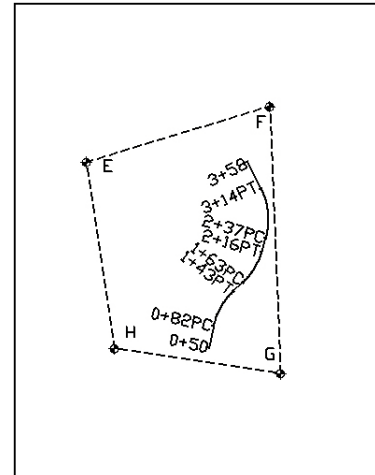
1. Primary Control:
 - A. Design Control Survey – Primary control points used to establish the Design Control Survey should be the published, high order control points in the vicinity of the proposed construction and be designated for use by the owner or agency
 - 1) Selection of primary control points for the Design Control Survey
 - a) Should be comprised of control points established from a single primary control survey or adjustment if possible
 - b) Primary control should exist outside of the design corridor and be physically located in the four quadrants of the project – one way to visualize this is to think of controlling the roll and pitch of the project – another is to remember that control should always be established from the outside/in and never from the inside/out
 - 2) *The Design Control Survey creates a Project Control Envelope* for which the extremity is defined by the location of the primary control that is used
 - a) When the Design Control Survey is performed it is not limited to creating a point in the ground, the Design Control Survey also has a relationship between the points that is unique unto itself and is usually defined by the stated precision of the survey
 - b) Each position or existing data that is located within the Project Control Envelope from the Design Control Survey is dependent on the location and precision of the Design Control Survey
 - 3) *Any positions that are established in the Project Control Envelope from control outside of the Project Control create errors in position and rotation.*
 - 4) The budget for the Design Control Survey is often set by entities that don't understand the entire process often resulting in a lack of funds and QA/QC issues.
 - 5) Strong consideration should be given to the location and type of Design Control Survey point that is set in the field.
 - a) Design Control Survey points are often set in a convenient location for the acquisition of data, i.e., within the road right of way – standard construction clearing activity often destroys the majority of the control
 - b) Design Control Survey points are often constructed of wooden hubs, heavy nails or reinforcement bars and are easily destroyed – the use of concrete monuments are not appropriate for each Design Control Survey point, but should be considered in key locations to perpetuate the control

B. Construction Control Survey should be dependant on the Design Control Survey or as much so as possible.

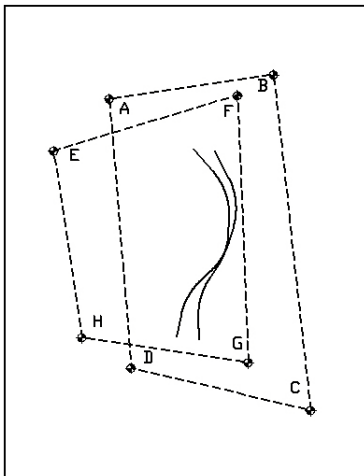
- 1) It is not always possible to establish the Construction Control entirely from the Design Control – if this is the case as much of the Design Control as possible should be located in the Construction Control Survey to establish any differences in the two surveys.
- 2) *An independent Construction Control Survey results in errors due unaccountable location and rotation differences in the staked positions compared to the designed positions.*



The example on the left represents a roadway alignment based on the Design Control Survey. The example on the right represents the same roadway alignment based on a Construction Control Survey that was established independent of the Design Control Survey.



Note that both alignments are related very precisely to the control that was established.



The final example on the left shows the potential result of an independent Construction Control Survey.

- Points A-D in the Design Control Survey and points E-H in the Construction Control Survey were established from different primary control points.
- Although the two surveys meet any defined specifications within themselves, the failure to reference the surveys to each other has resulted in unacceptable error.

In an actual project, the prudent contractor will make at least minimal QA/QC checks on points that are staked in the field. The prudent stakeout personnel will perform QA/ QC checks to catch errors as well. *The resolution of differences in the Design Control Survey and the independent Construction Control*

Survey are avoidable errors if rigorous procedures are used.

CONCLUSIONS

1. The Design Control Survey creates a Project Control Envelope
2. Any positions that are established in the Primary Control Envelope from control outside of the Primary Control create errors in position and rotation.
3. The failure to use the design control to establish the construction control results in errors due to unaccountable differences in the staked positions compared to the designed positions.
4. The resolution of differences in the Design Control Survey and the independent Construction Control Survey are avoidable errors if rigorous procedures are used.