CCSF BSM Projects: Surveying, Processing & Reporting Requirements

BSM contractors and their sub-contractors are expected to follow the methods and procedures for surveying, processing and reporting projects addressed herein. Control traverses established by contractors will be closed loops or closed on BSM Control Points. The horizontal and vertical coordinates, descriptions and photos for the control points are typically provided by BSM to control the contractor's field survey measurements and develop coordinates. Unless directed otherwise, the majority of BSM projects will be coordinated on a City specific grid projection called the CCSF Coordinate System of 2013 (CCSF-CS13). The elevations will be based on the CCSF-VD13 Vertical Datum which is NAVD88 as recovered by CCSF in 2013. (See "Geodesy Summary", "Datum-H-V Simplified CCSF", "CCSF 2013 HPN Coords", "CCSF-Benchmark List-2013 Vertical Datum" and the "CCSF-HPND Coordinate List" and the Public Works website at http://www.sfpublicworks.org/ccsf-geodetic-network)

In addition to establishing new control points, the traverse must tie existing reference points. All existing points falling in the traverse area of responsibility shall be tied to the control traverse including but not limited to HPN Points, HPND Points, TND Points, Benchmarks and City Monuments.

It is imperative the BSM point numbering scheme be adhered to. New control points are assigned an 8-digit BSM Project Specific number ID for example 17032101, 17032102 etc. and topo points are assigned a 10-digit BSM Project Specific number ID for example 1703210001 (See "Guide-Point Numbering System"). Do not assign new ID's to existing BSM CCSF-CS13 Control Points, CCSF-VD13 Benchmarks and City Monuments.

The field observations should be processed daily. After completion of the control traverse, submit the draft survey report with the minimally constrained and constrained traverse adjustments to BSM for review prior to beginning the topographic survey. BSM will make every effort to review and approve the results within 2-3 days.

StarNet is the Least Squares Program used by BSM to adjust traverses and is preferred for processing and adjusting traverse observations in CCSF-CS13 and CCSF-VD13. If there is sufficient redundancy and the adjustment parameters are set up properly, the least squares solution provides the most robust method for detecting blunders, properly distributing random errors and creating a statistical report of the accuracy.

BSM's intention is to have uniform and complete submittals from all contractors to expedite the process on both ends. The field surveys, data processing and preparation of submittals for BSM contracts entails the following.

1- Control Networks: The basis for BSM surveys will be the CCSF 2013 HPN (Primary High Precision Network), the HPND (Secondary High Precision Network Densification), or the TND (Tertiary Network Densification) employing the CCSF-CS13 Coordinate System with the correct projection parameters and the CCSF-VD13 Vertical Datum.

2- CCSF-CS13 is <u>not</u> a local coordinate system. Developing coordinates in the CCSF-CS13 Projection can best be accomplished utilizing Starnet or a similar adjustment application that accommodates projections and combined scale factors. The following projection parameters, settings and outputs are necessary.

   a- Starnet: Project settings for developing coordinates in the CCSF Coordinate System of 2013 (CCSF-CS13).

      1- Datum= NAD83, Ellipsoid= GRS80
      2- Projection= CCSF-CS13 (projection parameters are listed in RS #8080)
      3- Units= US Survey Feet
      4- Ellipsoid Height= -32.6 meters / -107 feet
      5- Adjustment Type: 3D
      6- Instrument Standard Deviations are per contractor's a-priori experience or instrument specs and should be similar to BSM's
      7- Output Listing: Sort Coordinates by NAME, Sort Unadjusted Input Observations by INPUT ORDER and List Adjusted Observations & Residuals by NAME. Activate "Coordinate Changes from Entered Provisionals" to list the differences from the published control coordinates to the computed coordinates.

   b- Adjustments: Provide a minimally constrained and constrained traverse adjustment listings, a control map and Google KMZ file of the control traverse for review. Adjustments 1, 2 and 3 below are typically developed for a traverse. Adjustment 2 is most useful for locating errors and validating the accuracy of the traverse. (For details see "Guide-Traverse Adjustment-Least Squares")

      1- Minimally Constrained 3D Adjustment: Fix one point for horizontal, one point for vertical, fix or float a bearing and view the differences (closures) on other known points.
      2- Free Weighted Constrained Adjustment: Set all horizontal and vertical constraints to a weight of 1 foot, do not fix a bearing and view the differences at all control points.
      3- Constrained 3D Adjustment: Fix all acceptable horizontal and vertical points to produce final project coordinates.

3- Reports: Survey Reports are the end-product of professional services. The report provides the details of the survey, an explanation of the findings, data produced and conclusions. Essentially, the report addresses the who, what, why, where, when and how of the survey. It includes the results, information (metadata) regarding the quality of the survey measurements, closures on the control, point descriptions and a list of the CCSF-CS13 and CCSF-VD13 coordinates. The Report enables BSM to follow in the surveyor's footsteps and is required in the On-Call Contracts. These reports are essential for BSM to QA/QC the survey and integrate the results into the BSM system. There are two types of Reports, the "Short Form" and the "Long Form" Survey Report as described below. BSM will specify what type is required for specific projects.

a. Short Form Survey Report: A fill in the blanks in the "Form-SurveyRpt-ShortForm-Traverse". It identifies the horizontal and vertical control points with their coordinate values, the points held, lines held for the basis of bearings, the differences between the published and measured values, and a narrative.

b. Long Form Survey Report: A more detailed report as described in "3-Reports" above (see example "Form-SurveyRpt-Long Form-Traverse"). It will include minimally constrained and constrained adjustment listings, a control map, and a Google KMZ file of the network. Please provide the adjustments of the control survey without the numerous topo side shots. (see "Guide-Traverse Adjustment-Least Squares")

c. BSM can assist contractors who use Starnet in producing results consistent with BSM procedures if provided a copy of the their StarNet project files listed below:

*.pts (plane coordinates and elevations),
*.pos (geodetic coordinates),
*.lst (listing), *.snproj (StarNet project file) and the
*.dat (StarNet constraints and observations files).

Appendix of Supporting Documents

General

CCSF 2013 HPN coords – 2013 HPN Geodetic and CCSF-CS13 Projection Coordinate Lists
CCSF-Benchmark List-2013 Vertical Datum - Benchmark List of all CCSF-VD13 Benchmarks with the heights in meters and feet current through the indicated date.
CCSF-HPND Coordinate List – HPND Coordinate List (HPN Densification) of lat., long., ellipsoid heights, CCSF-CS13 coordinates and CCSF-VD13 heights in feet current through the indicated date.
Datum-H-V Simplified CCSF - Explanation of CCSF Datums and Reference Frames in SF
Geodesy Summary – CCSF HPN Network densification description, history and status.

Forms

Form-SurveyRpt-LongForm-Traverse - Example Long Form Traverse Survey Report
Form-SurveyRpt-ShortForm-Traverse - Example Short Form Traverse Report (small projects)

Guides

Guide-Instructions for Monument Visit v20180605(subs)
Guide-Instrument&PointGroupFileNamingProtocols (subs) v20180627(subs)
Guide-PhotoDocumentation-SurveyPoints
Guide-Point Numbering System - Guide for naming control, topo etc. points
Guide-Point Numbering-MID vs Designation v20180615
Guide-StarNet v8-CS13 Install Instructions - Setting up the CCSF-CS13 Projection in Starnet
Guide-SurveyProcedure-Establishing CS13 CoordsOnMonuments (subs)
Guide-Traverse Adjustment-Least Squares.doc - Training Guide for processing traverse adjustments in Starnet