

## Chapter 5

### VERTICAL CONTROL (VERT) DATA

#### INTRODUCTION

For coding and processing purposes, the data associated with geodetic vertical control (VERT data) have been divided into three groups. The three vertical control data groups are (1) the field observations of elevation differences between survey points (OBS data), (2) descriptive data including original descriptions and recovery descriptions (DESC data), and (3) adjusted elevations (ELEV data). Detailed instructions and formats for the coding and keying of the OBS, DESC, and ELEV vertical control data sets are contained in Chapters 6, 7, and 8, respectively.

Although data of all three types are normally generated in connection with a vertical control survey project, OBS, DESC, and ELEV data must be submitted to NGS as separate data sets. There are two modes in which vertical control data may be submitted to NGS for insertion in the National Geodetic Survey Data Base. In order of preference, they are:

MODE 1 - Field Observations and Descriptive Data (VERT OBS and VERT DESC data)

MODE 2 - Adjusted Elevations and Descriptive Data (VERT ELEV and VERT DESC data).

The foregoing implies that every vertical control survey project (or several projects submitted as one "job" - see below) will be received at NGS as two distinct data sets: either OBS and DESC data sets under MODE 1, or ELEV and DESC data sets under MODE 2. The two data sets of each vertical control job must be submitted at the same time.

There are distinct benefits to be realized when vertical control data intended for insertion in the National Geodetic Survey Data Base are submitted in the MODE 1 configuration. Because the field observations which connect the survey points are given, MODE 1 data can be rigorously combined with data held by NGS and incorporated (adjusted) into the national vertical control network. This process insures that the elevations of the new survey points will be consistent with the existing vertical control in that area. By contrast, MODE 2 data consist of isolated points whose elevations are accepted as determined by the submitting agency. Because the connecting observations are not available, these elevations cannot be verified, and they cannot be rigorously updated when the vertical control network in their vicinity is readjusted.

For reasons cited in the preceding paragraph, vertical control data intended for insertion in the National Geodetic Survey Data Base should be submitted as MODE 1 data. MODE 2 data will be accepted only on an exception basis after consultation between NGS and the submitting agency.

#### JOB CODE AND SURVEY POINT NUMBERING

The basic unit or grouping of data to be submitted is given the name "job". A vertical control job may consist of data for a maximum 9999 survey points - see definition of "survey point" below. A job may consist of a single project (i.e., one unit of field work), or a number of projects may be included in one job. It is suggested that geographic proximity be the determining factor in selecting vertical control projects for inclusion in any one job. This approach eliminates duplicate keying of DESC data for vertical control survey projects which have points in common (e.g., a releveling over a previously established line, when both projects are to be submitted for insertion in the National Geodetic Survey Data Base).

A two-character alphanumeric code must be assigned to each vertical control job submitted by an agency in accordance with this publication. This job code, the data set type, the name of the submitting agency, and the data set creation date will serve to uniquely identify every data set received by NGS. The first character of the two-character job code must always be a letter; the second character may be either a letter or a number (1 through 9). Begin the assigning of job codes with A1 and end with ZZ, i.e., A1, A2, ..., B1, ..., Z1, ..., Z9, AA, AB, ..., ZZ. This allows for a total of 910 uniquely identified vertical control jobs to be submitted by any one agency. Should this sequence be exhausted, start assigning job codes again from the beginning: A1, A2, etc.

A vertical control point is defined as a survey point which is monumented (or otherwise permanently marked) and/or described and whose (adjusted) elevation is given (ELEV data), whose elevation is to be determined in an adjustment (OBS data), or whose elevation is available from other sources. A vertical control point is commonly known as a "bench mark" (BM). A survey point, in turn, is defined as any point which has one or more elevation differences measured to it or from it. A survey point may be a temporary bench mark (TBM, neither permanently marked nor described and therefore nonrecoverable), a described TBM, or a permanent bench mark (monumented and described). Henceforth, the term "bench mark" will be understood to also include the special class of described temporary bench marks (TBMs).

Each survey point that is leveled to in a vertical control job must be assigned a unique four-digit serial number (not necessarily consecutive)

**LEGEND**

- Bench Mark
- Temporary Bench Mark
- ⊗ Junction TBM
  
- Epoch 1 Project
- - - Epoch 2 Project
- ..... Epoch 3 Project

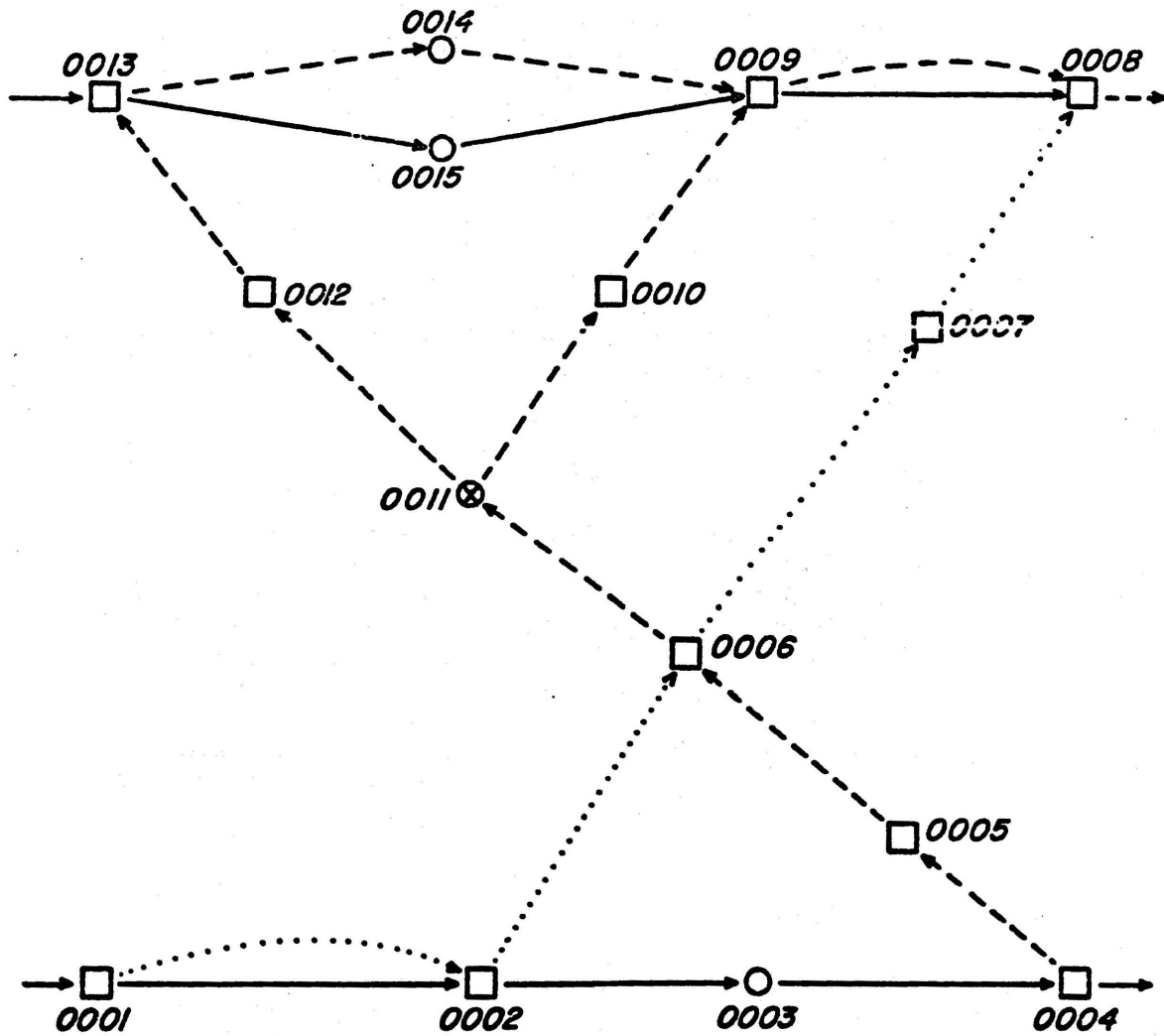


FIGURE 5-1 - Example of vertical survey point numbering.

in the range 0001 through 9999. If the number of survey points exceeds 9999, the vertical control data in question must be divided and submitted as two or more jobs. In general, level lines should not be subdivided. Figure 5-1 illustrates the assignment of survey point serial numbers (SPSNs). This numbering system provides a unique identifier for every survey point which is leveled in a vertical control job. The same survey point serial number (SPSN) must be consistently used whenever reference is made to the same point in either the OBS, DESC, or ELEV data sets of a vertical control job. All survey points for which recovery descriptions are written in this current project, but which are not leveled in this current project, will be assigned the SPSN code 0000.

As pointed out in the INTRODUCTION, a vertical control job consists of two separate data sets - either the VERT OBS and VERT DESC data sets under MODE 1, or the VERT ELEV and VERT DESC data sets under MODE 2. When MODE 2 data are submitted, there will be one-to-one correspondence between points in the respective ELEV and DESC data sets, because every control point in the ELEV data set must also have an original description and/or recovery description(s) in the corresponding DESC data set. When MODE 1 data are submitted, however, there will normally be a greater number of points in the OBS data set than in the corresponding DESC data set. This condition is brought about by the fact that there are, in general, temporary bench marks (TBMs) in the OBS data set for which no descriptive data have been prepared. It must be emphasized, however, that descriptive data should exist for all recoverable vertical control points.

When the data-recording medium is magnetic tape (see below), the two data sets of a vertical control job must be submitted as two separate files. These files may be on the same reel of tape or on different reels if the data are organized so that a tape contains data sets of only one type (e.g., VERT OBS data sets) when many jobs are being submitted. When the data-recording medium is punched cards, the two data sets must be submitted as two separate decks. In any case, the first record of every data set (see Chapters 6, 7, and 8) must contain the information by means of which the respective data sets are positively identified and correlated - the job code, the data set type, the name of the submitting agency, and the data set creation date.

#### MEDIA FOR SUBMITTING DATA

Although in principle any computer-readable, general-purpose data-recording medium can be handled, the two media acceptable to NGS on a routine basis at the present time are punched cards (80 columns) and standard 1/2-inch magnetic tape. Magnetic tape is the preferred medium for both small and large volumes of data; agencies submitting

large volumes of data should use this medium exclusively. Punched cards should be used only for small, isolated jobs.

When the data are submitted as decks of punched cards, care must be taken to package each deck separately in order to minimize the likelihood of cards from different decks becoming intermingled. Provision is made for a sequence number to appear on every card of a deck; however, only the first card of each deck contains the deck identification data. The following information must be given for each data set submitted as a deck of cards:

1. Name and address of the submitting agency.
2. Contents of the deck by job code and data type (e.g., A1 VERT OBS, XX VERT DESC, etc.).
3. Character representation code (BCD, EBCDIC, etc.) and/or keypunch equipment used (e.g., IBM 026, IBM 029, etc.).
4. Name and telephone number of person to be contacted in case of difficulty with the data.

This information should be given in a letter of transmittal, a copy of which should be packed with the data set in question.

When the data are submitted as files of formatted records on magnetic tape, the following information is expected to be given for each reel of tape:

1. Name and address of the submitting agency.
2. Reel number or identification symbol assigned by the submitting agency.
3. Number of files and contents of each file by job code and data type (e.g., A1 VERT OBS, XX VERT DESC, etc.).
4. Computer system on which the tape was created (e.g., IBM 360/XXX, CDC 6600, etc.).
5. Internal label information (e.g., non-labeled, standard IBM label, etc.).
6. Number of tracks (7 or 9) and parity (even or odd).
7. Recording density (556, 800, or 1600 BPI).
8. Record length (LRECL) and block size (BLKSIZE).

9. Character representation code (BCD, EBCDIC, etc.) and keytape equipment designation, if applicable.
10. Name and telephone number of person to be contacted in case of difficulty with the data.

In addition to being given in the respective letter of transmittal, this information should be entered on one or more "stick-on" labels affixed to the magnetic tape reel.

A letter of transmittal in which the data are described and itemized should always be prepared for each data shipment. One copy should be enclosed with the data shipment, one sent by separate mail to NGS, and another copy should be retained by the sender. See ANNEX K for the current mailing instructions. In every case, the submitting agency should retain a backup copy of all data included in a shipment until the receipt of that specific data is acknowledged by NGS.

#### CODING, KEYING, AND DATA VERIFICATION

All data submitted to NGS for insertion in the National Geodetic Survey Data Base must be coded and keyed in strict conformity with the formats and specifications contained in this publication. In addition, the keying of all data must be verified. Detailed formats and specifications for the coding and keying of vertical control jobs are contained in Chapter 6 (VERT OBS data), Chapter 7 (VERT DESC data), and Chapter 8 (VERT ELEV data). The formats were designed to allow the keying and verification of the data to be accomplished on standard keypunch or keytape equipment. The 80-character record (one punched card image) has been adopted for all applications.

In keying the data entries, care must be taken to insure that alphabetic characters (letters) are always keyed using the alphabetic keys on the keying device, and that numeric characters (numbers) are always keyed using numeric keys. In particular, the miskeying of the following characters must be avoided:

0 - number "zero"	1 - number "one"	2 - number "two"
0 - letter "O"	L - letter "L"	Z - letter "Z"

## SPECIAL CHARACTERS

In addition to alphabetic characters (letters A through Z) and numeric characters (numbers 0 through 9), the following special characters are allowed:

(*) asterisk	(+) plus sign
( ) blank or space	(-) minus sign or hyphen
(,) comma	(=) equal sign
(.) period or decimal point	(/) slash or solidus
(\$) dollar sign	(() left parenthesis
	()) right parenthesis

NOTE: A further restriction on characters is imposed for Bench Mark designations (see Annex D).

## SEQUENTIAL RECORD NUMBERING

The first six characters of every record are reserved for a record sequence number. The purpose of the sequential numbering of records is to insure that the proper sequence of individual records in a data set can be verified and, if necessary, restored. The record sequence numbers must form one continuing sequence throughout each data set, starting with the first record (the Data Set Identification Record) and ending with the last record (the Data Set Termination Record).

Start with assigning sequence number 000010 to the first record in the data set (the Data Set Identification Record) and increment by 10 on each successive record. This numbering system allows up to nine records to be inserted between any two originally numbered records without the necessity of renumbering any records in the data set. Even when a large block of omitted records must be inserted, only a few of the existing records will have to be renumbered. However, to allow for the detection of missing records, all insertions and/or deletions which cause deviation from the basic 000010, 000020, 000030, etc. "increment-by-ten" record sequence must be accounted for in the respective letter of transmittal.

Discounting any after-the-fact insertions, the above-described sequential numbering system will permit a maximum of 99,999 uniquely numbered records in any one data set. Should there ever be a need for a greater number of records in a data set, retain only the last six digits of the higher sequence numbers, i.e., ... 999980, 999990, 000010, etc.

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