

Leica/Wild Operation Codes

(This functionality is available with the Input / Output module)

This topic documents the operation **codes** that may be used when performing field surveys with **Leica/Wild** data recorders for processing in the system.

Refer to the [Leica/Wild Measurement Block](#) topic for information about the Leica/Wild GSI format and how it is processed into a Field file.

Please note that if you are using a TC-600 total station, the operation codes used depend on the firmware version of the particular TC-600 that you are using. Refer to the [TC-600 Field Operations](#) topic.

Please note that if you are using a Leica GPS-300, the operation codes available are documented in the [Leica GPS-300 Operation Codes](#) topic.

Please note that if you are using a Leica GPS-500, the field operations are documented in the [Leica GPS-500 Field Operations](#) topic.

Refer also to the [Traversing](#) topic.

Definitions:

Operation Code - LEICA/WILD Code Block

Feature Code - feature code used by the system

Note: The system uses point identifiers and the point identifier is extracted from the measurement block.

For metric data files, all distances are assumed to be in millimetres or tenths of a millimetre (as set on the instrument) unless a decimal point is encountered.

For imperial data files, all distances are assumed to be in tenths or hundredths of a foot (as set on the instrument) unless a decimal point is encountered.

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(Same as op code 90, but entered before observation)

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DETAILS OF EACH LEICA/WILD OPERATIONAL CODE

GROUP 0 - Field Measurements & Feature Code

OPERATION CODE 1

New Set Up (Before Observation)

1. Station Point Identifier
2. Instrument Height
3. Target Height
4. Backsight Station Point Identifier - Optional

The backsight station point must be known at reduction time. If on datum, information block 4 is not used or is set to zero. If a backsight station is set, the next observation will be used to calculate the bearing rotation to be applied to the following observations.

OPERATION CODE 2

New Target Height (Before Observation)

1. Target Height

OPERATION CODE 3

Sets of Directions (Before Observations)

1. Number of Arcs to be read (default is 2 arcs)
2. Number of Foresights (default is 1)

The maximum number of observations that can be included in a set of directions is 256. That is, the number of Arcs multiplied by the number of foresights can not exceed 256. If the number of observations in a set of directions exceeds 100, a reformatting error will occur.

Operation code 3 may be used to read a set of directions including vertical angles and slope distances. Note that a set must contain slope observations, as the vertical circle readings (and slope distances) are averaged and reduced as part of the reduction and extraction process. The observations must be read in the following manner.

Arc 1 - Face 1 reading clockwise from backsight to foresights

Arc 2 - Face 2 reading anticlockwise from the last observed foresight back to the backsight.

The process may be repeated any number of times provided the maximum number of directions in total set does not exceed 200.

Operation code 3 may contain 2 information words

Information Word 1 contains the number of arcs to be read

(The default if no value is entered is 2 - i.e. a set of directions consisting of a Face 1 reading followed by a Face 2 reading)

Information Word 2 contains the number of foresights read. (The default if no value is entered is 1)

To ensure that the system uses the required orientation and target heights when reducing a set of rounds and subsequent observations following a set of rounds, always use the following procedure:

1. Carry out a setup immediately prior to observing a set of rounds.
2. You may change target height for each "Arc 1" observation, but **do not** change the target height for subsequent arcs. The target height set for an "Arc 1" observation to a particular foresight point is automatically used by the system for the corresponding subsequent observations. Therefore, ensure that the target height is the same for all pointings to any particular point.
Note that if no distance is read, then the vertical angle associated with such observations can be ignored in the Reduction process by NOT selecting the "Mean All Verticals" option. This enables you to observe using any target height provided all you are interested in is sets of horizontal angles.
3. After the set of rounds is completed, carry out another setup to define the required orientation for any subsequent observations.

The following Leica/Wild Raw Data set shows sets of directions at two station set ups.

(Added comments are shown in italics)

WILD GIF-12

410067+00000001 42....+00000001 43....+0001.565 44....+00001.45 45....+0000STN2

(Backsight target height is set to 1.45)

410068+00000009 42....+00000001 43....+001000.0 44....+002000.0 45....+000030.0

410069+00000003 42....+00000004

(Operation code for the following set of rounds consisting of 4 arcs)

Note: The point identifier of the backsight [BS] and Foresight [FS] is only entered on the first pointing.

The target height of the foresight is entered only prior to the first pointing to that foresight)

110070+0000STN2 21.104+00000000 22.104+26828460 31..00+00037827 51..1.+0016+000 BS

410071+00000002 42....+000001.2 *(Foresight target height is set to 1.2)*

110072+000000A3 21.104+02956520 22.104+26727080 31..00+00018786 51..1.+0016+000 FS

110073+00000129 21.104+20957590 22.104+09233070 31..00+00018785 51..1.+0016+000 FS

110074+00000130 21.104+17959500 22.104+09131230 31..00+00037839 51..1.+0016+000 BS

110075+00000131 21.104+35959310 22.104+26828410 31..00+00037836 51..1.+0016+000 BS

110076+00000132 21.104+02956560 22.104+26726590 31..00+00018777 51..1.+0016+000 FS

110077+00000133 21.104+20957120 22.104+09233160 31..00+00018785 51..1.+0016+000 FS

110078+00000134 21.104+18000250 22.104+09131230 31..00+00037833 51..1.+0016+000 BS

(Point Identifiers 129 to 134 are replaced with the correct point identifiers on creation of the field file)

410079+00000001 42....+0000STN2 43....+00001510 44....+000001.4 45....+00000001

(Backsight target height is set to 1.4)

410080+00000003

(Operation code for the following set of rounds consisting of 2 arcs)

110081+00000001 21.104+04404280 22.104+27115260 31..00+00037832 51..1.+0016+000

410082+00000002 42....+000002.0 *(Foresight target height is set to 2.0)*

110083+000000A3 21.104+02030080 22.104+27212350 31..00+00023496 51..1.+0016+000

110084+00000135 21.104+20029410 22.104+08747430 31..00+00023510 51..1.+0016+000

110085+00000136 21.104+22404500 22.104+08844520 31..00+00037832 51..1.+0016+000

(Point Identifiers 135 and 136 are replaced with the correct point identifiers on creation of the field file)

410086+00000001 42....+000000A3 43....+00001.54 44....+000001.4 45....+00000001

(Backsight target height is set to 1.4)

410087+00000003

(Operation code for the following set of rounds consisting of 2 arcs)

110088+00000001 21.104+24151380 22.104+27111240 31..00+00018769 51..1.+0016+000

410089+00000002 42....+000002.0 *(Foresight target height is set to 2.0)*

110090+0000STN2 21.104+00824150 22.104+27007280 31..00+00023500 51..1.+0016+000

110091+00000138 21.104+18824340 22.104+08952530 31..00+00023516 51..1.+0016+000

110092+00000139 21.104+06150200 22.104+08848560 31..00+00018768 51..1.+0016+000

(Point Identifiers 138 and 139 are replaced with the correct point identifiers on creation of the field file)

On reduction and extraction, sets of directions are reduced and averaged. Vertical angles and distances are also averaged.

Note that for any consecutive station setups, the forward distances from the first station are averaged to obtain an average forward distance, and back observations from the next station are averaged to obtain an average back distance. The mean of average forward and back distances are then used to obtain the final result. Hence you should always read the same number of sets at each station to obtain a weighted average distance.

OPERATION CODE 4

Fixed Azimuth (After an instrument setup)

1. Fixed Azimuth

Operation Code 4 is always used in conjunction with and immediately after a new set up (operation code 1). These operation codes may be used together in the following methods.

Method 1-Setting an Azimuth to a reference object

OpcodeInfo1Info2Info3Info4

1Station IDInstrument HeightTarget HeightBlank

4Fixed Azimuth

The first observation after Opcode 4 is interpreted as a backsight to a point of specified fixed azimuth from the station setup point.

This will generate a field file setup code 103

Example

OpcodeInfo1Info2Info3Info4

111.61.5

490

First Observation is to point 5

Interpretation: The fixed azimuth of 90 degrees is from point 1 to point 5

Method 2-Setting an Azimuth on a traverse leg

OpcodeInfo1Info2Info3Info4

1Station IDInstrument HeightTarget HeightBacksight Point ID

4Fixed Azimuth

The first observation after Opcode 4 is interpreted as a backsight to the specified backsight point.

The second observation after Opcode 4 is interpreted as a foresight to the next traverse station.

The fixed azimuth entered is the azimuth from the setup station ID to the backsight.

Example

OpcodeInfo1Info2Info3Info4

111.61.55

490

First Observation is to point 5

Second Observation is to point 2

Interpretation: The fixed azimuth of 90 degrees is from point 1 to point 5

NOTE: For a closed traverse, use operation code 4 at the first traverse station setup.

For an open traverse, use operation code 4 at the first and last traverse station setups.

OPERATION CODE 5

New Feature Code (After first observation)

1. New feature code
2. Dimension 1 - Optional
3. Dimension 2 - Optional

When LISCAD processes operation code 5, the feature code (and the string identifier which may be contained within the feature code) is processed according to the code definition set in Field Transfer/Settings/[Code Definition](#) command.

Each point may have none, one or two symbols. Refer to the Symbol Library dialog box in Appendix 1 of the manual. Each symbol on each point may be assigned a height and width which governs the size at which the symbol is displayed.

Dimension 1 and Dimension 2 may be entered in this operation code to define the size of the symbol(s) in preference to using the dimensions of the symbol(s) contained in the code table.

If the feature code has one symbol, then Dimension 1 is used as the height and Dimension 2 is used as the width of the symbol. If Dimension 2 is zero, Dimension 2 will be taken as equal to Dimension 1. If Dimension 1 and Dimension 2 are both zero, the symbol will be drawn with the default symbol size defined in the code table.

If the feature code has two symbols, then Dimension 1 is used as the height and width of symbol 1, and Dimension 2 is used as the height and width of the symbol 2. If Dimension 1 and Dimension 2 are zero, then the corresponding symbol(s) will be drawn with the default symbol size defined in the code table. If only Dimension 2 is zero, then the corresponding symbol 2 will not be drawn. A typical example of using two symbols on one point would be one symbol for a tree's foliage and another for the tree trunk.

Note: All Dimensions cannot be greater than 32 metres.

Note: The feature code and dimensions are set for the previous point and subsequent points until changed.

If the feature code defines a string in the code table and you wish to end the current string but start a new string with the same feature code, simply use operation code 5 again and enter the same feature code. If feature code 102 is defined in the code table as a string, the example below would join points 10 through to 12 with a string and then start a new string at point 13 through to 15.

Example: Observation to point 10

Operation Code 5 (enter feature code 102)

Observation to point 11

Observation to point 12

Observation to point 13

Operation Code 5 (enter feature code 102)

Observation to point 14

Observation to point 15

OPERATION CODE 6

Measured Offsets (After Observation)

1. Offset +ve right, -ve left (as viewed from instrument)
2. Added Distance +ve away from instrument, -ve towards instrument
3. Height Difference +ve up, -ve down

OPERATION CODE -6

Move Point along Line

1. Distance
2. Elevation Flag
3. Offset Distance (-ve left, +ve right)

If zero is entered for the Elevation Flag then the point will have no elevation. Entering 1 will result in the point taking the elevation of the measured point, while entering 2 will result in a graded elevation being computed between the measured point and the previously measured point.

OPERATION CODE 7

Circle with Radii (After Observation)

1. Radius
2. Radius \
3. Radius } Optional
4. Radius /

OPERATION CODE 8

Line Creation Methods (After first observation)

Line Creation Method

For Line type 8 (Wings), the following blocks are also used:

Length of wing at start of string

Length of wing at end of string

The number of subsequent points included in the line feature depends on the Line Creation Method selected.

The following Line Creation Methods are supported.

1. Straight Line String[Default]
2. Curved Line String
3. Circle by radial and centre point
4. Circle by diameter points
5. Circle by 3 circumference points

6. Arc by 3 circumference points (Points observed in order)

Creates a three point arc using three sequential observations.

When using this operation code, the three points for the arc are observed sequentially in the field. That is, the first point is observed, the operation code is then entered, and the second and third points in the arc are then immediately observed.

-6. Arc by 3 circumference points (Points not observed in order)

Creates a three point arc using three non-sequential observations.

When using this operation code, the three points for the arc do not need to be observed sequentially in the field. It is however imperative that all three points have the same code and string identifier. For example, the first point on an arc is observed and coded TOP01. Immediately following this observation, the operation code is entered. The second and third points on the arc can be observed at any time during the survey but MUST have the same code and string identifier as the first point, in this case, TOP01. When reduced, LISCAD will use the first TOP01 observation and the following two TOP01 observations to create the arc.

7. Arc between tangent lines

Creates two tangent points and an arc tangential to two lines.

To use this operation code and automatically construct the tangent points and arc, observe two points on the incoming tangent line, then a point on the arc, then two points on the outgoing tangent line.

Note 1: The operation code must be entered after observing the point on the arc.

Note 2: Each tangent point is created at an elevation graded between the observed points. The lines are extended to the tangent points. As a result the second point on the first tangent line should be before the tangent point and the first point on the second tangent line should be after the tangent point to obtain correctly graded objects.

BUILDING WINGS

Building Wings explanation (Line type 8)

'Wings' of the specified lengths are added to the beginning and end of strings.

The operation code will take affect on the previous observation (if stringable) and any observation following which is stringable.

The operation will continue to run for subsequent strings until terminated with a new line type (Op Code 8) entry. - typically 1 - a straight line.

The format of the code block is:-

410028+00000008 42....+00000008 43....+00007500 44....+00007500.

Positive values for the 'Wing' will result in them being drawn to the right of the defined line, negative left.

If either dimension is not input, the previous entered value will be taken as the wing measurement. If there has been no value previously entered, the wing length will default to 5 metres.

NOTE: **All** straight and curved lines which are observed during the operation of a wing will have the defined wings attached.

OPERATION CODE 9

Fixed Co-ordinate (Independent)

1. Point Identifier
2. Easting or Northing
3. Northing or Easting
4. Reduced Level

Whether information blocks 2 and 3 are interpreted as Easting then Northing, or Northing then Easting by the system depends on the setting in the Utilities/Configure/Co-ordinates command. Ensure that this command is set for East first, or North first to suit your RAW file before creating the field file.

OPERATION CODE -9

Change Fixed Co-ordinate (Independent)

1. Point Identifier
2. Easting or Northing
3. Northing or Easting
4. Reduced Level

Whether information blocks 2 and 3 are interpreted as Easting then Northing, or Northing then Easting by the system depends on the setting in the Utilities/Configure/Co-ordinates command. Ensure that this command is set for East first, or North first to suit your RAW file before creating the field file. This operation is to update the point with new coordinate values. A record type 064 is generated when the field file is created.

GROUP 1 - Extended String and Point Functions

OPERATION CODE 10

Repeat Point (After Observation)

1. New Feature Code

Use operation code 10 if you wish to end the current string but start a new string with another feature code at the same point. If feature codes 102 and 103 are defined in the code table as strings, the example below would join points 10 through to 13 with a string of feature code 102 and then start a new string at point 13 through to 15 with feature code 103.

Example: Observation to point 10

Operation Code 5 (enter feature code 102)

Observation to point 11

Observation to point 12

Observation to point 13

Observation to point 14

Operation Code 10 (enter feature code 103)

Observation to point 15

OPERATION CODE -10

Repeat Point (Before Observation)

1. New Feature Code

Use operation code -10 if you wish to end the current string but start a new string with another

feature code at the same point. If feature codes 102 and 103 are defined in the code table as strings, the example below would join points 10 through to 13 with a string of feature code 102 and then start a new string at point 13 through to 15 with feature code 103.

Example: Observation to point 10

Operation Code 5 (enter feature code 102)

Observation to point 11

Observation to point 12

Observation to point 13

Operation Code 10 (enter feature code 103)

Observation to point 14

Observation to point 15

OPERATION CODE 11

Close Current String (After Observation)

This operation code closes the current string back to its starting point.

OPERATION CODE 13

Join points (Anytime after points are defined)

1. Feature Code
2. First Point Identifier
3. Second Point Identifier
4. Third Point Identifier (optional)

The point identifiers input must have been previously defined.

If the third point is entered, an arc is created, which will also replace that part of any line that is through the same three points with the same code.

OPERATION CODE 14

Description (After Observation)

1. Description
2. Description (Optional)
3. Description (Optional)
4. Description (Optional)
5. Description (Optional)
6. Description (Optional)
7. Description (Optional)

8. Description (Optional)

Information words 1, 2, 3,4,5,6,7 and 8 are concatenated into a single description, except where the wildcard "#x" is contained in the code table description. (x indicates the information word)

If #x is in the code table description, then it is replaced by the corresponding information word.

If #2 is in the codetable description but there is nothing in info 2, the resulting description is truncated after the #1 insertion. Similarly for #3, #4, #5, #6,#7 and #8.

Example

Code Table Description TREE #1 #2high.

Info 1ELM

Info 22.1

Resulting Point DescriptionTREE ELM 2.1high.

Info 1ELM

Resulting Point DescriptionTREE ELM

OPERATION CODE 15

New Point Identifier (Before Observation)

1. Point Identifier

The next observation will take the point identifier as defined in block 1. This Operation Code applies to observations only.

OPERATION CODE 16

Point on Line (After Line Defined)

1. New Point Identifier
2. Starting Point on Line
3. Ending Point on Line
4. Distance from Starting Point

OPERATION CODE 17

Rectangle (After first Point Observed)

1. Width of rectangle. (Optional)
2. Depth of Step (Optional)

The previous point and the subsequent point will define the base of the rectangle. The rectangle will be formed to the right of its defined base if a positive width is entered, or left if negative. If the first information word is not entered or is entered as zero, then a square will be constructed with all sides equal to the base defined by the two measured points. If "Depth of Step" is entered, lines will be drawn within the rectangle perpendicular to the base.

OPERATION CODE 18

Make point contourable (After Observation)

The previous point will be a contourable point.

OPERATION CODE -18

Make point noncontourable (After observation)

The previous point will be a noncontourable point.

OPERATION CODE 19

Remove R.L. from point (After Observation)

The R.L. of the previous observation will be removed. (set to -9999.999)

OPERATION CODE -19

Remove elevation from the current point and all points following (After observation)

Operation code 19 is used to turn this off when it is entered after the last point which is to have its elevation removed is measured.

GROUP 2 - Job Details

OPERATION CODE 20

Start of Job (Before Anything)

1. Up to 8 digits in job file/description.

This code must be entered as the first entry in a job.

OPERATION CODE 21

Personnel (Independent)

1. Surveyor
2. Party \
3. Party } Optional
4. Party /

OPERATION CODE 22

Date (Independent)

1. Date

OPERATION CODE 23

Atmospherics (Independent)

1. Temperature

2. Pressure

OPERATION CODE 24

Scale Factor (Independent)

1. Scale Factor

1.00012 is entered as 10001200

OPERATION CODE 25

Co-ordinate Origin Offsets (Independent) entered in whole units (metres or feet)

1. Easting or Northing
2. Northing or Easting
3. R.L.

Whether information blocks 1 and 2 are interpreted as Easting then Northing, or Northing then Easting by the system depends on the setting in the Utilities/Configure/Co-ordinates command. Ensure that this command is set for East first, or North first to suit your RAW file before creating the field file.

OPERATION CODE 26

Observation Comment

1. Text
2. Text
3. Text
4. Text

A comment may be added to an observation using this operation code.

The contents of information words 1 to 4 are concatenated and passed to the field file as a comment to the adjacent observation (Field File record type 45). Any leading zeroes are stripped from each information word.

The main purpose is to obtain a user entered comment in the field file. However, if a level sheet report is produced, the comment will be placed in the report against the previous observed point, provided that point is in the report.

OPERATION CODE 27

New Feature Code (Before observation)

1. New feature code
2. Dimension 1 - Optional
3. Dimension 2 - Optional

When LISCAD processes operation code 27, the feature code (and the string identifier which may be contained within the feature code) is processed according to the code definition set in Field Transfer/Settings/[Code Definition](#) command.

This operation code works the same as Operation Code 5, except that it is entered before the observation (operation Code 5 is entered after the observation).

OPERATION CODE 28

Line Feature Code

When LISCAD processes operation code 28, the line feature code (and the string identifier which may be contained within the feature code) is processed according to the code definition set in Field Transfer/Settings/[Code Definition](#) command.

A line will be generated with the Line Feature Code entered.

Operation code 28 enables line codes to be entered independently of point codes. It is entered prior to the first observation to which it applies.

This operation code will be in effect until it is changed by new line code.

While a line code is in effect, string identifiers associated with any point code (op code 5 or op code 27) can still be used in the current fashion to define strings. This means that two strings can run simultaneously. **The line operation code can be turned off by specifying the operation code without entering a feature code.**

All feature codes, both point and line must all conform to the current feature code settings. The no-stringing characters on a line code will however be accepted as a string code for string purposes.

Example of a job with [Code Definition](#) settings as

- numeric
- CCCSS
- non stringing character of 00

Observation 1 with feature code 32300 (point with feature code 323)

Line Code 45601 (start of string 01 of feature code 456)

Observation 2 with feature code 31300 (point with feature code 313 added to string 01 of feature code 456)

Observation 3 with feature code 11206 (point with feature code 112 in string 06 of feature code 456 - this point will also be added to string of code 112, with feature code 112 as normal)

Line Code (end of string 01 of feature code 456)

Observation 4 with feature code 31300 (point with feature code 313)

Observation 5 with feature code 11206 (Point added to string of 112, with feature code 112)

Observation 6 with feature code 45601 (Point added to string of 45601, [created with line code above) with point feature code 456)

The following lines will result.

Line CodePoint (point code) making up line

4562(313), 3(112), 6(456)

1123(112), 5(112)

There is no line between 2 and 4, as the non stringing character for point codes was set to 00.

OPERATION CODE 29

Photo or Image

1. Image link (0=none, 1=preceding point, 2=preceding line, 3=preceding polygon)
2. File name
3. File name continued
4. File name continued
5. Image Source (0 = unknown, 1=web cam, 2=data logger camera, 3=total station overview camera, 4 = total station on axis camera)
6. Image description
7. Image description continued
8. Image description continued

Links to Areas/Polygons are not currently imported (as Areas/Polygons themselves are not imported).

Links to lines are only imported if Leica lines are imported

GROUP 3 - Dimension Coding

Operation codes 31 to 33 do not change the field codes of the underlying points. The field code defined in these operation codes is simply to define the symbol to be used and has no connection to the current running point or line codes.

OPERATION CODE 30

Symbol Edges (After first observation)

1. Feature code of symbol (e.g.: feature code 102 entered as 102, not 10200)
2. Symbol Width - Optional
3. Elevation Flag
4. Isolation Flag

Two edge points of the symbol are observed to define height and direction. If Symbol Width is zero then it is assumed to be the same as the height, a positive width is to the right of the edge point, negative to the left.

If zero is entered for the Elevation Flag then only the two observed edge points will have elevations. Entering 1 will result in the average elevation being transferred to the system created symbol origin point with the two edge points being flagged as non contourable, while entering 2 will result in the average elevation being transferred to the system created symbol origin point and the elevations removed from the two edge points.

Entering 3 will result in the average elevation being transferred to the system created symbol origin point and the elevations of the two edge points being flagged as non-contourable. These two

points will not be included in the currently running string and will both be placed on the construction group.

If the isolation flag is set to 1, the symbol will not be included in the currently running string.

Note: Symbols used for this operation code should be those that fill the entire symbol grid.

OPERATION CODE 31

Symbol Centre line (After first observation)

1. Feature code of symbol (e.g.: feature code 102 entered as 102, not 10200)
2. Symbol Width - Optional
3. Elevation Flag
4. Isolation Flag

Two centre line points of the symbol are observed to define height and direction. If Symbol Width is zero then it is assumed to be the same as the height i.e. a circle.

If zero is entered for the Elevation Flag then only the two observed edge points will have elevations. Entering 1 will result in the average elevation being transferred to the system created symbol origin point with the two edge points being flagged as non contourable, while entering 2 will result in the average elevation being transferred to the system created symbol origin point and the elevations removed from the two edge points.

Entering 3 will result in the average elevation being transferred to the system created symbol origin point and the elevations of the two measured points being flagged as non-contourable. These two points will not be included in the currently running string and will both be placed on the construction group.

If the isolation flag is set to 1, the symbol will not be included in the currently running string.

Note: Symbols used for this operation code should be those that fill the entire symbol grid.

OPERATION CODE 32

Create Symbol with defined direction (after observation)

1. Feature code
2. Point Id to define direction (must be previously defined point. Set as -1 if the previously observed point is used to set the direction).
Optional: if not entered the previously defined direction is used)
3. Symbol dimension (optional - if not entered, the dimension of the symbol is taken from the code table)
4. Pivot: Sets the position of the symbol in relation to the observed point.
0 - centred (default) (symbol is placed at the observed point)
1 - left (symbol is placed with the left side of the symbol at the observed point)
2 - right (symbol is placed with the right side of the symbol at the observed point)

This operation code creates a symbol of the defined code (info 1) with its direction being defined by the direction of the observed point to a previously defined point (info 2). It is entered after the observation to the point.

OPERATION CODE -32

Isolated Symbol with defined direction (after observation)

1. Feature code
2. Point Id to define direction (must be previously defined point. Set as -1 if the previously observed point is used to set the direction).
Optional: if not entered the previously defined direction is used
3. Symbol dimension (optional - if not entered, the dimension of the symbol is taken from the code table)
4. Pivot: Sets the position of the symbol in relation to the observed point.
 - 0 - centred (default) (symbol is placed at the observed point)
 - 1 - left (symbol is placed with the left side of the symbol at the observed point)
 - 2 - right (symbol is placed with the right side of the symbol at the observed point)

This operation code creates a symbol of the defined code (info 1) with its direction being defined by the direction of the observed point to a previously defined point (info 2). It is entered after the observation to the point.

The symbol is not included in a currently running string.

If the point Id used to define the direction is the previous point measured (whether entered as an Id or as -1) and is not in the currently running string, this point will be placed on the construction layer.

OPERATION CODE 33

Create Symbol between two points

1. *Width (optional - if not entered the width is taken the same as the height defined by the distance between the 2 points)*
2. Pivot: Sets the position of the symbol in relation to the observed points.
 - 0 - centred (default) (symbol is placed with its origin on the axis of the observed points)
 - 1 - left (symbol is placed with the left side of the symbol at the observed points)
 - 2 - right (symbol is placed with the right side of the symbol at the observed points)
3. *Elevation Flag*

This operation code creates a symbol of the currently running feature code with its dimensions being defined by two observed points and optional width (info 1). It is entered after measurement to the first point. The symbols on the two measured points are removed.

The direction of the symbol is defined as from the first observed point to the second observed point.

If zero is entered for the Elevation Flag then only the two observed points will have elevations. Entering 1 will result in the average elevation being transferred to the system created symbol origin point with the two observed points being flagged as non contourable, while entering 2 will result in the average elevation being transferred to the system created symbol origin point and the elevations removed from the observed points.

Entering 3 will result in the average elevation being transferred to the system created symbol

origin point and the elevations of the two measured points being flagged as non-contourable. These two points will not be included in the currently running string and will both be placed on the construction group.

OPERATION CODE 34

Create Symbol with defined direction (after observation)

1. Feature code
2. Dimension 1 (Optional)
3. Dimension 2 (Optional)
4. Point Id to define direction (must be previously defined point - Optional: if not entered the previously defined direction is used)

Set as -1 if the previously observed point is used to set the direction).

OPERATION CODE -34

Create Isolated Symbol with defined direction (after observation)

1. Feature code
2. Dimension 1 (Optional)
3. Dimension 2 (Optional)
4. Point Id to define direction (must be previously defined point - Optional: if not entered the previously defined direction is used)

Set as -1 if the previously observed point is used to set the direction).

The symbol is not included in a currently running string.

If the point Id used to define the direction is the previous point measured (whether entered as an Id or as -1) and is not in the currently running string, this point will be placed on the construction layer.

OPERATION CODE 35

Create Symbol from 2 edge points and an offset point (after first observation)

1. Feature code
2. Elevation Flag (Optional)

This operation code creates a symbol of feature code entered with its edge position and height being defined by the first two measured points and the width being defined by the third measured point (computed as an offset to the first two points).

If zero is entered for the Elevation Flag then all measured points will have elevations. Entering 1 will result in the elevation of the third point being transferred to the system created symbol origin point with this observed point being flagged as non contourable, while entering 2 will result in the elevation of the third point being transferred to the system created symbol and all measured points having their elevations removed.

Entering 3 will result in the elevation of the third point being transferred to the system created symbol and all measured points will be flagged as non contourable and be placed on the

construction group.

The three points will not be included in the currently running string and will be placed on the construction group.

OPERATION CODE 36

Create a fully defined Symbol at one measured point with the direction defined from a second measured point (after observation)

This operation code creates a symbol of the feature code entered

Position being defined by the first measured point and its direction being defined as the first to the second measured point.

1. Feature code
2. Dimension 1 (Optional)
3. Dimension 2 (Optional)
4. Construction Flag (Optional)

If the construction flag is set(1), the symbol and its direction point will be removed from any currently running string and the direction point will be placed on the construction group.

GROUP 4 - Enhanced Field Coding

OPERATION CODES 40 to 48

Define Field Templates (before observations)

Retrieve Field Templates (after first observation in template)

1. First Feature Code
2. Second Feature Code
3. Third Feature Code
4. Fourth Feature Code

The Operation Code may be repeated another 4 times to define up to 20 feature codes in a field template.

Up to 9 field templates, each using one of the operation codes 40 to 48, and each containing as many as 20 feature codes, may be defined and retrieved during a field session.

OPERATION CODE 49

End a Field Template Definition

Code 49 is used to end a field template definition.

The following Leica/Wild Raw Data set shows the use of operation codes 40 to 49.

(Added comments are shown in italics - the derived feature code for each point is shown at the end of each data record))

410017+00000043 42....+00040901 43....+00040801 44....+00040701 45....+00040302

(Code 43 defining four codes in the field template number 43 - namely 40901, 40801, 40701 and 40302)

410018+00000049

(Code 49 end the field template definition)

110019+00000100 21.104+10713240 22.104+09114340 31..00+00007475 51..1.+0016+000
60301

410020+00000005 42....+00060301

110021+00000101 21.104+12756210 22.104+09113280 31..00+00009088 51..1.+0016+000
60301

110023+00000102 21.104+17316450 22.104+08933230 31..00+00013089 51..1.+0016+000
40901

410022+00000043

(Code 43 commences the field template - starting at the previous point as are codes)

110024+00000103 21.104+17251030 22.104+08926210 31..00+00013107 51..1.+0016+000
40801

110025+00000104 21.104+17218480 22.104+09001170 31..00+00013070 51..1.+0016+000
40701

110026+00000105 21.104+17037280 22.104+08946340 31..00+00013119 51..1.+0016+000
40302

110027+00000106 21.104+16800330 22.104+09157350 31..00+00005714 51..1.+0016+000
40901

110028+00000107 21.104+16649210 22.104+09202220 31..00+00005751 51..1.+0016+000
40801

110029+00000108 21.104+16625320 22.104+09216570 31..00+00005752 51..1.+0016+000
40701

110030+00000109 21.104+16224490 22.104+09159300 31..00+00005819 51..1.+0016+000
40302

110032+00000110 21.104+00649250 22.104+09427310 31..00+00008676 51..1.+0016+000
40302

410031-00000043

(Code -43 re-commences the field template 43 but in the reverse direction)

110033+00000111 21.104+00329590 22.104+09351510 31..00+00008588 51..1.+0016+000
40701

110034+00000112 21.104+00249120 22.104+09359330 31..00+00008585 51..1.+0016+000
40801

110035+00000113 21.104+00329290 22.104+09331090 31..00+00012863 51..1.+0016+000
40901

110036+00000114 21.104+00139130 22.104+09343450 31..00+00012938 51..1.+0016+000
40302

110037+00000115 21.104+00115350 22.104+09309190 31..00+00012912 51..1.+0016+000
40701

110038+00000116 21.104+00044570 22.104+09311510 31..00+00012905 51..1.+0016+000
40801

110039+00000117 21.104+07408100 22.104+09428550 31..00+00005150 51..1.+0016+000
72001

410040+00000005 42....+00072001

(New feature code ends the field template)

110042+00000118 21.104+07551230 22.104+09350550 31..00+00005836 51..1.+0016+000
72001

110043+00000119 21.104+05206300 22.104+08648420 31..00+00010088 51..1.+0016+000
72001

OPERATION CODES 50 to 59

Predefined codes

1. Operation code
2. First Information Word of Operation Code
3. Second Information Word of Operation Code
4. Third Information Word of Operation Code

Codes 50 to 59 can be used to pre-define commonly used operation codes.

The operation codes that can be pre-defined are restricted to those with a maximum of 3 information words.

Once the predefined operation code is defined, then, whether it is used before or after the observation depends on the particular predefined operation. For example a predefined target height would be entered before the observation, whereas a predefined feature code would be entered after.

The following Leica/Wild Raw Data set shows the use of operation codes 50 to 59.

(Added comments are shown in italics)

410046+00000050 42....+00000005 43....+00020100 44....+000002.0

(Code 50 pre-defines an operation code 5 which defines a feature with size 2.0)

410047+00000051 42....+00000005 43....+00071300 44....+00001000

(Code 51 pre-defines an operation code 5 which defines a feature with size 1.0)

110048+00000120 21.104+35933480 22.104+09428330 31..00+00005959 51..1.+0016+000

410049+00000050

(Code 50 is interpreted as 410049+00000005 43....+00020100 44....+000002.0)

110050+00000121 21.104+35746400 22.104+09320390 31..00+00009176 51..1.+0016+000

410051+00000051

(Code 51 is interpreted as 410051+00000005 43....+000713100 44....+00001.0)

110052+00000122 21.104+35640000 22.104+09257460 31..00+00012562 51..1.+0016+000

410053+00000050

(Code 50 is interpreted as 410049+00000005 43....+00020100 44....+000002.0)

110054+00000123 21.104+35637180 22.104+09243330 31..00+00016841 51..1.+0016+000

410055+00000051

(Code 51 is interpreted as 410055+00000005 43....+000713100 44....+00001.0)

110056+00000124 21.104+35650400 22.104+09228220 31..00+00021096 51..1.+0016+000

410059+00000050

(Code 50 is interpreted as 410059+00000005 43....+00020100 44....+000002.0)

410060+00000001 42....+0000STN1 43....+00001.55 44....+000001.3 45....+0000AB29

OPERATION CODE 60

Add last point to end of other string (after observation)

1. Field Code 1
2. Field Code 2
3. Field Code 3
4. Field Code 4

This operation is used to add the point just observed to the current end of another string.

Up to 4 feature codes can be added to at the same time.

If the field code entered has already been used to define a string, then the point is added as the next point in that string.

If the field code entered has not already been used to define a string or is negative, then the point starts a new string of that field code.

The currently running field code is not affected, and remains unchanged. That is, the observed point is also added to the current string, as defined by the current field code.

Naturally, to get the required results, the field codes entered must be stringable. The operation code may be repeated up to ten times to add the point up to ten strings.

Example: Consider to following example. (The code definition being used is CCCSS).

I observe points along a fence line using field code 90304.

Observation to point 200

Operation Code 5 (enter field code 90304)

Observation to point 201

Observation to point 202

There is one last point on the above fence line where it intersects another fence, but the instrument needs to be moved to view this point. So I move the instrument and take observations along the second fence using field code 90305.

After taking the observation to point 212 (which is the fence intersection point), I use operation code 60 and enter field code 90304 to add that point to the first fence (after point 202). There is also a third fence emanating from point 212, so I use operation code 60 again and enter field code 90306 to start a string for the third fence. I will continue this string later. Then I continue to take observations along the second fence until it ends at point 214.

Observation to point 210

Operation Code 5 (enter field code 90305)

Observation to point 211

Observation to point 212

Operation Code 60 (enter field code 90304)

Operation Code 60 (enter field code 90306)

Observation to point 213

Observation to point 214

Finally I observe the remaining points on the third fence.

Observation to point 220

Operation Code 5 (enter field code 90306)

Observation to point 221

The resulting strings from this example are:

Field CodePoints in String

90304200, 201, 202, 212

90305210, 211, 212, 213, 214

90306212, 220, 221

OPERATION CODE -60

Add last point to start of other string (after observation)

1. Field Code

This operation is identical to Operation Code +60, except that the point just observed is added to the start of another string.

Had operation Code -60 been used in the previous example, the resulting strings would be:

Field CodePoints in String

90304212, 200, 201, 202

90305210, 211, 212, 213, 214

90306212, 220, 221

OPERATION CODE 61

Add any previously observed point to end of other string

1.Point Identifier

2.Field Code (optional)

This operation is used to add any previously observed point to the current end of any string. It has the same affect as taking another observation to the point. Instead of taking the observation, you simply enter the point identifier.

If no field code is entered in Info 2, the point identifier is included at the current end of the string specified by the current field code.

If a field code is entered in Info 2, the point identifier is included at the current end of the string specified by the entered field code.

If a minus sign is put in front of the feature code, the point is not added to the existing string, but it is used to start a new string.

The entered field code is then used for subsequent points.

Example:

Observation to point 200

Operation Code 5 (enter field code 90304)

Observation to point 201

Observation to point 202

Operation Code 61 (enter point Identifier 200)

(closes string of code 90304 back to 200)

Observation to point 210

Operation Code 5 (enter field code 90305)

Observation to point 211

Observation to point 212

Operation Code 61 (enter point identifier 202)

(adds 202 in string of code 90305 after 212)

Observation to point 213

Observation to point 214

Operation Code 61 (enter point identifier 211, field code 90306)

Operation Code 61 (enter point identifier 201)

(starts new string of code 90306 at 211 and adds 201 to it)

Observation to point 221

Operation Code 61 (enter point identifier 221, field code -90305)

(adds 221 to existing string of code 90305, after 214)

The resulting strings from this example are:

Field CodePoints in String

90304200, 201, 202, 200

90305210, 211, 212, 202, 213, 214, 221

90306211, 201, 221

OPERATION CODE 65

Create Line from existing points

1. Line Type
2. Feature Code (No string identifier)
3. Line Description
4. Point Identifier
5. Point Identifier
6. Point Identifier (Optional)
7. Point Identifier (Optional)

The line Types may be:-

1. 1 - Straight Line
2. 2 - Arc by 3 Points (the following list must contain 3 points)
3. 3 - Curve
4. 4 - Arc by 2 Points and Centre (the following list must contain 3 points in the order: Point, Point, Centre)

The points MUST either exist in the database or be defined in the raw file prior to this operation code being entered.

OPERATION CODE 66

Extend a line by existing points.

1. Point Identifier
2. Point Identifier (Optional)
3. Point Identifier (Optional)
4. Point Identifier (Optional)
5. Point Identifier (Optional)
6. Point Identifier (Optional)
7. Point Identifier (Optional)
8. Point Identifier (Optional)
9. Point Identifier (Optional)

This operation code is used to extend a line defined via operation code 65. It MUST directly follow operation code 65 or another operation code 66.

OPERATION CODE 69

User Notice

1. Text
2. Text
3. Text
4. Text
5. Text
6. Text
7. Text
8. Text

A user notice may be added at any time.

The contents of information words 1 to 8 are concatenated and passed to the field file as a user notice. This notice is added to the field file (Field File record type 46). Any leading zeroes are stripped from each information word.

The main purpose of this operation code is to add a warning to the LISCAD field reduction report to inform the user that some special condition applies. E.g. "Point 214 has wrong target height - should be 1.456"

OPERATION CODE 70

Define Control Line or End Control Line

1. Field Code *to start a control line*
or
Blank to end a control line operation
2. Point Identifier (optional)
3. Point Identifier (optional)
4. Measured Control Line

This operation is used to define a control line for use with operation codes 71 and 72, or to end a control line operation.

This operation must immediately precede operation code 71 and 72.

To define a control line, Info 1 is the field code of the control line. Info 2 and Info 3 define the start and end points of the control line. If Info2 and Info3 are not present, the two previous observations are taken as the start and end points.

To end a control line operation, info 1 is blank.

A measured distance for the control line can be added in info 4 and used to determine a scale factor that is applied when using operation codes 71 and 72.

OPERATION CODE 71

Create point by Chainage and Offset

1. Chainage
2. Offset

This operation is used to create a point by chainage and offset with respect to the current control line. It must be preceded and ended by operation code 70.

The chainage is taken as positive in the direction from the start of the control line toward the end of the control line.

The offset is taken as positive to the right of the control line.

Example:

Operation CodeFields

70 304022021

(defines control line of field code 30402 starting at point 20 and ending at point 21)

7110.6 0.6

7112.4 1.7

7122.4 1.7

7130.7 -1.6

7132.5 0.0

(creates five points at various chainages and offsets to the control line)

70

(ends the control line operations)

The points are created with the field code entered in operation code 70. If the field code is stringable, the points created will be joined to each other, but the resulting string is not joined to any other points of the same field code. That is, string construction from an operation code 70/71 is independent of all other string construction.

OPERATION CODE 72

Building measurements

1.Distance

This operation is used to record consecutive distances around the sides of a building with perpendicular edges.

Operation Code 72 must be preceded and ended by operation code 70 to define the control line. The control line must consist of any two corners of the building, and the distances must be in consecutive order around the building from the first control point to the end control point.

The first distance must be from the start of the control line and is always entered as positive. Each other distance is entered as positive if the internal object angle formed with the previous side is 270 degrees. Conversely, the distance is entered as negative if the internal object angle formed with the previous side is 90 degrees. The last distance must be to the end of the control line.

When processed to construct the building, the distances are scaled if necessary to ensure that they close with the control line.

Example:

Consider the following orthogonal building.

SideBearingDistance

1 - 209.0

2 - 3905.0

3 - 406.0

4 - 5907.0

5 - 618015.0

Consider also that points 1 and 6 have been observed.

Then the object would be recorded as follows.

Operation CodeFields

70 3040216

(defines control line of field code 30402 starting at point 1 and ending at point 6)

729.0

72-5.0

726.0

72-7.0

72-15.0

(distances around the building starting at 1 and finishing at 6)

70

(ends the control line operations)

The points are created with the field code entered in operation code 70. If the field code is stringable, the points created will be joined to each other, but the resulting string is not joined to any other points of the same field code. That is, string construction from an operation code 70/72 is independent of all other string construction.

OPERATION CODE 73

Orthogonal Line String

1. Distance
2. Point Identifier

This operation is used to record consecutive distances around the sides of a building with perpendicular edges having first established an orientation and starting point from two previously measured points.

The first distance must be from the last measured point. Each distance is entered as positive if the internal object angle formed with the previous side is 270 degrees. Conversely, the distance is entered as negative if the internal object angle formed with the previous side is 90 degrees.

OPERATION CODE 74

Point by Intersecting Distances

1. Distance 1
2. Distance 2
3. Elevation Flag (optional)
4. Field Code (optional)

This operation is used to record two intersecting distances that are used to define a "hidden" point that are measured from the previous recorded point and the next recorded point.

As there are two possible solutions for the point created by the intersecting distances the following rule is applied to distinguish the correct result.

Standing at the first measured point and looking towards the second measured point, if the point to be created falls to the left of this line of sight, then Distance 1 must be entered as negative.

Elevation Flag

- 0 - No Elevation
- 1 - Take elevation of the first point
- 2 - Take elevation of the second point
- 3 - Take elevation of the mean of the two points

If the field code is not entered, the current running field code is used.

The points are created with construction point identifiers.

This operation code can be repeated any number of times to create intersection points from the

same two recorded points.

OPERATION CODE 75

Create a secant offset point.

(after observation).

1. Feature code (optional)
2. Secant/Offset distance (-ve left, +ve right) (Optional)
3. Secant/Offset type flag (Optional)
4. Symbol Dimension (Optional)

This operation code creates secant or offset points (joined by a line to the measured point if the code is stringable). The constructed points use the attributes of the feature code and well as the line if created. Only ONE Secant/Offset operation code can be entered at a point.

If the Feature code is not entered or entered as zero, the previously entered Feature code of operation code 75 is used.

If the Secant/Offset distance is not entered or entered as zero, the previously entered value is used. Its initial default value is 5.

The Secant/Offset flag can be

- 1 - Offset point created from the current point the direction defined as from the current point to the next observed point.
- 2 - Secant point defined from the previous, current and next observed points.
- 3 - Offset point created from the current point the direction defined as from the current point to the previous observed point.

OPERATION CODE 76

GNSS Coordinate Quality read from a Leica DBX.

This operation code is used by the system to store coordinate quality for GNSS coordinates that are read from a Leica DBX when the GSI file is created.

This operation is therefore not applied by the user, but is documented such that the information transferred from the DBX is clearly understood.

1. Point Identifier
2. Coordinate quality of the X coordinate
3. Coordinate quality of the Y coordinate
4. Coordinate quality of the Elevation

OPERATION CODE 80

Parallel Line(s) by Measured Points

1. 1 or blank *1 to start definition; blank to end definition.*

This operation is used to automatically generate one or more lines parallel to a base string.

The first observation after operation code 80 must be a point on the base string. The base string is identified by the field code given to this point. The other section lines will be created parallel to this base string, for the entire length of the base string.

Any number of other observations may then be taken, each defining a point on the section passing through the base string point at right angles to the base string.

Ensure that the section is perpendicular to the base string, or incorrect results will occur.

Constructed lines generated by operation code 80 will not be joined to other lines of the same field code. If a field code entered for the parallel lines is non stringable, the required points will be created but not joined.

Example:

The code structure used in this example is CCCSS with non stringing characters 00.

Operation CodeFields

80 1

(starts the "parallel line by measured points" operation)

Observation to point 200

(this is a point on the base string)

540801

(assigns field code 40801 to point 200 and identifies 40801 as the base string)

Observation to point 201

540901

Observation to point 202

540701

Observation to point 203

540600

(Records observations to three points defining the rest of the section {201, 202, 203}, and assigns field codes {40901, 40701, 40600} for the points and parallel lines that are to be created)

(Points 200, 201, 202 and 203 are all on a section line perpendicular to the base string)

80

(ends the "parallel line by measured points" operation)

Observation to point 204

540801

(records observation to another point on the base string and assigns the base string field code to

the point)

Observation to point 205

Observation to point 206

Observation to point 207

(records the rest of the base string)

The results from this example are:

Field CodePoints in String

40801200, 204, 205, 206, 207

40901New points joined by a string parallel to 40801 passing through point 201

40701New points joined by a string parallel to 40801 passing through point 202

40600New points not joined by a string parallel to 40801 passing through point 203

Note that in the above example, operation code 80 was defined at the first point in the base string. While this is a typical approach, the operation could have been applied at any other point in the base string. For example, you may wish to select a point other than the starting point of the base string, where the perpendicular section is more easily observed.

OPERATION CODES 81 and 82

Section definition by offset and height difference

These operation codes are used to define an independent section, which can be applied to any base string to generate parallel lines to that base string. Up to 10 sections may be defined. Each defined section may have up to 10 points, each of which will generate a parallel line.

81

1. Section Number

Operation Code 81 is used to start a new section definition and enter the Section Number. (Section number range is 0 to 9)

82

1. Field Code

2. Offset

3. Height Difference *optional*

Operation code 82 is used to enter offsets and height differences with respect to a base string.

For any particular section, operation code 82 is repeated until the section is fully defined. Each use of operation code 82 defines a point on the section.

The field code entered is the code to be applied to the parallel line and points created. If the code is not stringable then the required points will be created but not joined.

The offset entered is the perpendicular distance from the base string to the parallel line. A positive offset is to the right of the base string when looking in the direction of the base string. A negative

offset is to the left of the base string.

The height difference from the base string to the parallel line (-ve down).

Once a section is defined, it can be applied to any base string by using operation code 83.

Example:

The code structure used in this example is CCCSS with non stringing characters 00.

Operation CodeFields

811

(starts the definition of section 1)

82 409010.20

(defines a parallel line and points of field code 40901 at an offset of 0.2 to the right of the base line and at the same height as the base line.)

82 407010.22-0.2

(defines a parallel line and points of field code 40701 at an offset of 0.22 to the right of the base line 0.2 below the base line.)

82 406000.5-0.15

(defines points of field code 40600 not joined by parallel line at an offset of 0.5 to the right of the base line 0.15 below the base line.)

Section 1 is stored by the system as an independent structure, which may be attached to any base strings (Refer to Operation Code 83). Section 1 would therefore be stored in the following independent format.

Field CodeOffsetHeight Difference

409010.20

407010.22-0.2

406000.5-0.15

OPERATION CODE 83

Parallel Line(s) by predefined section

1.Field Code

2.Section Number(0 to 9)

This operation is used to apply an independent predefined section to a base string and generate parallel lines to that base string.

The predefined section must first have been defined using operation codes 81 and 82.

The field code entered defines the base string to which the section is to be applied.

The base string must already exist, or be observed using code 5 to define the field code.

The section number defines the section to be applied to the base string.

A negative operation code (-83) can be used to mirror the section. This will reverse the direction of the offsets stored in the section when they are applied to the base string. The height differences are not reversed.

Example:

The code structure used in this example is CCCSS with non stringing characters 00.

Operation CodeFields

-83 408012

(applies a mirrored section 2 to the string of field code 40801)

The required points and parallel lines will be created according to the section 2 definition, parallel to base string 40801, but mirrored to be on the opposite side of the base line.

OPERATION CODE 84

Start or End secant functions

This operation code is used to start or end the creation of additional points by secant distance and/or secant width. It is used in conjunction with operation codes 85 and 86.

1. Field code of secant point This is the field code that will be used for secant points created via operation code 85 Info 1.
2. Field code of left mirror point *(Optional)* This is the field code that will be used for the left mirror points created via operation code 85 Info 3, or operation code 86 Info 1.
3. Field code of right mirror point *(Optional)* This is the field code that will be used for the right mirror points created via operation code 85 Info 3, or operation code 86 Info 1.

If a field code is entered for info 1 only, the same field code will be automatically assumed for info 2 and info 3.

OPERATION CODE 85

Secant Distance, Change in Elevation, Secant Width

1. Secant distance from observed point
2. Change in Elevation from observed point *(Optional)*
3. Secant width *(Optional)*

This operation code is used enter values used in conjunction with operation code 84. It must follow operation code 84.

The secant distance (Info 1) specifies that secant points are to be created at that secant distance from the following observed points. It is entered as positive if the secant points are to be to the right of the observed point joins, and conversely, negative if to the left.

The change in elevation (Info 2) specifies that the secant points are to be at a vertical offset to the observed points. It is entered as positive for up or negative for down.

The secant width (Info 3) specifies that mirror points are to be created left and right of the secant points specified by info 1. The mirror points will be created at half the entered secant width from

the secant point. Operation Code 86 may be used as an alternative.

OPERATION CODE 86

Secant Width

1.Secant width

This operation code is used enter values used in conjunction with operation code 84. It must follow operation code 84.

The secant width (Info 1) specifies that mirror points are to be created left and right of the secant points specified by operation code 85 info 1. The mirror points will be created at half the entered secant width from the secant point. Operation Code 85 Info 3 may be used as an alternative.

Examples of Secant Constructions using operation codes 84, 85 and 86.

A number of different constructions are possible depending on whether certain of the info words contain zero.

If secant distance (op code 85 info 1) is zero, secant points are not created, and any mirror points are mirrored about the observed points.

If secant width (op code 85 info 3, or op code 86 info 1) is zero, mirror points are not created.

The default value for all info words in operation codes 85 and 86 is zero.

Example of secant points only:

This example would typically be used to define a string when the points on the string cannot be observed.

The code structure used in this example is CCCSS with non stringing characters 00.

Operation CodeFields

8420201

(starts a secant construction and specifies that all constructed points will have field code 20201)

852.00.0

(an additional point of field code 20201 will be created at secant distance 2.0 metres to the right of the following observed points i.e. 500, 501, 502)

Observation to point 500

510400

Observation to point 501

Observation to point 502

853.00.2

(an additional point will be created at secant distance 3.0 metres to the right and 0.2 above the following observed point i.e. 503)

Observation to point 503

84

(ends the secant structure)

In this example the following was created:

PointField CodeSecant DistanceChange in Height

50010400

50110400

50210400

50310400

500S202012.0 right of 500level with 500

501S202012.0 right of 501level with 501

502S202012.0 right of 502level with 502

503S202013.0 right of 5030.2 above 503

Note: The point identifiers 500S to 503S are shown above to indicate that they are **Secant** points, but would not actually be created by the system. The actual point identifiers created will be according to the construction point identifier set in Utilities/Configure/Point Identifiers.

Since the non stringing characters are 00, points 500 through to 503 are not strung.

But the following string is drawn:

Field CodePoints

20201500S, 501S, 502S, 503S

A string through the secant points

Example of mirror points only:

This example would typically be used to define both sides of a structure with width (such as a hedge or creek), by observing only the centre points of the structure.

The code structure used in this example is CCCSS with non stringing characters 00.

Operation CodeFields

8420202

(starts a secant construction and specifies that all constructed points will have field code 20202 and all constructed mirror points will have a field code of 20202)

861.5

(Additional mirror points of field code 20202 will be created at 0.75 metre to the left of the following observed points i.e. 500, 501, 502. Additional mirror points of field code 20202 will be created at distance 0.75 metre to the right of the following observed points i.e. 500, 501, 502)

Observation to point 500

510400

Observation to point 501

Observation to point 502

863.0

(Additional mirror point of field code 20202 will be created at distance 1.5 metre to the left of the following observed point i.e. 503. Additional mirror point of field code 20202 will be created at distance 1.5 metre to the right of the following observed point i.e. 503)

Observation to point 503

84

(Ends the secant structure)

In this example the following was created:

PointField CodeSecant Distance

50010400

50110400

50210400

50310400

500ML202020.75 left of 500

501ML202020.75 left of 501

502ML202020.75 left of 502

503ML202021.5 left of 503

500MR202020.75 right of 500

501MR202020.75 right of 501

502MR202020.75 right of 502

503MR202021.5 right of 503

Note: The point identifiers 500ML to 503ML and 500MR to 503MR are shown above to indicate that they are **M**irror points **L**eft or **R**ight of the observation, but would not actually be created by the system. The actual point identifier created will be according to the construction point identifiers set in Utilities/Configure/Point Identifiers.

Since the non stringing characters are 00, points 500 through to 503 are not strung.

But the following strings are drawn:

Field CodePoints

20202500ML, 501ML, 502ML, 503ML

(a string through the mirror points to the left of the observed points)

20202500MR, 501MR, 502MR, 503MR

(a string through the mirror points to the right of the observed points)

Example of secant points and mirror points:

This example would typically be used to define both sides of a structure with width (such as a hedge or creek), where the centre points of the structure cannot be observed.

The code structure used in this example is CCCSS with non stringing characters 00.

Operation CodeFields

84202012020220203

(starts a secant construction and specifies that all constructed secant points will have field code 20201, constructed left mirror points will have a field code of 20202, and constructed right mirror points will have a field code of 20203)

852.00.01.5

(an additional point {secant point} of field code 20201 will be created at secant distance 2.0 metres to the right of the following observed points i.e. 500, 501, 502.

A further additional point {left mirror point} of field code 20202 will be created at secant distance 0.75 metre to the left of each secant point. A further additional point {right mirror point} of field code 20203 will be created at secant distance 0.75 metre to the right of each secant point)

Observation to point 500

510400

Observation to point 501

Observation to point 502

853.00.2

(the additional points will continue to be created as before, except that the 20201 points will be at secant distance 3.0 metres (instead of 2.0) and height difference 0.2 (instead of 0.0) from the observed point)

863.0

(the additional points will continue to be created as before, except that the 20202 and 20203 points will be at distance 1.5 metres (instead of 0.75) from the secant point)

Observation to point 503

84

(Ends the secant structure)

In this example the following was created:

PointField CodeSecant DistanceHeight Difference

50010400

50110400

50210400

50310400

500S202012.0 right of 500level with 500

501S202012.0 right of 501level with 501

502S202012.0 right of 502level with 502

503S202013.0 right of 5030.2 above 503

500SML202020.75 left of 500S

501SML202020.75 left of 501S

502SML202020.75 left of 502S

503SML202021.5 left of 503S

500SMR202030.75 right of 500S

501SMR202030.75 right of 501S

502SMR202030.75 right of 502S

503SMR202031.5 right of 503S

Note: The point identifiers 500S to 503S, 500SML to 503SML and 500SMR to 503SMR, are shown above to indicate that they are **S**ecant points, or **M**irror points **L**eft or **R**ight of the **S**ecant point, but would not actually be created by the system. The actual point identifiers created will be according to the construction point identifier set in Utilities/Configure/Point Identifiers.

Since the non stringing characters are 00, points 500 through to 503 are not strung.

But the following strings are drawn:

Field CodePoints

20201500S, 501S, 502S, 503S

(a string through the secant points)

20202500SML, 501SML, 502SML, 503SML

(a string through the mirror points to the left of the secant points)

20203500SMR, 501SMR, 502SMR, 503SMR

(a string through the mirror points to the right of the secant points)

OPERATION CODE 87

Parallel Line(s) by predefined section

1. Offset +ve right, -ve Left
2. Height difference - Optional [Default zero]

3. Feature Code (Includes string identifier) - Optional [Code of currently running string]

This operation is used to create a string parallel to the currently running string.

The operation code should be entered immediately after the start of the string is defined.

Any number of operation codes can be entered after each other. This can be used to create multiple parallel lines to the currently running string.

A feature code that is entered MUST contain a string definition.

Lines created with code will have their Line-Styles reversed.

Example:

The code structure used in this example is CCCSS with non stringing characters 00.

Operation CodeFields

87 2.7 -1.1 40801

The required points and parallel line (code 408) will be created at an offset 2.7 to the right of the currently running string. Each point will have an elevation 1.1 below the adjacent measured points.

If a feature code is entered with the non stringing characters, the points at the secant to the current line will be created but will not be joined. This can be useful in creating objects (e.g. Posts) at an offset to the currently running string.

Operation CodeFields

87 2.7 -1.1 40800

OPERATION CODE 90

Split Feature Code and String Identifier

1. Feature Code
2. String Identifier

This is an alternative to using operation code 5.

In operation code 5, the feature code and string identifier are entered in a single item in info 1.

Operation code 90 allows the feature code component to be entered in info 1 and the string identifier to be entered in info 2. When LISCAD processes operation code 90, the two info words are combined into a single field code containing the feature code and the string identifier. This is then processed according to the code definition set in the Field Transfer/Settings/[Code Definition](#) command.

An alternative to using Operation Code 90 is to use the decimal point '.' or question mark '?' character. The table below shows the different options available for the use of this Operation Code.

OpCode	Code Format
90	TOE

.	.TOE
?	?TOE

OPERATION CODE 91

Split Feature Code and String Identifier (before observation)

1. Feature Code
2. String Identifier

This operation code works the same as Operation Code 90, except that it is entered before the observation (operation Code 90 is entered after the observation).

GROUP 5 - Editing Codes

OPERATION CODE 98

Ignore a range of measurements (Independent)

1. Start Point Identifier
2. End Point Identifier (Optional)

Any measurement to a point identifier in the range.

Start Point Identifier to End Point Identifier (Inclusive) will be marked and passed to the EDM file as a comment only.

If the End Point is not entered, only the Start Point will be ignored. This has the same effect as Code 99 but can be entered at any time.

OPERATION CODE 99

Ignore last measurement (After observation)

The previous measurement will be marked and passed to the EDM file as a comment only.

GENERAL NOTE:

After Observation - Operation code entered after observation.

Before Observation - Operation code entered before observation.

Independent - Operation code can be entered any time.