MATIENZO CAVES

# Underground Surveying – data collection

**Introduction**

This short document is intended as an introduction to surveying a cave in the Matienzo context. It is for beginners and those unsure of the method and uses traditional equipment and techniques. (The DistoX and PDA combo is best used by experienced surveyors.)
For simplicities sake, the example below assumes a short cave with one pitch.

**Rationale**

A centre line through a cave gives an indication of the direction and depth. As the surveyor progresses through the cave sketches are made to show the passage walls, floor deposits and wall and ceiling formations. To create some order out of what can be a very complex 3 dimensional maze, every cave survey is based on "stations" – convenient points in the cave from which other stations can be seen, and legs – the length, magnetic bearing and inclination between the stations. The centre line can be seen as a "join-the-dots" exercise with legs linking the stations together. As well as writing down the data for the legs, the note-taker in the team draws the approximate line between stations and sketches the passage detail at and between each station. To aid later drawing up and for a more informative computer display left, right, up and down distances (splays) are also measured at each station.

**Before the survey trip**

Equipment required Suunto compass, Suunto clinometer, laser distance measurer, A5 notebook or two (waterproof if possible), 2 or 3 short pencils (double pointed), liquid paper and some paper strips for marking survey stations, plastic bag(s). Two more team members – one should be an experienced surveyor to help and point out best practice.
If the notebook does not have headings for data collection then it is best to mark out pages with columns as shown:

| Station | Left | Right | Up | Down | ↓↑ | Length | Bearing | Clino |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

An alternative layout which requires no prior preparation is shown at the end. Leave some blank pages for sketches.

**Underground**

The survey trip cannot be rushed. Wrong data is almost as bad as no data.

As survey team "jefe", it is likely that you will choose the stations, take the notes and sketch the passage outline; the second in the team might choose the stations, but will take the readings and shout them out to you, and a third will ferret into any leads and point out any features you may miss.
Stations are fixed points in the cave – they can be on the wall, floor, roof or a point in space, eg a caver's helmet. At passage junctions they can be marked with a cairn and small piece of paper giving details. Stations can also be marked with dots of liquid paper.
Choosing a station requires some practice. The position of the station should allow

- the rear of the laser distance measurer to sit on it with a clear view to the next station
- the surveyor's head to easily read the compass along the leg between stations, or at least parallel to it.
- the surveyor's head to easily read the clinometer along the leg between stations, or at least parallel to it.

Stations are often positioned at large passage changes, eg changes in height, depth, width, deposits, etc, or at a junction.

Depending on the cave, it may be that you enter first, choosing stations, or follow from behind, or leap frog each other. It is absolutely vital that the readings are written down correctly! The collected data has a direction, ie the instrument reader is reading from a station to another. Writing down the wrong direction "from" and "to" station numbers is possibly the most common error. The "from" station is where the instruments are; the "to" station is the next station.

As an example, the caver with the surveying instruments stays on the surface at a small entrance while you and the cave ferret scoot into the cave down a shallow slope to choose a station. On the first sketching page you sketch a couple of points with a line between them, labelling the station at the entrance "0" and the first station inside the cave "1". You sketch in the passage detail, perhaps the walls are further apart at station 1 than at the entrance and there are rocks on the floor. You then realise that some data needs collecting at the entrance - the splays. Station 0 is in mid-air in the middle of the entrance (where it has previously been GPS'd to give the map coordinates). The caver at the entrance, as he/she looks into the cave, calls out the left, right, up and down distances from this mid-air station and you write them down on the station 0 line. The instruments will be looking from station 0 to station 1 so you draw in an arrow showing the direction from 0 to 1. You also draw a cross section at station 1. (See scan at end of this doc.)
A warning about the laser is then shouted out as the entrance caver sends the laser beam down the passage in search of station "1". A hand, helmet, or paper on the station might be easier to aim for. The distance reading for the leg is shouted out which you then write down. (Use a "/" instead of a "." (dot) as a decimal point will soon merge with mud.) The compass reading is shouted out and, again, it may be that the reader requires the station to be highlighted in some way. Similarly with the inclination reading.

| Station | Left | Right | Up | Down | ↓↑ | Length | Bearing | Clino |
|---|---|---|---|---|---|---|---|---|
| 0 | 0/50 | 1/52 | 0/35 | 0/25 | | | | |
| 1 | | | | | ↓ | 5/23 | 154 | -26 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

Ideally, to reduce errors, surveyors should "leap frog", but often surveying teams will progress one behind the other down a cave passage. We'll assume the latter in this example.
The caver with the instruments moves down to station 1 while you move to station 2 (sketching the passage detail between stations 1 and 2), where the small entrance passage meets a pitch down. The left, right, up, down readings (at station 1, looking towards station 2 and bisecting the angle of the 2 legs) are shouted out and written down. The leg readings from station 1 to 2 are read, shouted out and written down.

| Station | Left | Right | Up | Down | ↓↑ | Length | Bearing | Clino |
|---|---|---|---|---|---|---|---|---|
| 0 | 0/50 | 1/52 | 0/35 | 0/25 | | | | |
| 1 | 1/55 | 2/04 | 2/45 | 1/23 | ↓ | 5/23 | 154 | -26 |
| 2<br>P top | | | | | ↓ | 6/14 | 95 | -15 |
| 3 | | | | | | | | |

The pitch top and bottom LRUD readings are best not taken in the direction of the drop. Leave those for the next time. They can be taken in the direction of the passage heading towards the pitch head, ie the LRUD dimensions just before the pitch lip. These measurements "complete" the "tube" to the pitch head.

You go down the pitch to station 3 and the instrument reader shouts down the measured depth and you write this down as shown below. A sketch of the pitch plan and elevation should be drawn, with the dimensions of the drop. When the instrument reader descends to station 3, LRUD data for 3 can be taken at the start of the ongoing passage – a new tube carrying on.

| Station | Left | Right | Up | Down | ↓↑ | Length | Bearing | Clino |
|---|---|---|---|---|---|---|---|---|
| 0 | 0/50 | 1/52 | 0/35 | 0/25 | | | | |
| 1 | 1/55 | 2/04 | 2/45 | 1/23 | ↓ | 5/23 | 154 | -26 |
| 2<br>P top | 2/32 | 2/64 | 3/00 | 1/00 | ↓ | 6/14 | 95 | -15 |
| 3 | 2/31 | 1/56 | 4.65 | 1.35 | ↓ | 8/30 | - | down |
| | | | | | | | | |

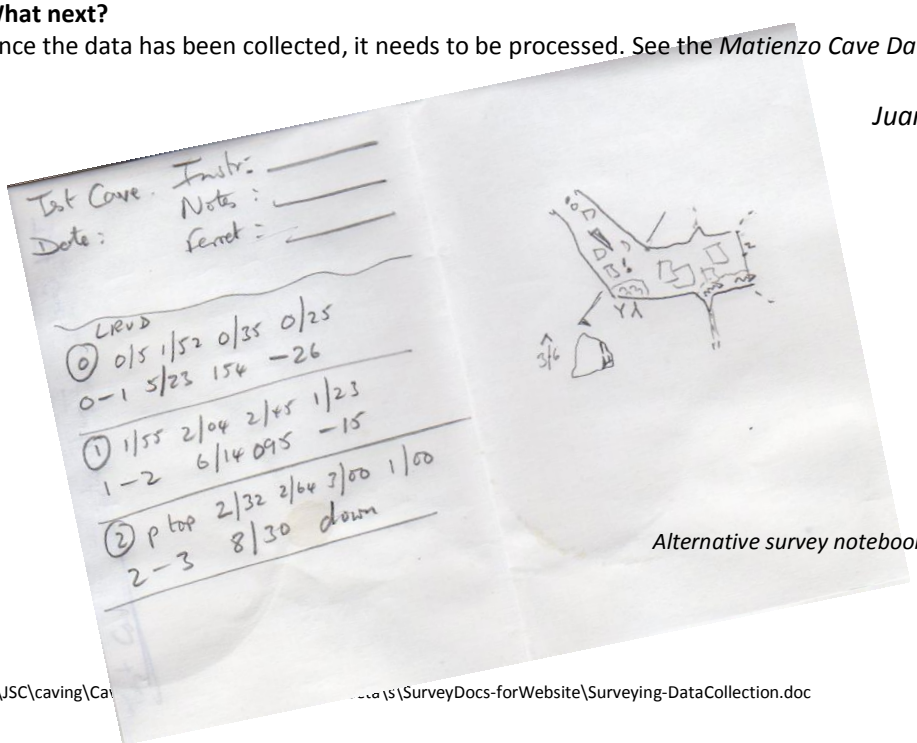
A tube carrying on over the top of the pitch would be surveyed from station 2, ie from 2 to (for example) 16, the next available station number or letter. A new set of LRUD data would need to be collected at station 2 because the view and direction 2 to 16 is different from the previous direction at station 2.
Nobody said it was easy or straightforward. The important data for the computer and the final drawing, showing direction and depth, are the length, bearing and inclination readings. The sketches are important to produce a meaningful final drawn survey.

**Reading the Instruments**
Compass and clinometer can be read along a line parallel to the leg. Make sure that the compass scale is read in the correct direction: it spins with the larger numbers coming in on the left. Ensure the correct scale is read on the clinometer: it's the one which moves to -90 degrees when the instrument is pointed straight down.

**Other factors to consider – search the Internet**
Compass and clinometer calibration
Leap frog method surveying
Accurate compass reading – one eye or two?

**What next?**
Once the data has been collected, it needs to be processed. See the *Matienzo Cave Data Entry & Processing Guide*.

*Juan Corrin 10/02/2014, 9/6/2014*




*Alternative survey notebook layout.*