

How to Survey

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What is it, and how do I do it?

Cave surveying is in its most basic form simply a description of a cave. Here we will try to cover the basics of how to accomplish a basic 'grade 5' survey. This is generally considered to be the minimum acceptable accuracy level for most applications. It is suggested that for your first few maps you choose small horizontal caves of no more than 200' in length or so, to minimize the number of survey stations you will have to deal with.

Surveying Equipment

- A compass accurately readable to one half degree.
- A clinometer accurately readable to one half degree.
- A survey measuring tape, normally a 100 foot open reel tape is used.
- Notebook(s) for the data and the sketch.
- Some method to mark the station, carbide lamp, flagging etc..
- Extra pencils.

Description of Survey Equipment

The compass is used to measure the horizontal angle while the clinometer is used to measure the vertical angle. The tape is then used to measure the direct distance from the current point to the next point. Each of these readings is recorded in the data book. All the while the sketch book is being used to draw a generalized picture of the cave using standardized symbols.

How do I do it?

A cave survey takes the three dimensional line plot generated from the recorded data, and draws the cave in around it from the sketch to produce a final map. To start a survey one usually picks an arbitrary point at the entrance to the cave. This point should be at the edge of overhang, or dripline, for horizontal entrances. For vertical entrances the point should be at the highest closed contour, or the lip, of the pit or sink. When placing your survey point always make sure you have a direct line of sight to the next spot you want a point, remembering to place a point at leads or passage junctions for later use.

From this original point take the compass azimuth, clinometer angle, and taped distance to the next point. To label your stations you may want to start with names such A1 for the first point, with the second being A2. The first point down a side lead might be called B1. The person taking data should be writing down these measurements and recording the distance from the survey point to the ceiling, floor, left and right walls. The sketcher is drawing the outline of the cave walls, indicating and labeling where survey points are and adding the features of the cave using map symbols. The sketcher also records such data as the ceiling height, drop off distances, floor type, water and wind strength and direction etc.. An important detail that the sketcher should include regularly are passage cross sections. This is especially true where the passage character changes significantly.

Generating the line plot

To make a two dimensional, or plan view plot of the cave one must first calculate the horizontal distance between each station. This is due to the fact that the distance as it will be displayed on the map is as it would appear if viewed from directly above. This distance is not usually the same as the measured point to point distance. Fortunately, using the clinometer reading it is a simple calculation to determine the horizontal distance. The formula is...

Horizontal distance = taped distance times the cosine of the clinometer angle

The calculated distance will then be the distance used to make the line plot. Often, the horizontal distance is the distance used in recording the official length of the cave.

Survey Grades

- A rough sketch from memory(i.e. not done in the cave) not to scale.
- A sketch generally to scale, distances and angles estimated.
- Rough sketch, compass and paced lengths.
- A compass and tape are used, but no clinometer.(Bearing to within 1 degree)
- A compass, tape, and clinometer used.(To nearest inch, and degree)

Each grade higher represents more accurate methods. There are even more detailed and accurate ways to conduct a survey, but that is not a concern here.

Adding the sketch

After getting your line plot on the paper, you are now ready to start adding the contents of the sketch. Usually it is best to start with drawing the walls in, making sure to indicate passages overlain by higher ones by a dashed line for the lower passage. After the walls for a section of cave are drawn, go back and start filling in the detail for that area. Since you will be working directly from the in-cave sketch, this is where it becomes helpful if the person drafting the map was also the person sketching in the cave. Make sure to clean up all the little bobbles that occur on the sketch, and adjust to scale if necessary.

	Slope Symbol
	Breakdown
	Passage Height
	Drop Depth
	Elevation Relative to First Station
	Water Flow Direction
	Drop Off
	Ceiling Rise

Common Cave Survey Symbols

These symbols are what you will use to fill in the details of the nature of the cave passage. There are special symbols for just about anything that one might encounter in a cave, but remember not to make the map too crowded. This will provide a good set of the most common ones to start out with. Some quick explanations....

- Slope - the 'toes' of the chicken foot point downslope, and the wider the foot, the less slope there is.
- Breakdown - a general symbol for rock that has fallen into the passage. It is good to vary these up so they don't all look the same.
- Passage Height - used as a general indicator of the total vertical size of the passage at that point. This way a reader can tell at a glance if they will have to crawl or not.
- Drop Depth - used to indicate the depth of a drop or climb.
- Elevation - this is usually used to give a relative elevation of the current point to the entrance or first station. It is not necessary to give an elevation at every point, just enough to give a general idea of the vertical relationships. If you know the actual elevation of the entrance point and wish to display that throughout the cave that is fine, but make sure to note it on the map.
- Water Flow Direction - obviously the arrow points in the direction of flow. This can also be associated with a tag to indicate a flow rate i.e. 2.5cfs. Airflow can be treated the same way, but do not use the circle on the arrow, and it might be good to label each one in the legend to avoid confusion.
- Drop Off - this is a hatched line with the hatchures (the little lines coming off the main one) pointing to the lower side of a drop, or other sudden vertical change in the floor.
- Ceiling Rise - this is a symbol similar to the drop off, but it is a dashed, hatched line that indicates a sudden change in the ceiling height. The hatchures point to the higher side.

After adding the detail I usually add the cross sections last after I have seen where everything needs to go, but this is a matter of preference. It is good to put cross sections at major changes in passage shape, or at a reasonable interval without crowding the map. Most people that have been mapping for a while also do profile views of the cave, often just a line plot, to give an idea of the vertical relationships in the cave. This adds additional complexity in how to generate the profile view, scale and display it and is not covered here. For most small horizontal caves a profile is not especially helpful anyway.

Finish and presentation

There are a few basic items to always include on a map so as not to leave a map user scratching their head trying to decipher your work. Always put the name, a north arrow, either a scale bar or verbal scale, the date it was surveyed, who surveyed it, and who made the map. Putting the location of the cave on the map is not in general done, but can be added for certain circumstances. Make sure that margin information is easily discernable from the map labels, and that you maintain a consistent lettering scheme of size and font. The font will probably be best if the same one is used throughout most of the map. Size of the text should be consistent in that the more of a particular label type there are, the smaller the font. For instance, there is one title and it will usually be the largest font size, there are more names, and the font size will be smaller. Hand lettering maps is not recommended unless you have especially clear, artistic handwriting.

Finally, after you have gone over the map and readied it for presentation, get someone else to proof read it for you. Get them to be critical and tell you what they like or don't like, and why. Just like writing a paper, a map can also get cluttered with the authors ingenious devices, and fall short of conveying the basic information it was intended to illuminate. Start simple, then build on that experience and try new techniques and experiment. Have some fun with it.