



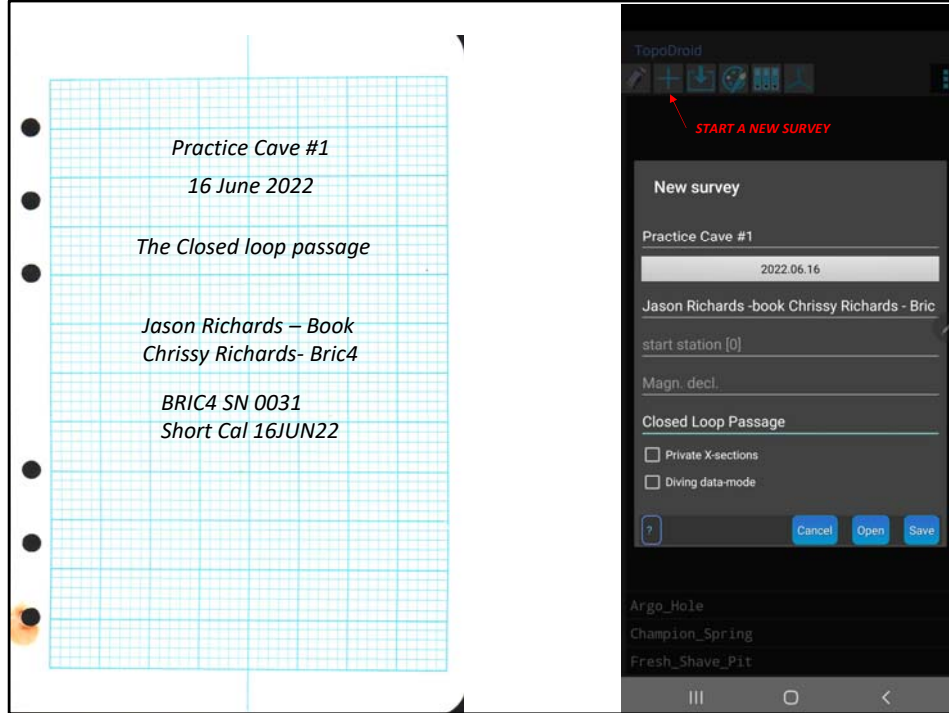
Links:

<http://marcocorvi.altervista.org/caving/speleoapps/speleoapks/TopoDroidApks.html>

<https://rchrds.org>

<https://sacs.caves.org/resources/symbols-full.pdf>

Some Links!



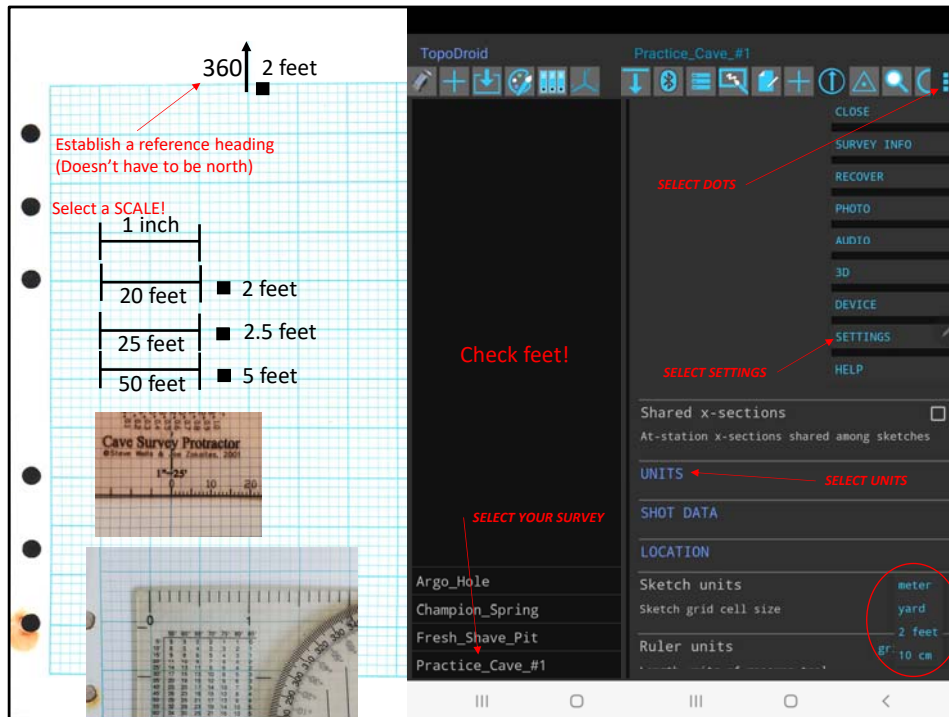
Analog on the left, Topodroid on the right-

Enter survey data-

Include date of survey, names of participants and instrument data

Don't forget type of tape (if not laser) and compass/clino SNs.

Include calibration dates- this can later be used to determine accuracy of survey



Set up your sketch page-

Analog- pick a reference heading- doesn't have to be north- on small pages, sometimes another cardinal direction makes better use of the page. On 8.5x11 it matters less.

Analog- select a scale. This can be important for major projects- use the same scale as everyone else!!!

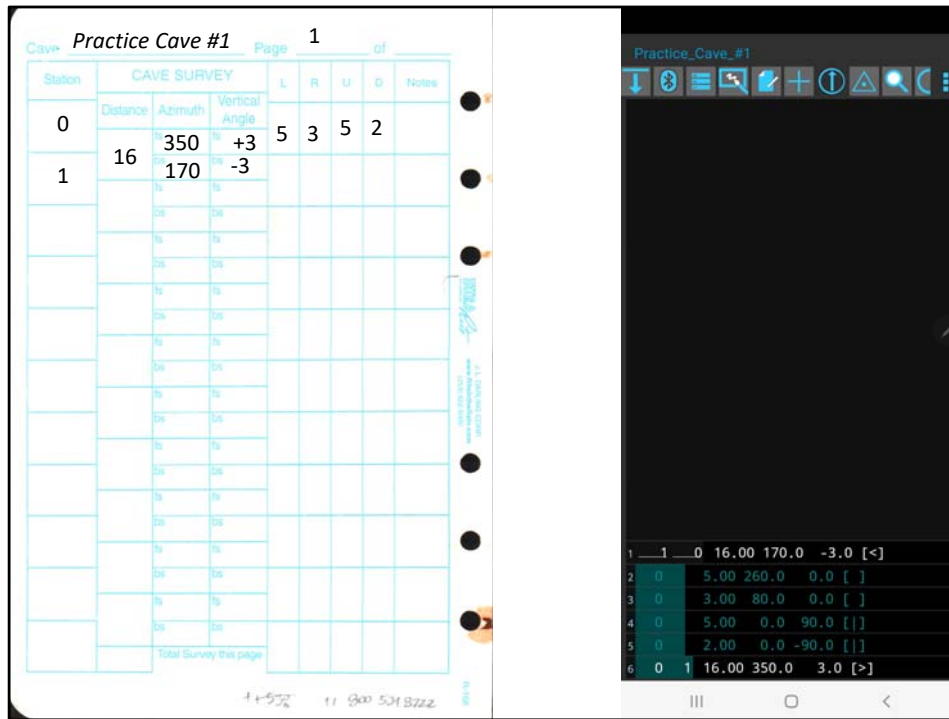
Blue blocks on this paper 2=1 inch. Big grey blocks = 1 inch.

Smaller blocks divided as expected.

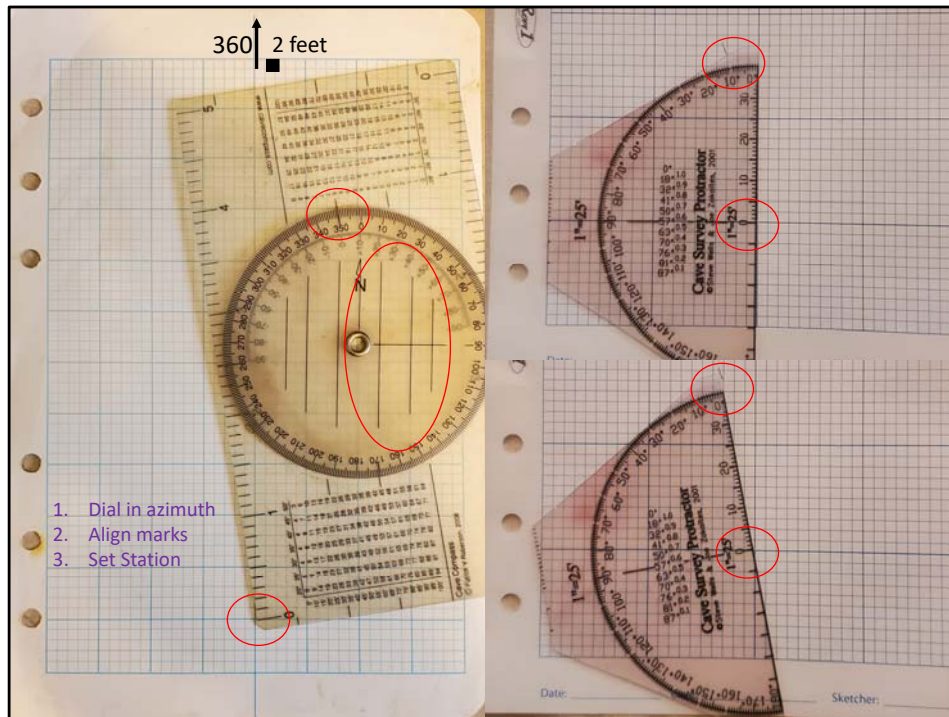
Metric paper follows similarly.

Topodroid- wont matter. North is up. Grid size is limited, and 1"=50 feet isn't an option.

For this exercise make sure you are set up so your sketch grid units are 2 feet.

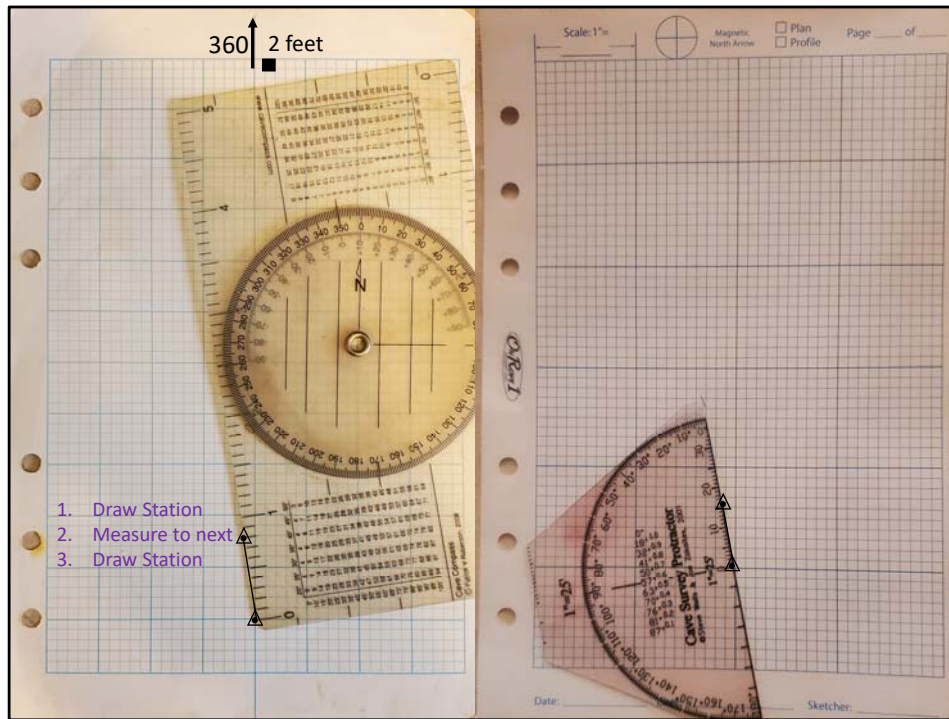


Data Entry! The Green background in Topodroid indicates that this data is the most recent collected (or entered in this case.)

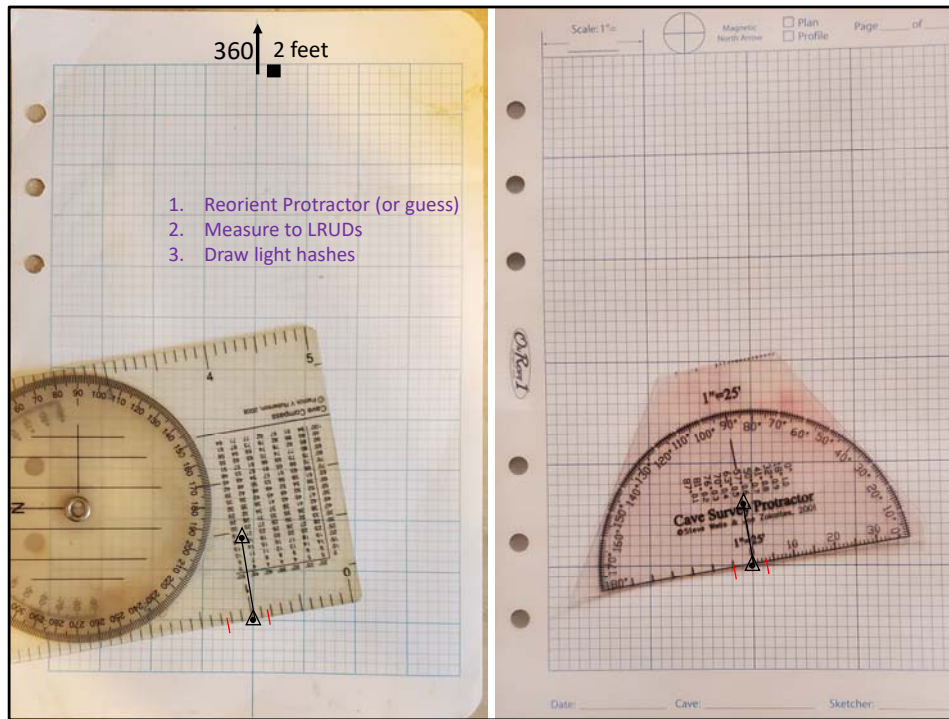


Topodroid: Establish your sketch, Name it and tell which station it begins at. (Zero in this case) then stand by.

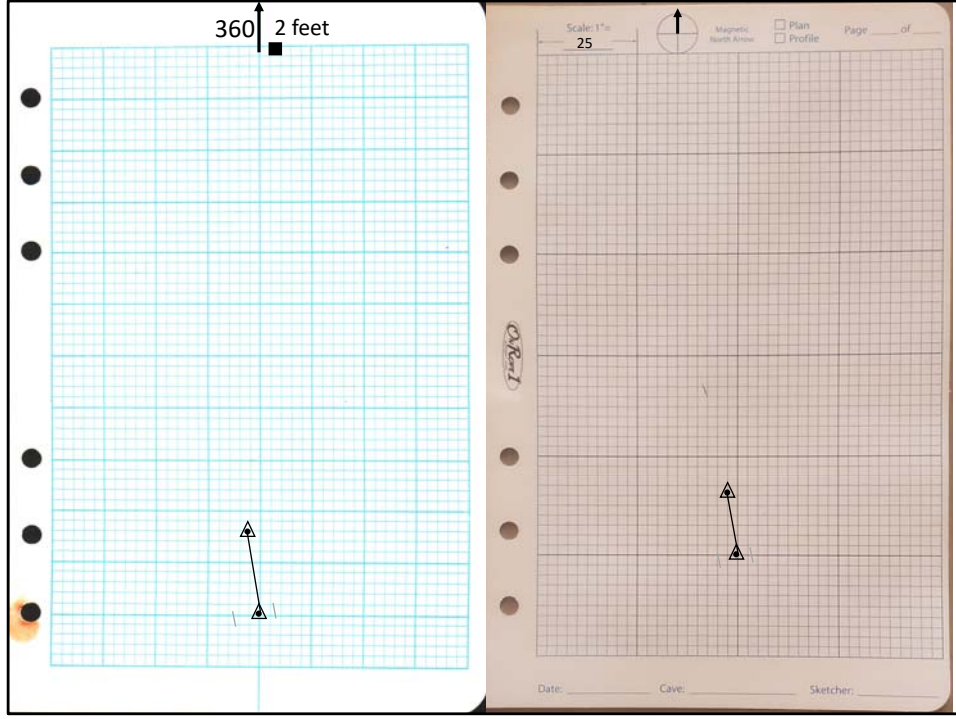
Analog: Set your protractor and align. With the Cave Compass, set your heading aligned with the large hash outside the ring. Align the north arrow generally with the north of your page, then use the lines next to the center pivot to line up your grid correctly. With the Cave Survey Protractor, Align the center or zero mark with your station, then rotate the protractor the appropriate amount from your reference heading. In this example, 10 degrees left of 360.



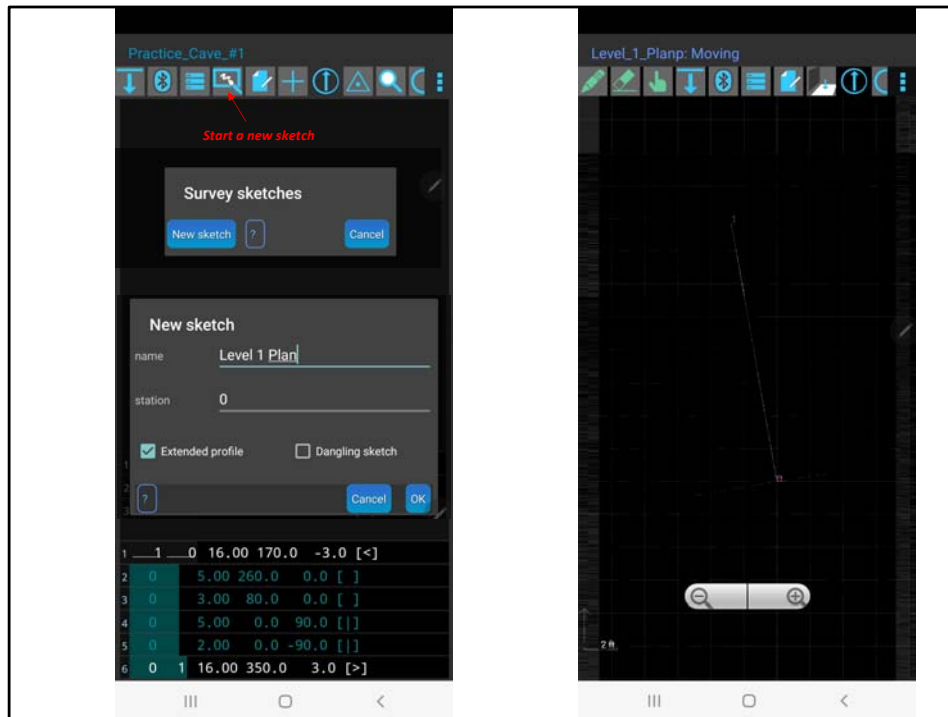
Once the protractors are aligned, in either case, use the scale on the protractor to measure your length, and mark your second station.



When drawing your LRUDs, (at least the L and R in the plan view) use the same distance scales on the protractor to make light hash marks where the walls were measured. The alignment of the protractor is less important here, but you can take the time to line up a 90 degree angle, just be aware that your survey crew will likely choke you out for being the slowest sketcher on the planet if you make a habit of this.

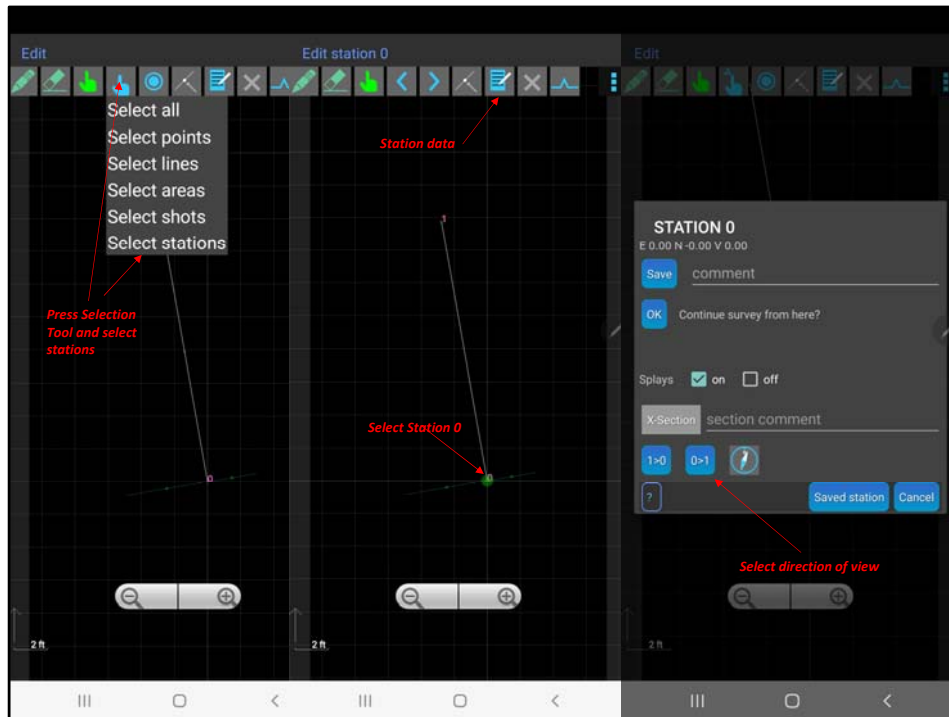


Matchy matchy! (scales are slightly different due to paper and protractor scales!)



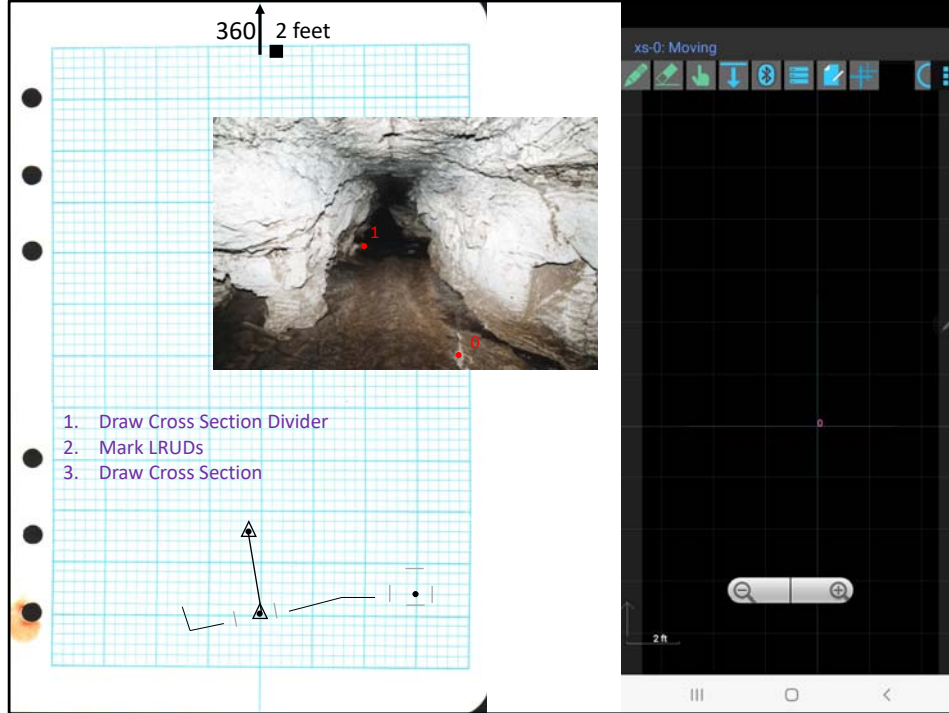
Lets start our topodroid sketch.

Select the new sketch tool, and name your sketch. Remember, if you have a multi-level cave that you are sketching you will want multiple plan sketches- trying to do two sketches on top of each other in either topodroid or paper is a fast way to lose accurate data. Make sure that your sketch starts at the station you intend- in this case, we start with zero- as this is the beginning of our part of the sketch.



Here we want to add a cross section for the station 0. Use the blue selection hand, pick select stations, then select station zero (it will get a green circle, and the LRUDs will also have green midpoints).

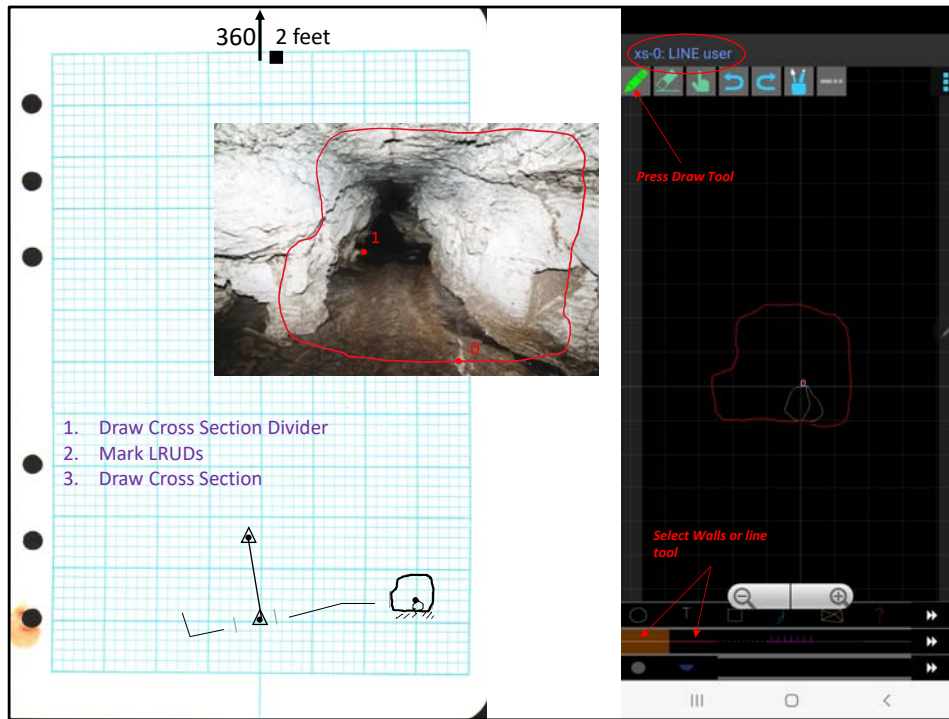
The station dialog will allow you to create a cross section sketch. Select the view direction using the two buttons below the X-Section grayed out button. In this case, since we are surveying forward, we want to view the cross section from 0>1.



Analog: Here is your chance to move to the side of your plan view sketch and lay out your cross section. Make a dot for your station, then using the LRUD measurements, make light hashes that will define the maximum extends of the cross section view.

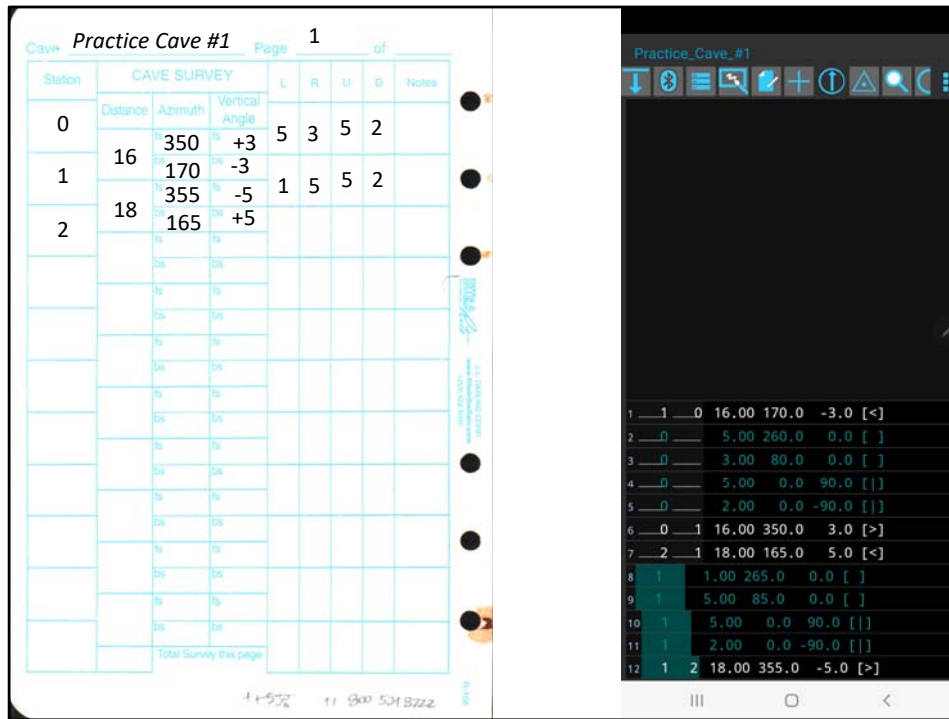
Digital: You are now in the cross section view- you can verify this with the top line- it says xz-0: moving. This means you are looking at the Cross section at Station Zero. Pay attention to the top data line- this can reduce confusion later.

Your station zero is visible (it may not always be- if you don't see it, zoom out, and scroll around till you find it.) And you LRUD measurements, and any additional measurements are visible as light blue lines.



Analog: Using the picture- draw your cross section. The cross section wall should not extend beyond the LRUD measurement hashes.

Digital- using the green draw tool, select the Wall line type, and draw your wall. Using the Line line type, draw your rock or any details you want to add. (including floor composition!)



Data Entry! Remember to check backsights for correctness, and in Topodroid, you will have to select the field to enter the backshots.

Practice Cave #1 Page 1 of

Station	CAVE SURVEY			L	R	U	D	Notes
	Distance	Azimuth	Vertical Angle					
0								
	16	350	+3	5	3	5	2	
1		170	-3					
	18	355	-5	1	5	5	2	
2		165	+5					

RECIPROCAL TRICKERY

The backsight should always be 180 degrees from the front sight. $355 - 180 = 175$. But that math can get tough when you are tired.

Look at the first digits of 355, 35. The shift by two trick is helpful. If you can add or subtract 2 from the first digit, you do the opposite to the second digit.

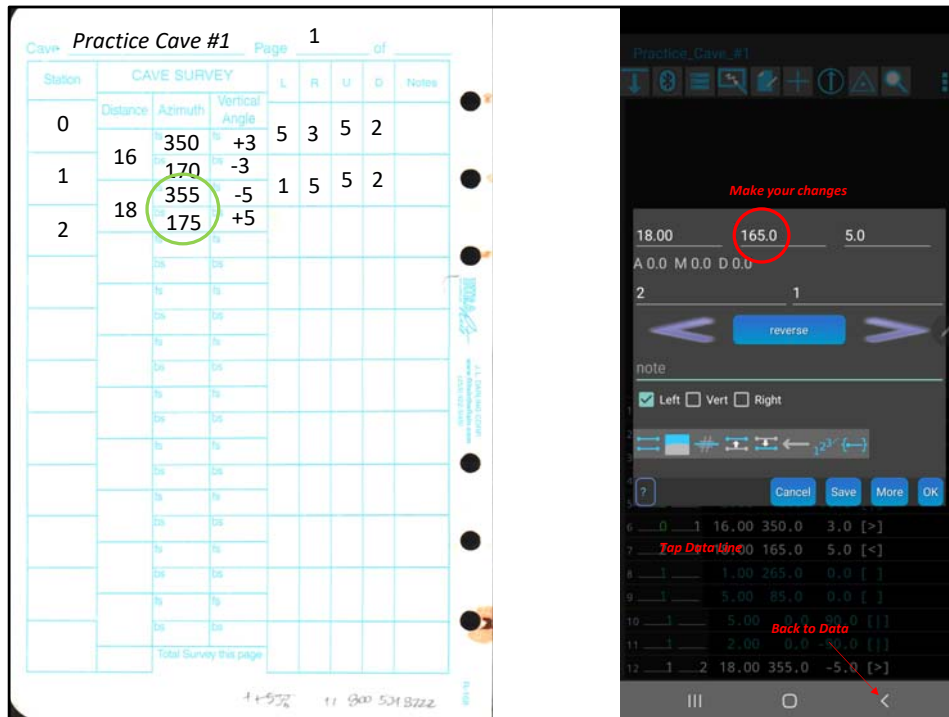
35- subtract 2 from 3, and add 2 to the 5. 17- are the first two digits of your reciprocal. (Don't forget azimuth is a 3 digit number)

The last number should be the same, but your survey accuracy will determine how much it can vary by (2 degrees max is common)

Data Entry! Remember to check backsights for correctness.

In the case of topodroid- when we go to the plan view sketch- the shot is orange- indicating a data error!

Why did we blunder? Look at the Reciprocal Rule, and see what changes need to be made to our back sight.



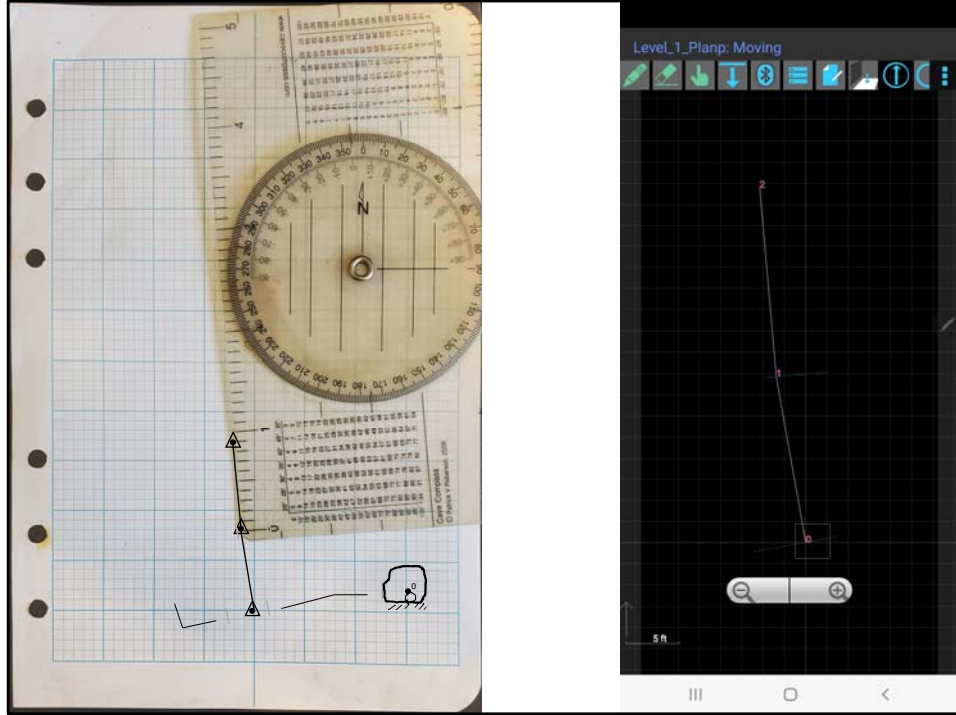
Data Entry! We managed to blunder the backsight, or the numbers were bad data from the instrument reader. Either way, it must be corrected.

Make the data collection crew reshoot both the front and backsight for correctness.

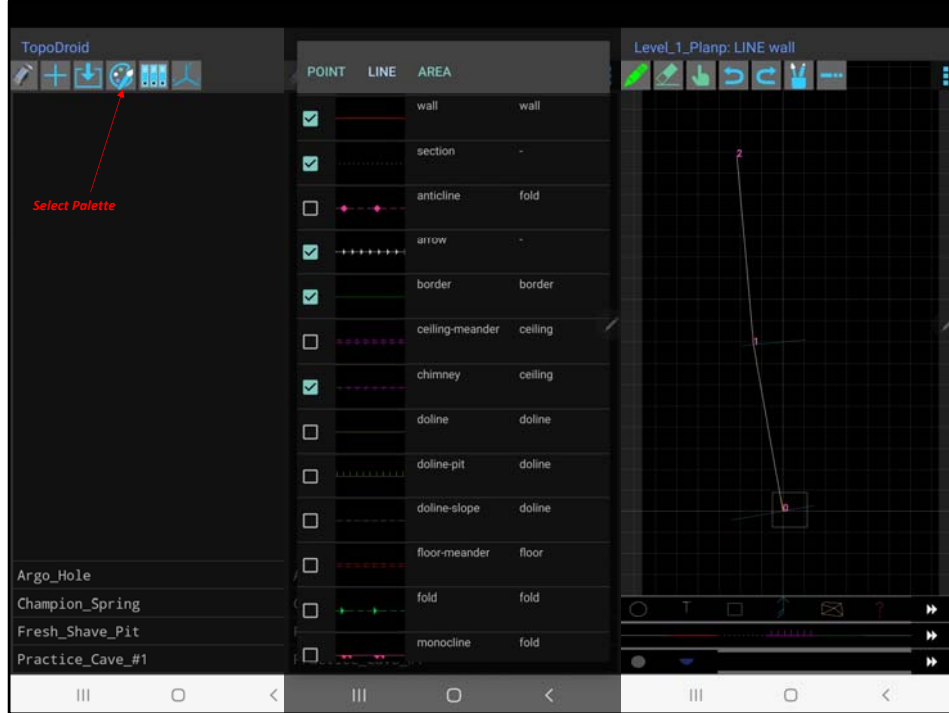
Analog: Get out your eraser, and make your changes.

Digital: Tap the line of data in white that is incorrect. The data information box will show up. Keep in mind that this is only the backsight shot.

Unlike the initial data entry, now front and backsights have separate data blocks. If updated data shows both are incorrect, you will have to edit both data lines.



Analog: Draw your next leg, and add the hash marks for the LRUDs at Station 1.
Digital: Notice that your corrected data is now white.



Digital: you may have had a hard time finding the appropriate tools for your first cross section drawing, lets clean up your palette.

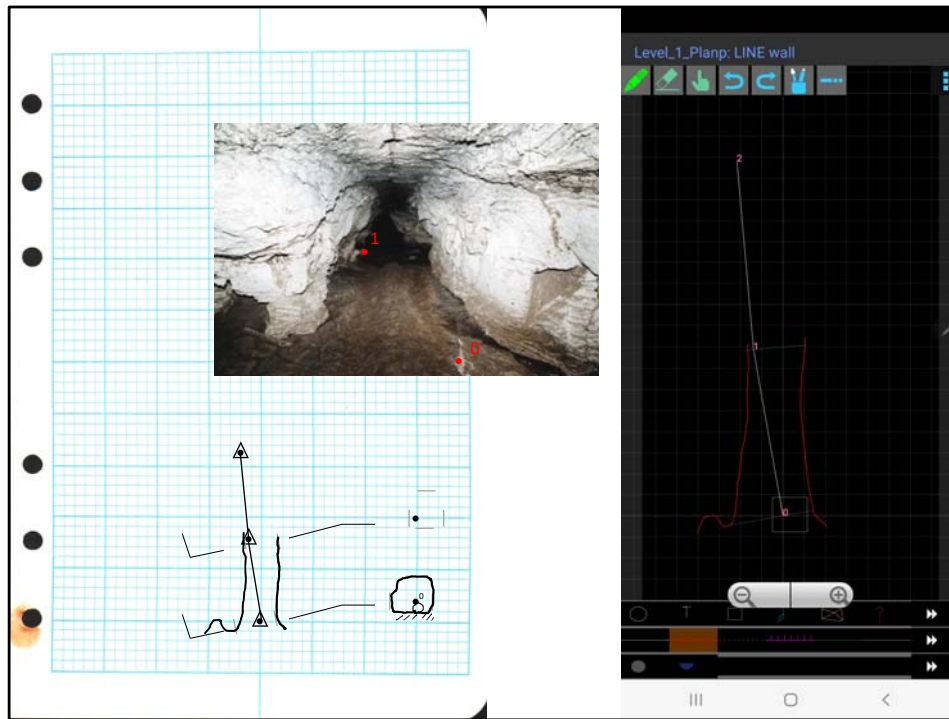
Back out to your survey list page

Select the Palette tool.

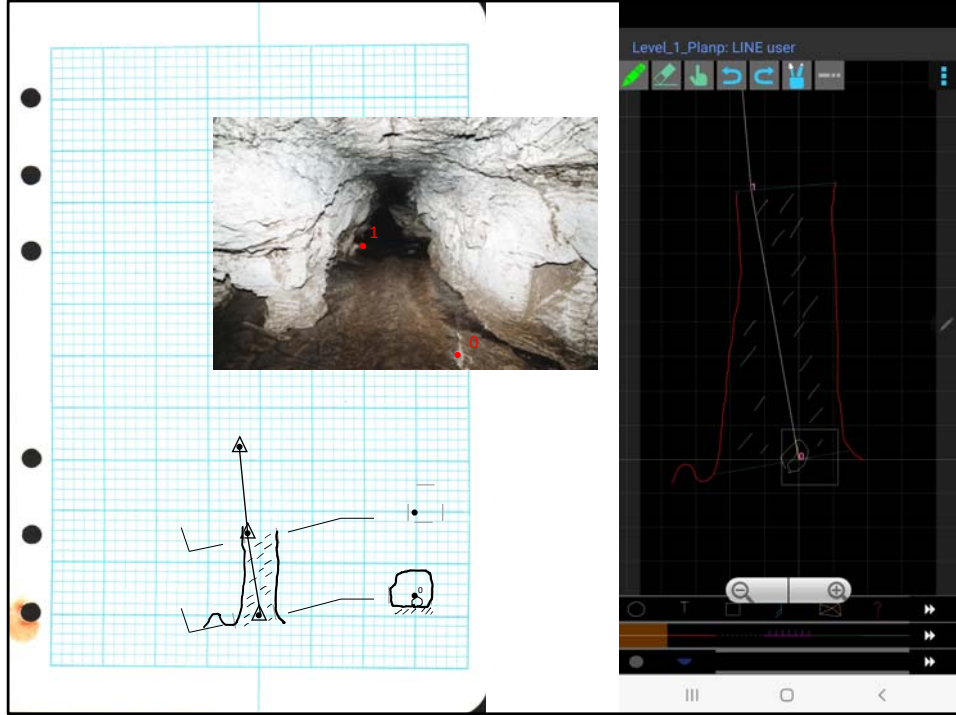
Select the items you think you might need at least: Wall, Section, border, chimney, pit

Same for point and area

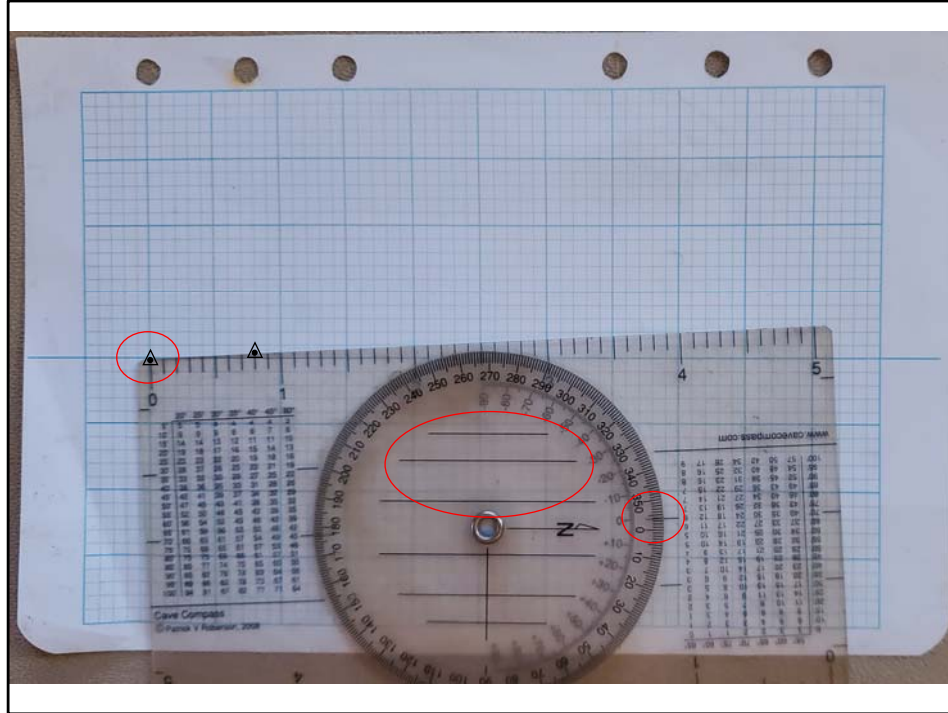
Return to your survey, and return to your sketch page.



Analog and digital- using the picture, draw your walls. Make sure to use a heavy pencil thickness, or in topodroid, the Wall tool.

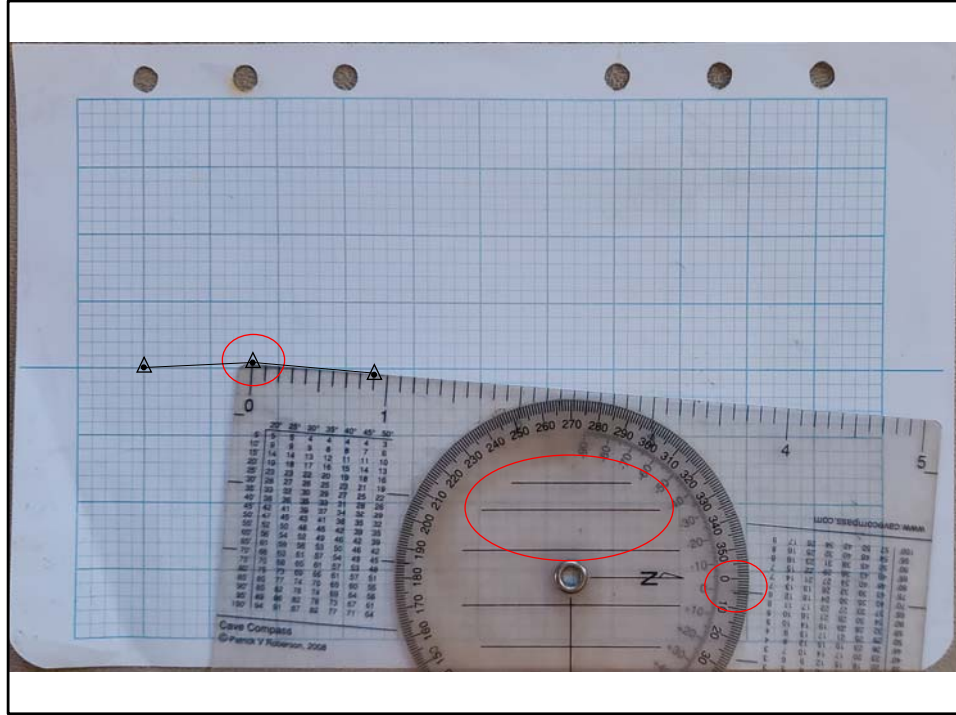


Analog and Digital- makes sure to add floor detail, and any ceiling detail if necessary.

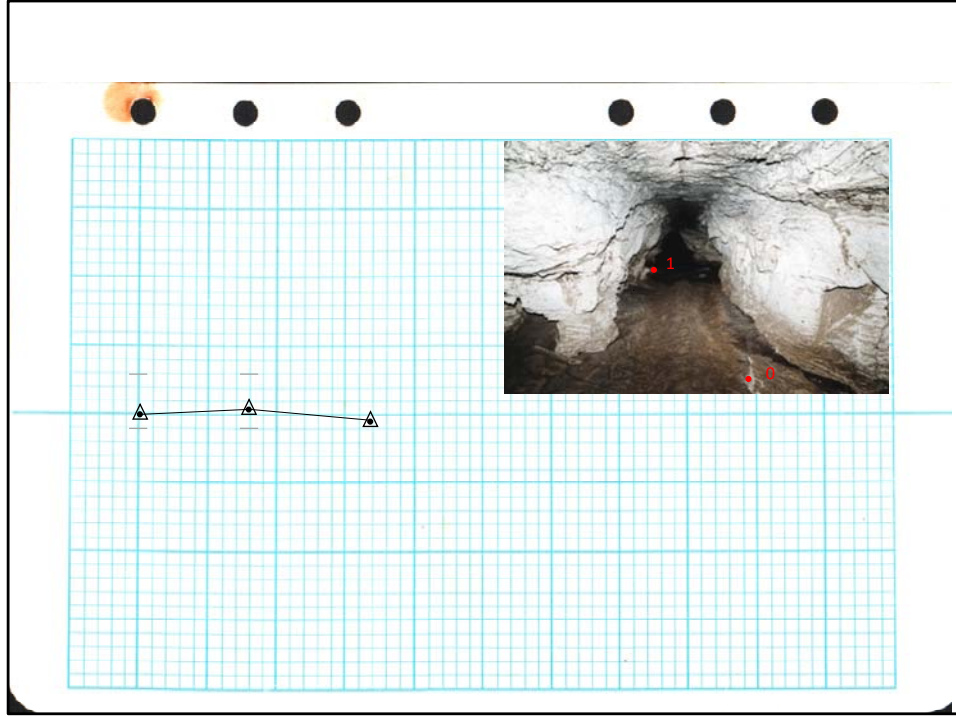


Lets set up our Plan view!

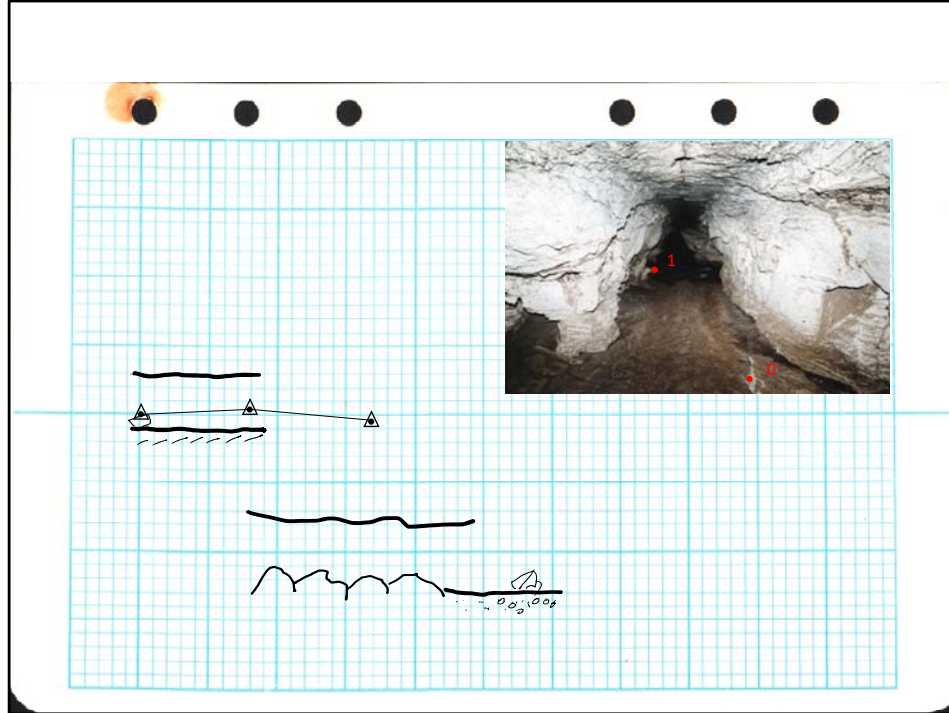
Analog: Set your protractor to the clinometer value between stations 0 and 1. again, use the lines around the pivot to align your protractor. Draw your stations.



Analog: continue for shot 1-2.

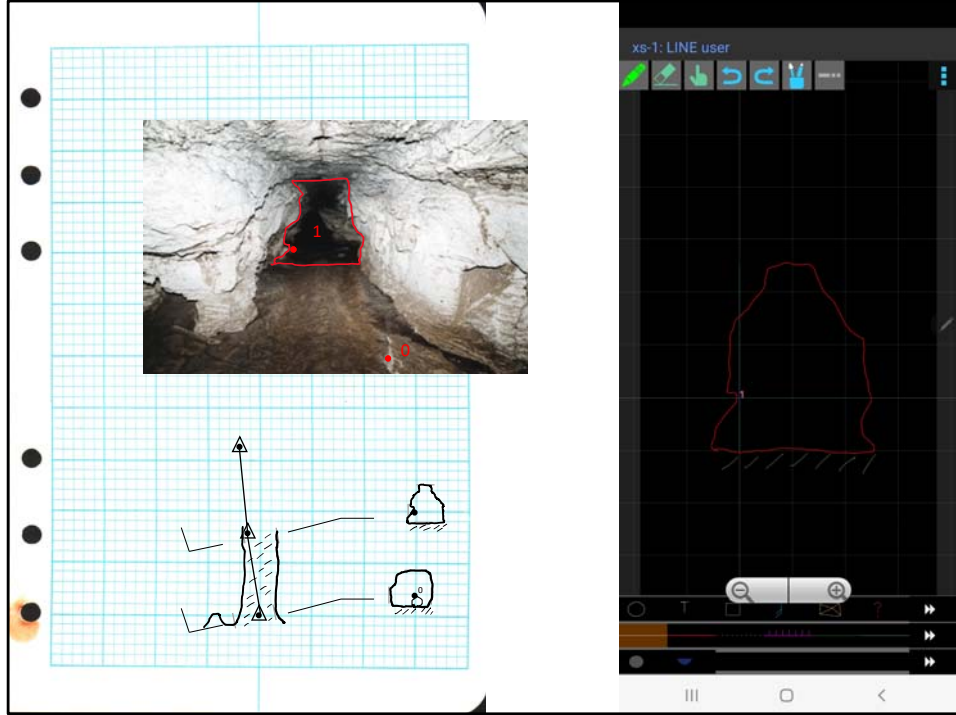


Analog: Take the data from the U and D of your LRUDs and make hash marks at stations 0 and 1.



Analog: Using the picture, draw your roof and floor. Don't forget to add the floor composition detail!

Additional sketches- Examples of breakdown floor, and mixed dirt and rock floor. Floor line does not have to be continuous- particularly in the case of breakdown, but the if breakdown is substituted for floor line, it should be drawn at the same line thickness as the wall, instead of a lighter interior detail thickness.



Analog and Digital: Draw your second cross section at station 1.

Cave Practice Cave #1 Page 1 of

Station	CAVE SURVEY			L	R	U	D	Notes
	Distance	Azimuth	Vertical Angle					
0								
	16	350	+3	5	3	5	2	
1		170	-3					
	18	355	-5	1	5	5	2	
2		175	+5					
	25	020	-37.6	7.2	0	4.2	2.8	
3		201	37.0					

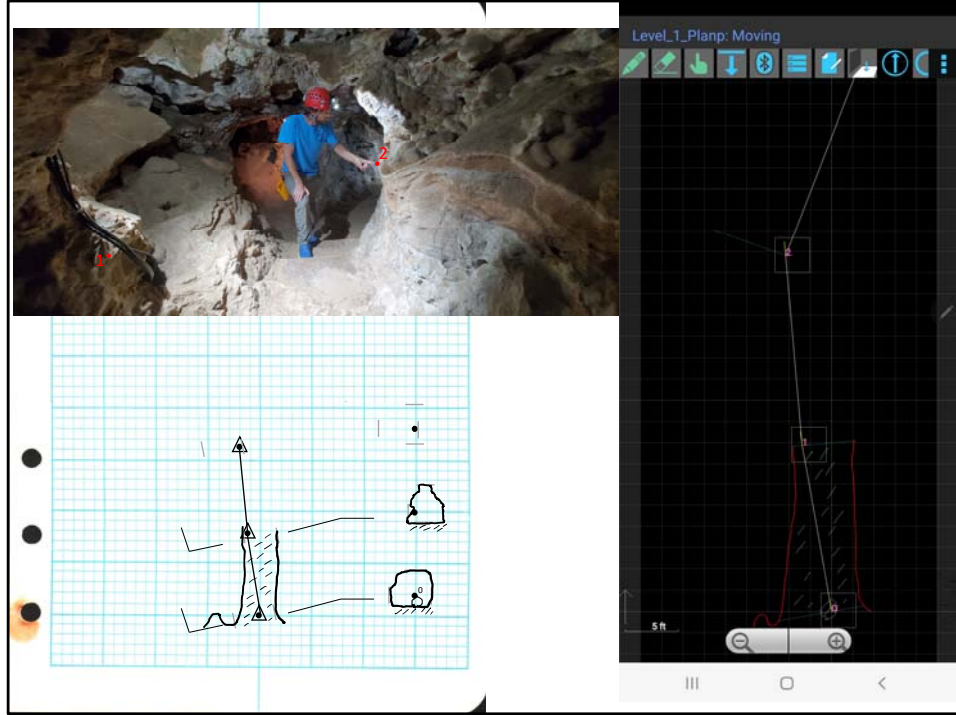
Total Survey this page

4+5% 11 800 5018772

Practice_Cave_#1

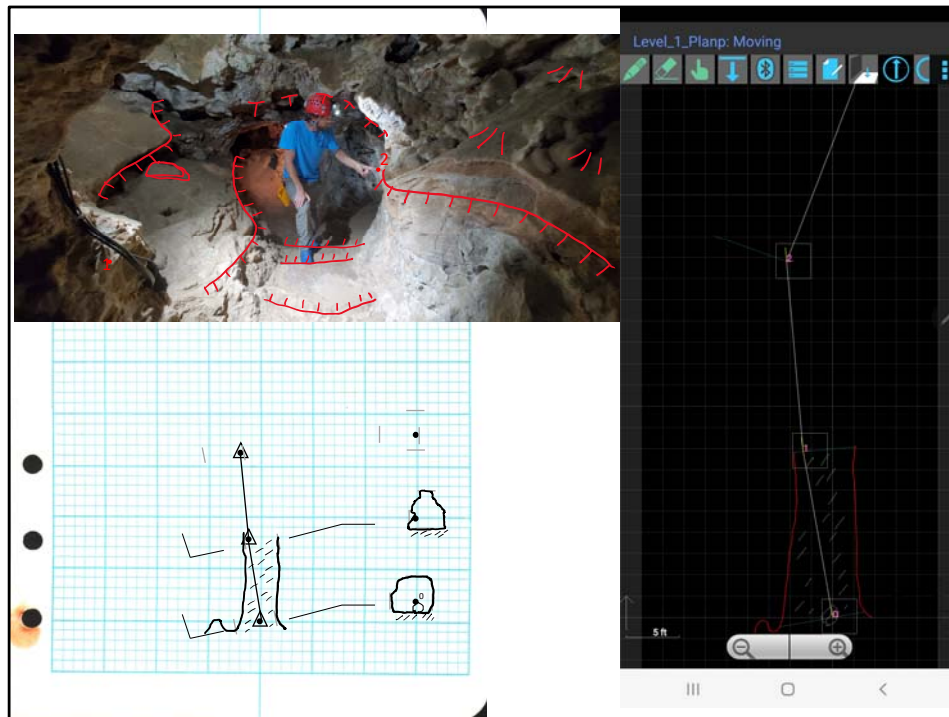
1	1	0	16.00	170.0	-3.0	[<]#
2	0		5.00	260.0	0.0	[]
3	0		3.00	80.0	0.0	[]
4	0		5.00	0.0	90.0	[]
5	0		2.00	0.0	-90.0	[]
6	0	1	16.00	350.0	3.0	[>]
7	2	1	18.00	175.0	5.0	[<]
8	1		1.00	265.0	0.0	[]
9	1		5.00	85.0	0.0	[]
10	1		5.00	0.0	90.0	[]
11	1		2.00	0.0	-90.0	[]
12	1	2	18.00	355.0	-5.0	[>]
13	3	2	25.00	201.0	37.0	[<]
14	2		7.20	290.0	0.0	[]
15	2		0.00	110.0	0.0	[]
16	2		4.20	0.0	90.0	[]
17	2		2.80	0.0	-90.0	[]
18	2	3	25.00	20.0	-37.6	[>]

Data Entry!

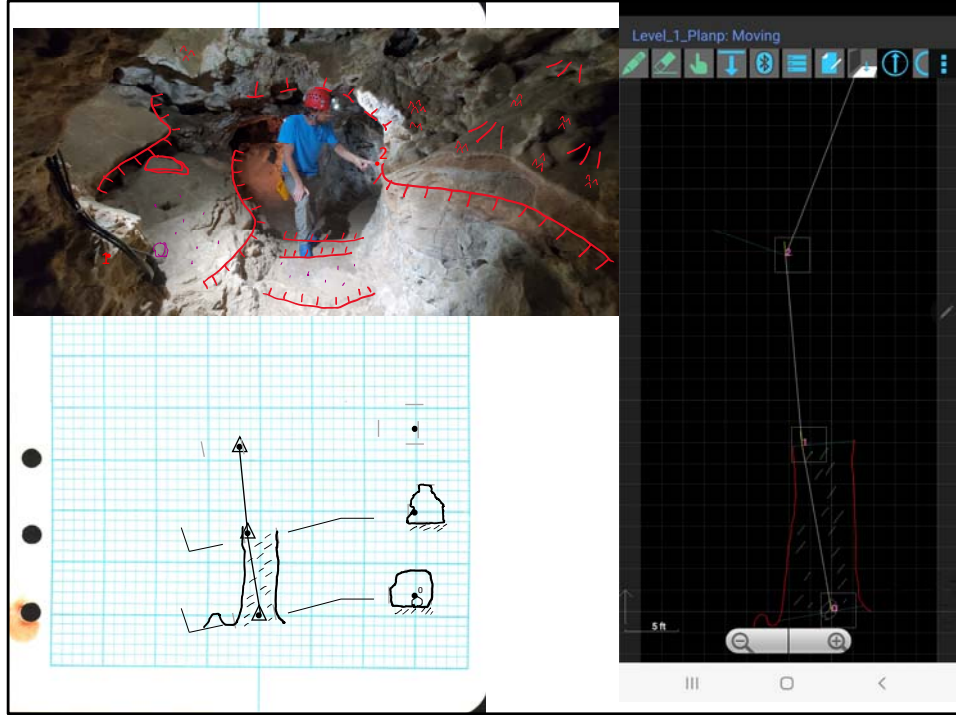


Analog: Add your hash marks for LRUD and set up your cross section for station 2.

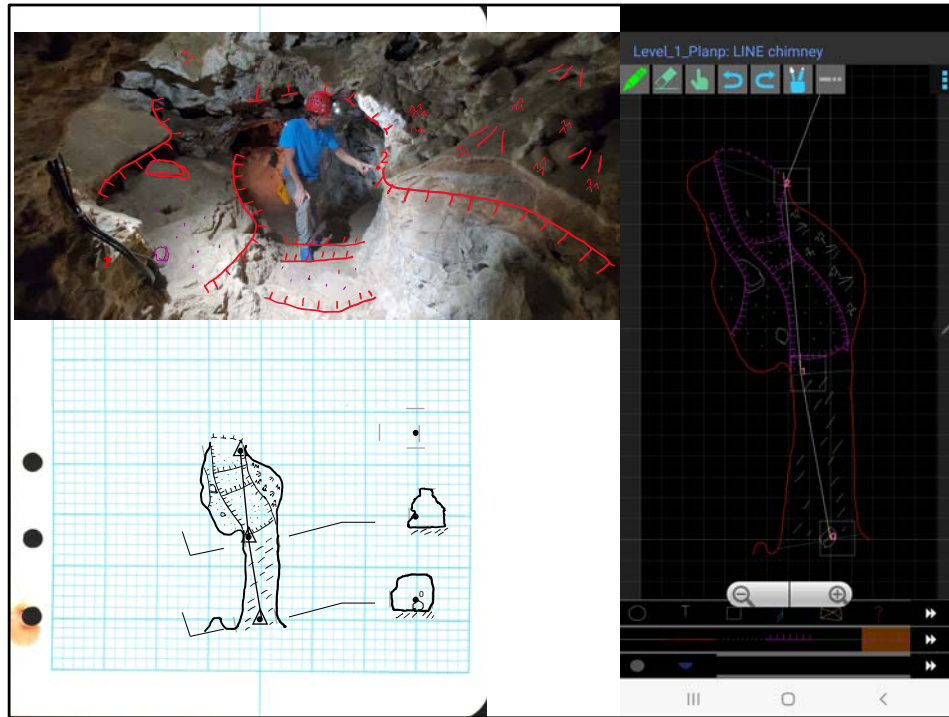
Digital: Notice that the box around the station number means that you have a cross section view associated with that station.



A visualization of floor and ceiling and slope markings. Notice that the delineation between floor details and ceiling details is normally the elevation at which the viewer's eye traverses the passage. The hashes behind Sexy Chuck are ceiling markings because they are dashed. The small lines always point towards the lower elevation, in that case, the lower ceiling behind Chuck's head is indicated by the hash marks pointing that direction. On the ledges in front and behind him, the line is solid, because they are floor details, and the hashes point towards the lower floor. Same with the steps on the floor. The slope marks spread out towards the lower end of the slope.

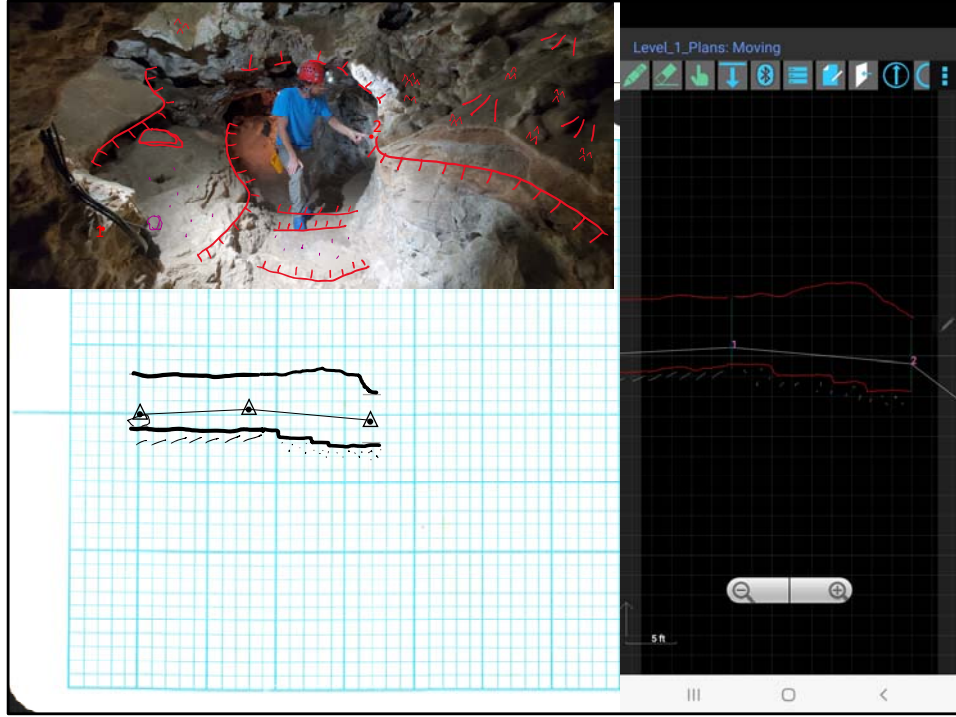


We can add floor and detail as well, notice that I have added sand markings between the steps (randomly placed small dots) and a homemade symbol for dog tooth spar, small groups of three triangles, in areas where it appears. It is not necessary to completely cover a surface with symbology- this isn't a painting, but a -representation- of what is at that area. Add as much as is appropriate, but keep in mind, its faster to only add what minimally describes the area.

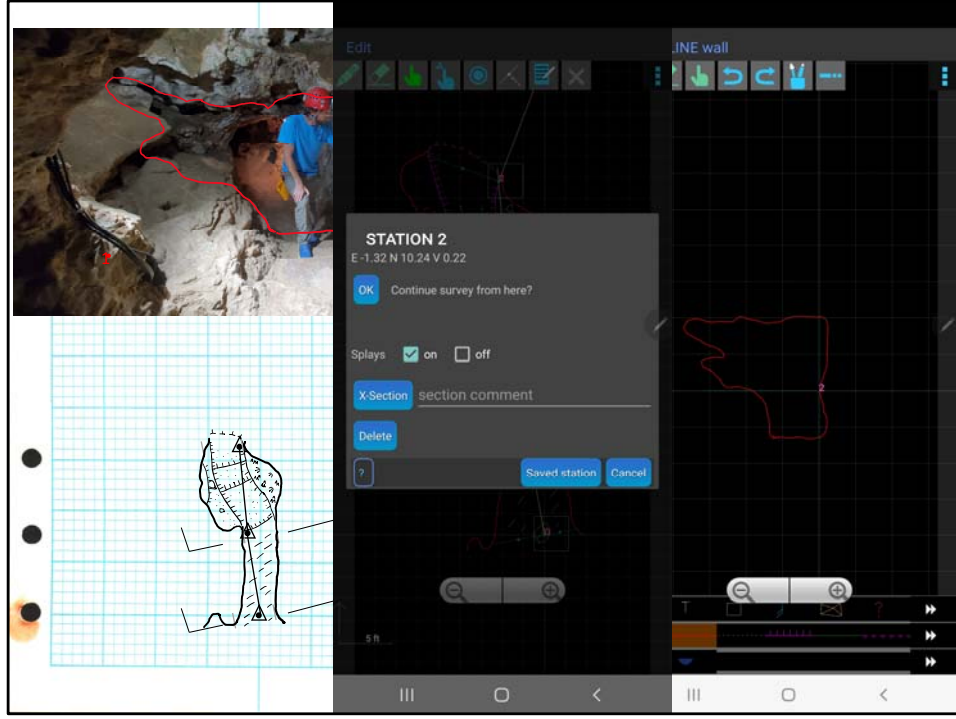


Analog: draw your representation of the visualized symbols on your plan view with walls and floor detail.

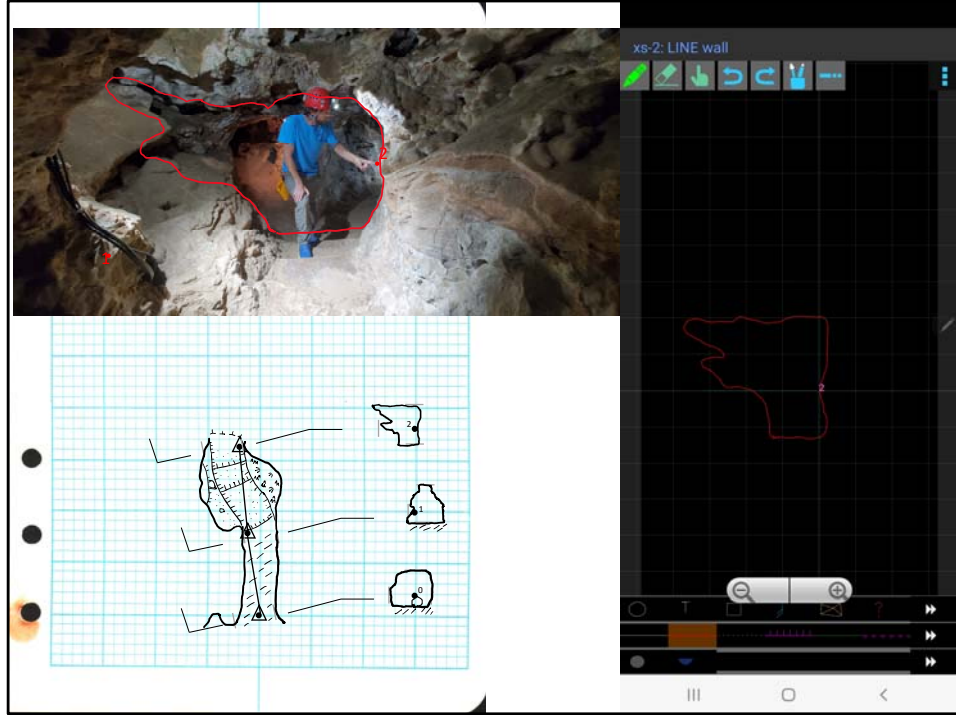
Digital: same- but use the floor and ceiling ledge palette tools. Beware that its easier to draw the ledge tools in the wrong direction and then just back up the step than to go through and swap the directions of the symbol, which can be done by selecting with the selection tool.



All: Draw your profile details.



Digital: Add a cross section at Station 2.



Analog: draw your cross section.

Cave Practice Cave #1 Page 1 of 1

Station	CAVE SURVEY			L	R	U	D	Notes
	Distance	Azimuth	Vertical Angle					
0								
1	16	350	+3	5	3	5	2	
		170	-3					
2	18	355	-5	1	5	5	2	
		175	+5					
3	25	020	-37.6	7.2	0	4.2	2.8	
		201	37.0					

FORESHORTENING TRICKERY

	20°	25°	30°	35°	40°	45°	50°		55°	60°	65°	70°	75°	80°	85°	
5'	5	5	4	4	4	4	3		5	3	3	2	2	1	1	0
10'	9	9	9	8	8	7	6		10	6	5	4	3	3	2	1
15'	14	14	13	12	11	11	10		15	9	8	6	5	4	3	1
20'	19	18	17	16	15	14	13		20	11	10	8	7	5	3	2
25'	23	23	22	20	19	18	16		25	14	13	11	9	6	4	2
30'	28	27	26	25	23	21	19		30	17	15	13	10	8	5	3
35'	33	32	30	29	27	25	22		35	20	18	15	12	9	6	3
40'	38	36	35	33	31	28	26		40	23	20	17	14	10	7	3
45'	42	41	39	37	34	32	29		45	26	23	19	15	12	8	4
50'	47	45	43	41	38	35	32		50	29	25	21	17	13	9	4
55'	52	50	48	45	42	39	35		55	32	28	23	19	14	10	5
60'	56	54	52	49	46	42	39		60	34	30	25	21	16	10	5
65'	61	59	56	53	50	46	42		65	37	33	27	22	17	11	6
70'	66	63	61	57	54	49	45		70	40	35	30	24	18	12	6
75'	70	68	65	61	57	53	48		75	43	38	32	26	19	13	7
80'	75	73	69	66	61	57	51		80	46	40	34	27	21	14	7
85'	80	77	74	70	65	60	55		85	49	43	36	29	22	15	7
90'	85	82	78	74	69	64	58		90	52	45	38	31	23	16	8
95'	89	86	82	78	73	67	61		95	54	48	40	32	25	16	8
100'	94	91	87	82	77	71	64		100	57	50	42	34	26	17	9

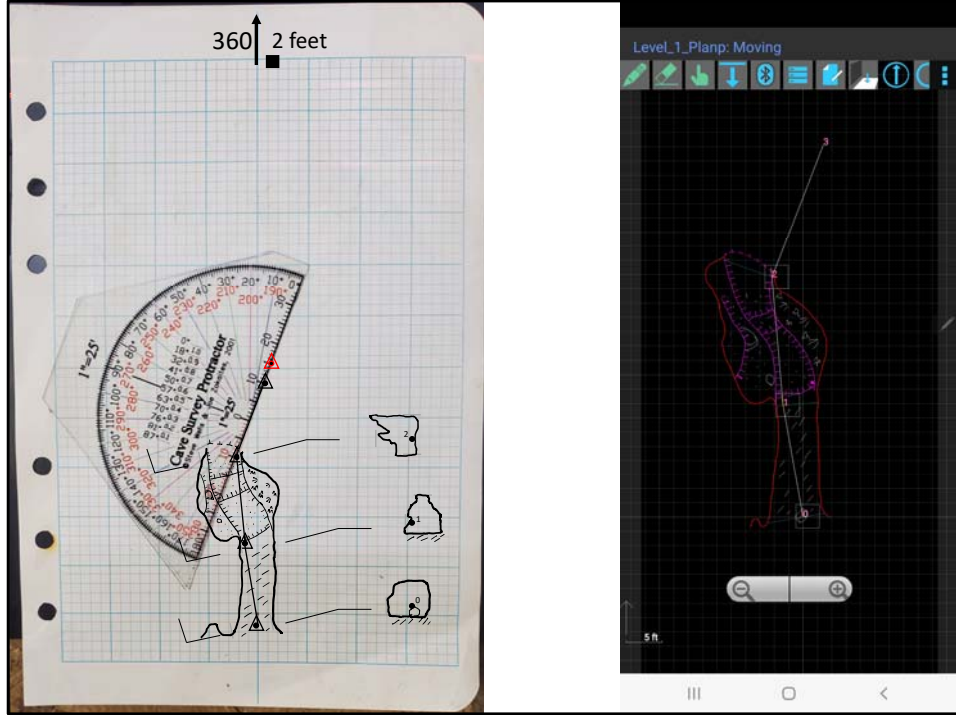
Practice_Cave_#1

1	1	0	16.00	170.0	-3.0	[<]#
2	0		5.00	260.0	0.0	[]
3	0		3.00	80.0	0.0	[]
4	0		5.00	0.0	90.0	[]
5	0		2.00	0.0	-90.0	[]
6	0	1	16.00	350.0	3.0	[>]
7	2	1	18.00	175.0	5.0	[<]
8	1		1.00	265.0	0.0	[]
9	1		5.00	85.0	0.0	[]
10	1		5.00	0.0	90.0	[]
11	1		2.00	0.0	-90.0	[]
12	1	2	18.00	355.0	-5.0	[>]
13	3	2	25.00	201.0	37.0	[<]
14	2		7.20	290.0	0.0	[]
15	2		0.00	110.0	0.0	[]
16	2		4.20	0.0	90.0	[]
17	2		2.80	0.0	-90.0	[]
18	2	3	25.00	20.0	-37.6	[>]

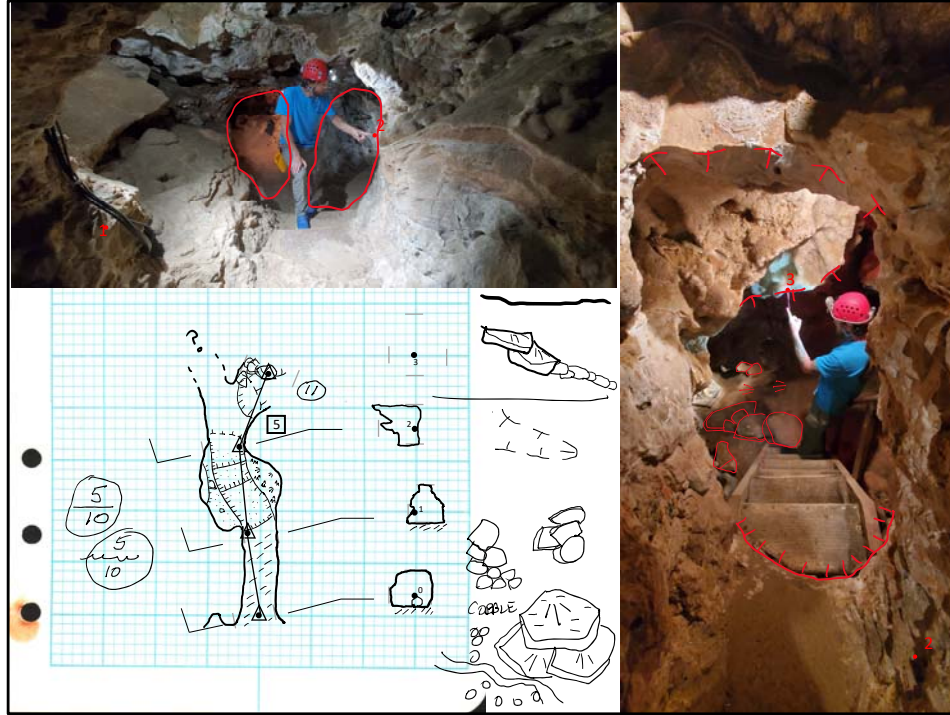
Data Entry!

Analog: Beware as your vertical angle increases or decreases above 20 degrees. Remember that you are measuring with the tape or laser the slant distance to the second target. This is not the same as the plan view distance, which is a horizontal representation. This difference between the hypotenuse of a triangle and the horizontal base distance is called foreshortening when applied to survey. On the Cave Compass, you can see the foreshortening tables, recreated above. For our shot between stations 2 and 3, notice our angle is 37 degrees. That puts us between the 35 and 40 degree columns. Our measured distance was 25 feet. The table tells us that the distance you plot on your page will be between 19 and 20 feet. Lets us 20 feet to be simple.

Digital: never fear, topodroid calculates this all for you!



Analog: See the difference between where we would have put the station (in black) and where the station belongs (in red) due to foreshortening.



Analog- Notice how our passage splits behind Sexy Chuck- both conveniently lit by different color lights. That passage that we are not going down presently should not be drawn. Do not get into the habit of just drawing passage you cant see, and hoping it will come out right. If you don't come back, it can create false leads or prevent the next crew from checking it out if other leads look better. Only represent what you can physically see.

The next picture is the view between stations 2 and 3. Notice the visualizations. I have chosen to omit the man made stairs, and found that the natural drop was 5 feet. A natural drop is shown as a number circumscribed by a box, as shown in the sketch on the left.

Additional notes (we were running out of class time) From top to bottom on the right: In your profile view, see how the large rocks on the floor are shown in heavier line width to represent the wall of the cave.

Below that, a ceiling channel or meander is shown as two parallel dashed ceiling symbols, with the hashes facing outward from the middle. This actually shows a fin of rock hanging from the ceiling.

Different versions of rocks- on the left cobble, where the edge of the rocks all touch. On the right, a method of showing rocks with some 3d dimension, which can indicate lower side of a stack of rocks.

Below that- larger rocks, with sloping tops- if rocks are large enough, they can also have

floor texture- in this case mud, with a slope indicated- the worst possible, sloping, muddy, breakdown.

On the left side ceiling heights are shown as a number with a circle around it. In the case of water passage, there will be a number above the water level to the ceiling, and a water depth below. The circle encompasses both numbers. The line between can be straight, or is sometimes shown with waves to indicate water. The lower number can be a question mark if water depth is unknown.



The last shot, draw your sketch between station 3 and 4.