7.3.4 Profiles

As you'll now know from reading Wheeler's chapter 4, stratigraphic profile drawings are the key to understanding a multi-period site like Monte Polizzo. Some archaeologists like to say that excavation reports are really nothing more than commentaries on a series of profile drawings. There's a little more to it than this, but there's still no good archaeology without good profiles.

During the season you'll draw profiles of the stratigraphy of the significant balks in your trench. The first rule of profile-drawing is **always keep the balks absolutely clean, straight, and vertical**. Expect to have the zone supervisor and director ask you repeatedly to straighten the balks. Sloppy balks are sure signs of a bad excavation.

The second rule is that in the Mediterranean sun, stratigraphic distinctions that are clear while you're digging and the soil is moist rapidly disappear as the sun bleaches the earth and everything turns light brown. Using a knife or the point of a trowel, mark the junctions between layers on the balk as you expose them. Otherwise when you come to draw the balk at the end of the season you won't be able to find the distinctions that were so clear a couple of weeks earlier. Also label the layers whenever possible.

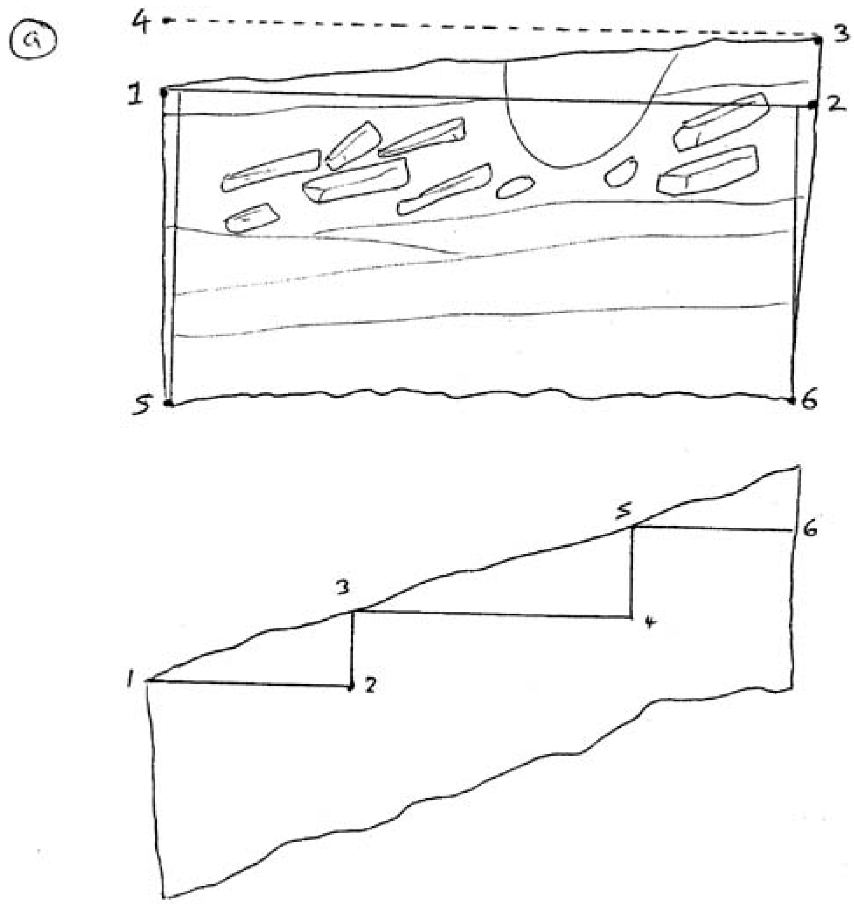
Before starting a profile drawing, consult with the zone supervisor and director. Normally we draw profiles at 1:20 scale (1 cm on the profile drawing = 20 cm on the ground, so 5 cm on the drawing = 1 meter in reality). When doing the drawing, begin as far into the corner of the sheet of graph paper as you can; if you put it in the middle you can't get much else on that sheet, wasting paper, and making more records for us to carry back. Roll the drawing up when you're finished rather than folding it. When you roll it, make sure that the drawing is on the inside; if it's on the outside, the pencil lines rub off the paper. Finally, make sure the drawing is labeled—MP Acrop 2004, the zone, trench, trial trench/es if relevant, which balk, the date, and your initials. There's a checklist at the end of section 7.3.4; use it.

Make sure the profile has at least one, and preferably two, elevations marked, and include a small sketch plan showing where in the trench the profile is. When you've finished, get the assistant director and director to go over the drawing with you, and get one of them to initial and date it. Write on the drawing what number it is in your trench-specific numbering system, and enter that information on the context sheets. The assistant director will keep a log of all profile drawing numbers.

The best times to draw profiles are first thing in the morning or in the evening, when the light is less strong, and strikes the balks at an oblique angle. Unfortunately, things rarely work out that conveniently, and you'll probably end up drawing profiles in the noonday glare. If that's the case, though, whenever it's possible you should bring your drawing back to the site next day and check it against what you see in better light.

The easiest way to draw a profile is to drive in a nail at the end of the profile that has the lowest elevation (point 1 in fig. 7.18a). Then, using string and a line level, put in a perfectly horizontal line and drive in another nail at point 2 (if you'd started the operation from point 3 in fig. 7.18a you'd need to put in the other end of the leveled string at point 4, which is obviously a problem). Use big nails so they don't fall out. If you're drawing a steeply sloping balk, this procedure might not work; instead, you may need to repeat it several times, producing a stepped series of strings (fig. 7.18b). Use the Dumpy Level to check that the nails at points 1 and 2 (and the other nails, if you're dealing with a series of steps) are indeed level. Write down the scale of the drawing, and label the ends N, S, E, W, etc.

Fig. 7.18 *Laying out profile drawings*



Next, measure along your string from point 1, and mark it at 1-meter or 50-centimeter intervals. Drive pegs into the wall of the trench, with the distances marked on them. Don't attach a tape measure or line-level to your string, because the weight of these will pull the string down so that it's no longer level.

The first step is to draw in the shape of your balk—where the ground level lies, and where the trench stops. Use the plumb bob and a stiff tape measure. Hold the plumb bob so that its tip touches the ground at point 5 in fig. 7.18a. Pinch the string on the plumb bob where it crosses the leveled string; then measure how far from point 1 the two strings cross, and the distance from where you pinched the string of the plumb bob to the tip of the plumb bob. Make a mark on your drawing to show where point 5 is. Measuring back from point 2, repeat the process to establish point 5. Get point 6 by measuring down vertically from the ground to nail 2. There's no fixed rule about how many points to take; do enough so that you can get an accurate rendering of the shape of the profile you're drawing. On the whole, the more experience you have the fewer points you'll need to measure.

Next, repeat these steps to plot in all significant "landmarks" in the profile, such as large stones, potsherds, tree roots, etc. Once you've got these in, and double-checked some of them, you can start using some of them to measure to points in the junctions of the layers. At this stage you'll be very glad if you marked the layers clearly as you were excavating.

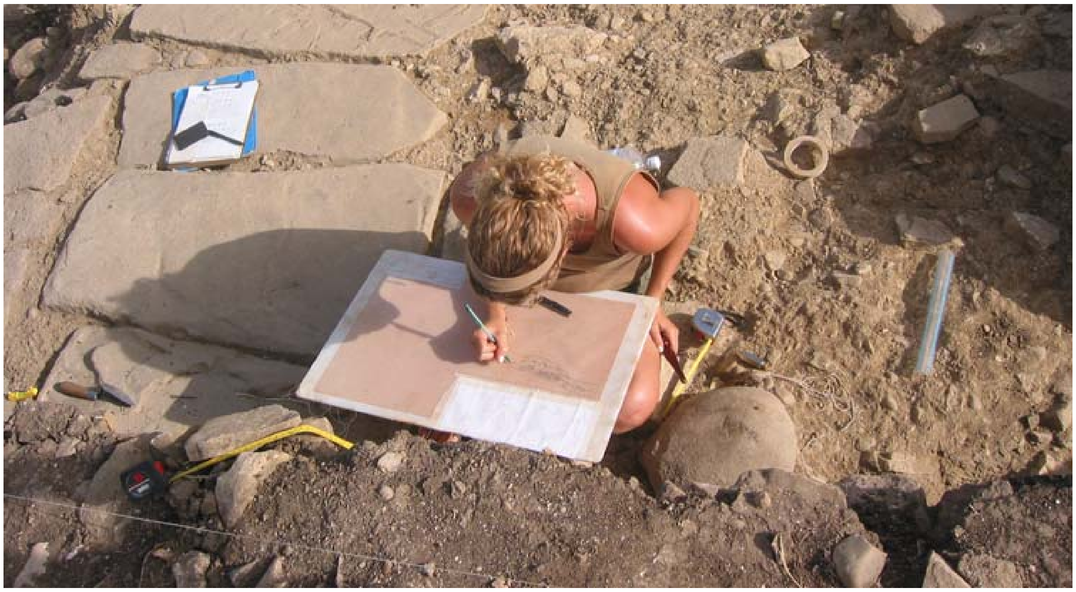


Fig. 7.19 Kathryn Lafrenz (Stanford) drawing a profile in building A5 (2003)

Mark the distinctions between the layers with strong, clear, lines, except in those relatively rare cases in which layers really do blur into each other. Wheeler is right (*Archaeology from the Earth*, pp. 78-79) to reject "pictorial" renderings of stratigraphy. No two layers are ever completely distinct, since they are continuously in flux, and when examined microscopically they inevitably blur, meaning that distinctions between layers are really statistical abstractions from the data. But profile drawings are stylized representations designed to convey information, and at the level at which the human eye works, it makes sense to treat the layers we identify as discrete objects.

Number all the layers, using the same numbering sequence as in your context sheets. Don't add the kind of symbols for the composition of the soil that Wheeler illustrates on p. 77, and that we use in the published preliminary reports; that's best left till the final inking of the drawings. Instead, write a brief description/interpretation of the layers represented in the profile next to the drawing.

The first time you draw a profile it can be a nerve-racking business, and it may take you a long time. But the more you do, the easier it gets.

PROFILE DRAWING CHECKLIST

MP Acrop 2004
Zone
Trench
Trial trench
Balk
Corner labels
Sketch plan showing location
At least 2 elevation points
Scale
North
Your name, date

Profile number
Layer numbers
Have you drawn in the most significant features—walls, floors, pits?
Does your profile clearly show the layers' relationships?
Does your profile clearly show the layers' junctions with walls, floors, and pits?
Description of layers
Approval from director or assistant director

7.3.5 Plans

The Total Stations produce many plans for us, but we also need hand-drawn plans. Total Stations are extremely accurate and they do many things faster and better than humans. But Total Stations become very slow indeed if we ask them to map in every tiny stone in a wall or sherd in a destruction deposit. So we produce a lot of composite plans. In these the Total Station maps in the main features of a wall, and we then take a printout, put millimeter tracing paper over it and trace through the features that the Total Station has recorded, and add manually dozens of smaller stones and sherds. The margins of error on manually drawn plans are higher than with digitally produced ones, but Total Stations can't capture the nuance and character of deposits in the same way as human beings. Producing a plan or a profile is an interpretive act, and there's a place for human input as well as digital.

7.20 Vic Schorn (left) and Ben Grant (right) of Stanford planning a destruction deposit dating around 575 BC in room C1/1 (2003)

Before starting a plan, consult with the assistant director or director. The rules are much the same as with the profiles; normally draw at 1:20 scale; put the drawing in the corner of the paper; roll rather than fold the paper; make sure that the drawing is on the inside; make sure it's labeled—MP Acrop 2004, the zone, trench, trial trench/es if relevant, the date, a north arrow, at least 2 elevation points (and probably 5 or 6 times that many), and your initials. When you've finished, get the assistant director and director to go over the drawing with you, and get one of them to initial and date it. Write on the drawing what number it is in your trench-specific numbering system, and enter that information on the context sheets.

As with a profile, start by getting the framework in place. Draw your trench onto the paper. Label the corners, as described in section 7.2.3 above. Again as with the profile, you need to identify the most important landmarks, and get them onto the plan first. Sometimes you'll be able to work from a Total Station plan; other times you'll need to triangulate their positions, as described in section 7.3.7 below. You don't need to triangulate every point; some you'll be able simply to measure on the ground. Also if you're working in a relatively flat and open area, you can use a planning frame. Using line levels, make sure that it's absolutely flat. Triangulate the corners onto the plan, and then you can easily draw in the details within the 20 cm squares. The planning frame is very helpful with complicated floor deposits, scatters of pottery and bone, etc. There are other tricks—if you're drawing a straight wall that for some reason hasn't been recorded by the Total Station, put a nail at each end and run a string between them, then all you need do is triangulate the two nails, draw the string onto the plan, measure along the string to the end of each wall stone, then transfer the points onto the plan. Repeat for the other face of the wall, and you can do even a long wall in half an hour or so.

One thing to remember—a plan is like a map, reducing the sloping and uneven world to a perfectly flat, level, two-dimensional fiction. Remember that all measurements must be horizontal, and done with a line level. If you take even one measurement that's not level, it's going to mess up the entire plan, and it may take hours to figure out what went wrong.

PLAN DRAWING CHECKLIST

MP Acrop 2004
Zone
Trench
Trial trench
Corner labels
At least 2 elevation points (usually a lot more)
Scale
North arrow
Your name, date
Plan number
Layer numbers
Description of the layers shown on the plan
Have you drawn in the most significant features—walls, floors, pits?
Approval from director or assistant director

7.3.6 Elevations

On a site like Monte Polizzo where the ground slopes steeply, it's vital that we have lots of accurate elevation readings to keep control of the stratigraphy. The Total Stations provide very accurate elevation readings, but it's very inefficient to use such an expensive technology for taking the hundreds of readings we need each day. The main tool for taking elevations is the Dumpy Level.

Fig. 7.21 Lela Urquhart (Stanford) and Olivier Mariaud (Bordeaux) taking elevations with the Dumpy level in building A1, 2003

This is a two-person instrument. One person holds a measuring rod at the point being recorded while the other sights through the instrument, takes the reading , enters it in the site notebook, does a simple calculation, then enters the final result on the context sheet, profile, or plan.

It's not safe to leave the Dumpy levels in position all season, because they'll get damaged, so we set them up every morning. The assistant director will nominate volunteers each day.

Chris Sevara will give the trench supervisors lessons in using the Dumpy level at the start of the season; they'll then teach the other members of their teams. **Everyone must know how to use the Dumpy levels**.

7.3.6.1 Set up

1. Put the tripod in a relatively level place, above the points to be measured, and (if possible) away from the main foot traffic.
2. Use a line level to make sure the top of the tripod is roughly level.
3. Mount the Dumpy level on the tripod.
4. Adjust the leveling screws on the Dumpy level until the bubble is in the center of the circle.

5. Place the measuring rod on a known elevation point (established by the Total Station at the beginning of the season).
6. Looking through the Dumpy level, center the crosshairs on the measuring rod, and read the height.
7. **Add** this measurement to the elevation of the known point. This is the Dumpy level's height.
8. Write the date and the instrument's elevation on a piece of tape and attach it to the tripod in a prominent place. Make sure all previous days' pieces of tape have been removed. Also write the elevation of the instrument in your trench notebook.

7.3.6.2 Taking elevations

1. Place the measuring rod on the point in question. Make sure that there's been **proper communication** between the rod-holder and the person taking the reading—the rod-holder needs to know exactly where the base of the rod should be. Poor communication is the source of most errors.
2. Looking through the Dumpy level, center the crosshairs on the measuring rod, and read the height.
3. **Subtract** this measurement from the instrument height. This gives you the right of the point being measured.
4. Write the result on the context sheet, profile, or plan.

7.3.6.3 Things to remember

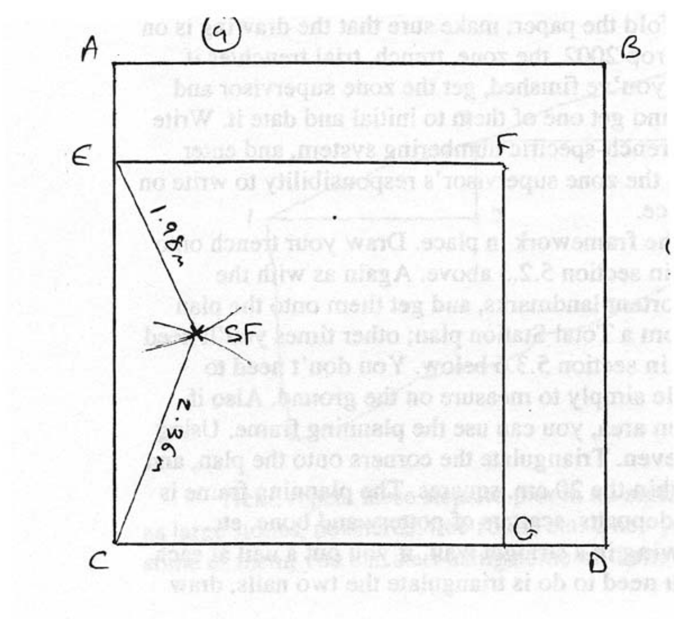
1. Check the instrument is still level before taking readings. If the bubble is slightly off-center, adjust the leveling screws without touching the tripod. If the bubble is completely off-center, someone has knocked the tripod, and you need to re-do the set up. If that happens, tell all the other trenches that use that Dumpy level. Remove the tape showing that day's instrument elevation, and replace it with one showing the new elevation.
2. If you knock the tripod, set it up again, and let everyone know that the elevation has changed.
3. When taking an elevation, never lean on the Dumpy level.
4. **Think about the elevations** you're getting. If at the end of the day the readings are higher than those at the beginning of the day ("digging upward"), something's gone seriously wrong. Cross-check your results occasionally to make sure that the elevations make sense.
5. To avoid confusion, you should normally use the same instrument throughout the day. That way if it turns out there's been a mistake in set-up, you only need to make one calculation to correct all the figures.
6. Keep all your readings and calculations in the site notebook, and label each one, so that if there are any errors it's easy to go back and check the numbers.
7. Be careful when you're carrying the instruments; they're easy to damage.

7.3.7 Triangulation

Despite all the high-tech Total Stations and GPS, things can still go wrong and data can disappear, so as a backup you need to take manual triangulated readings for all small finds and flotation, charcoal, pollen, micromorphology, and C14 samples. This is the way archaeologists took most readings before Total Stations were available. You enter the manually triangulated readings on the context sheets where it says "manual." Always do this. If the paper-based recording system ever gets disassociated from the digital record, triangulation may be the only way to pinpoint particular finds or samples.

Triangulation is very simple. You can fix any point so long as you have two points to measure from. Hold a plumb bob over the point you're measuring to (marked X in fig. 7.22). Stretch the tape measure (pulling it very tight) from corner E to X. Use the line level to check that it's horizontal; or, as a shortcut, since the shortest distance between two points is always the horizontal, simply move the tape up and down against the edge of the string until you get the lowest reading, and that's the horizontal. Convert this distance to 1:20 scale for your formal plan or 1:100 for a sketch plan, set the compasses to that distance, and draw a curve on your plan. Repeat the whole process from corner C. Where the two curves cross is the exact point X.

Fig. 7.22 Triangulating to a small find



Under normal circumstances, use triangulation only to establish a point in horizontal space, and use the Dumpy level to fix the point vertically. Taking elevations manually is much harder than fixing a point horizontally, and we only do it in dire emergencies where no other devices are available. This is because when measuring horizontally from B or E to X in fig. 7.20 it's hard to be off by more than a centimeter, which, on a 1:20 plan, is only half a millimeter, and virtually invisible. When using a line level to get a string horizontal and then measuring the length of the string on the plumb bob, it's easy to be 5-10 cm. off. Manual elevations should only be used when there's no alternative. It's good to know how to do manual elevations for emergencies, but normally take elevations with the Dumpy Levels.

7.3.8 The Harris matrix

Excavators have always faced a dilemma. The best way to control stratigraphy is to dig narrow trenches, so that there are lots of balks. That way you can draw plenty of profiles, and you'll probably have profiles running through most of the important deposits on site. However, the narrower the trench, the harder it is to see what you're excavating. So there's a competing tendency to excavate large, open areas (championed most forcefully by Philip Barker in *Techniques of Archaeological Excavation* [1st ed. 1977]). That way you can tell what kind of structures you're finding, but the price is some loss of stratigraphic control. Open-area excavation works very well when the team does absolutely everything right, but if there's a mistake, there are no balks to consult, and no way to figure things out.

Mortimer Wheeler aimed to get the best of both worlds: a grid of 4 x 4 m trenches separated by 1-m. wide balks gives a broad view, and the balks gave continuous profiles (e.g., Wheeler, *Archaeology from the Earth* fig. 5). At the end of the season he could remove the balks to give wide-open areas, or leave them in place to give future excavators a way to check his work.

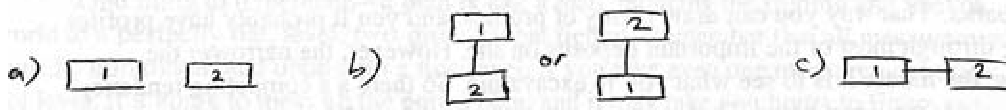
This still has certain problems, because even with 4 x 4 m. trenches, there's no guarantee that the most important features will be cut by a balk that can be drawn. It's unusual for the walls to be aligned on a north-south axis, so at best you end up with profiles with strangely distorted walls because the balk cut them at an oblique angle. There's some evidence that some of Wheeler's most famous profile drawings (like fig. 7.5 above) were actually fudged a bit, with important features being "moved" horizontally so the profile could be shown running through them. That's OK so long as everyone remembers that the profile is a schematic device to show the relationship between layers, not a naturalistic representation of reality, but in fact we all tend to mistake the representation for reality.

In the early 1970s, Ed Harris, excavating at the complex site of Winchester in England, added a valuable refinement that sidesteps most of these problems. The point of a profile drawing in the logic of an excavation, he reasoned, is to tell the reader where a layer came in the sequence. There are three possible ways to express the relationship between two layers: we can say that layer ← has no relationship to layer ↑; that layer ← is earlier than layer ↑; that layer ← is later than layer ↑; or that layer ← is the same as layer ↑. Harris reasoned that you don't need a profile drawing to express this: you can do it with a simple diagram, like fig. 7.23a (labeled fig. 11 below—don't ask why).

So long as you're digging accurately, you don't actually need permanent balks. You can cut a small profile through two or more problematic layers to make it easier to see their stratigraphic relationship, but then that mini-balk can be excavated away. Every single layer in the site can then be positioned in a single matrix showing its stratigraphic relationships to everything else. In any matrix (you can find the matrices for the areas around buildings A1 and A5 in section 14 below), the layers form stratigraphic chains, but as you can see, a lot of these chains don't intersect. Walls, erosion, or—as in the case of the matrices for A1 and A5—cuttings into the bedrock interrupt the overlapping and cutting of the layers. We therefore "phase" the matrix, using finds from the layers to work out equivalences between layers that don't have direct links between them.

In theory, we could do away with profile drawings altogether and simply express all stratigraphic information through Harris matrices (particularly if we use the widely accepted conventions shown in fig. 7.23b (labeled fig. 12), so that floors, occupation debris, and

Fig. 11 **Principles of the Harris matrix**



a) No relationship b) Layer 1 is later than layer 2 c) Layers 1 and 2 are the same

Fig. 12 **Modified Harris matrix (after Steve Roskams, *Excavation* [Cambridge 2001] fig. 29)**

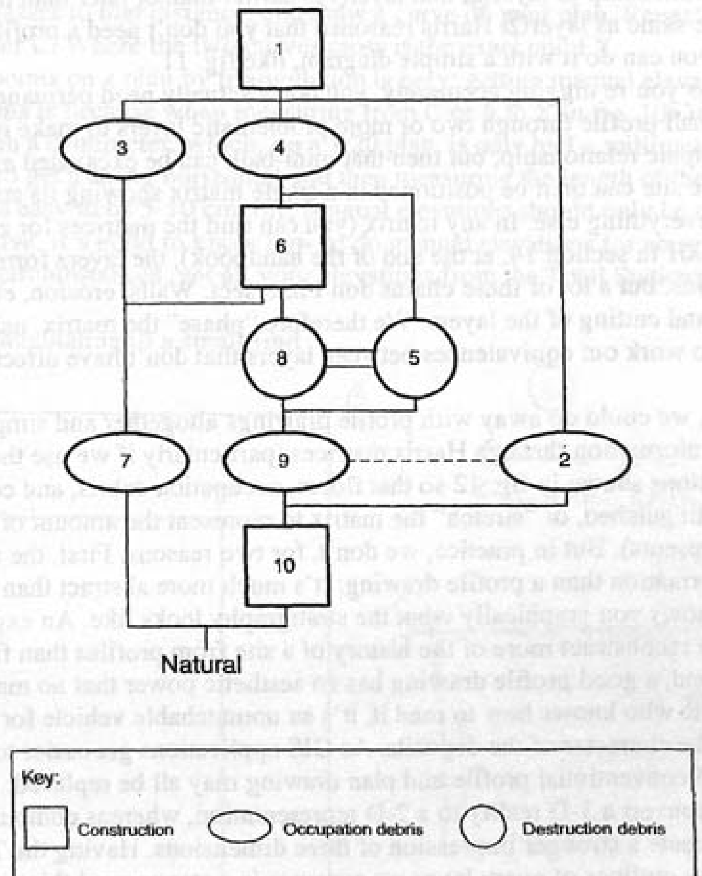


Figure 29 The box shapes in a Harris matrix amended to show interpretative types of strata, also indicating different strengths of linkage between strata.

Fig. 7.23a: basic types of stratigraphic relationships
7.23b: a Harris matrix adapted to express types of deposits and the passage of time.

construction debris can be distinguished, or if we "stretch" the matrix to represent the amount of time that each deposit represents). But in practice, we don't, for two reasons. First, the matrix still conveys less information than a profile drawing: it's much more abstract than a profile, which actually shows you graphically what the stratigraphy looks like. An experienced archaeologist can reconstruct more of the history of a site from a matrix than from profiles, but there are kinds of information that are much easier to grasp from the profiles. And second, a good profile drawing has an aesthetic power that no matrix can match: to someone who knows how to read it, it's an unmatchable vehicle for communicating the character of the deposits. As GIS applications get easier to use, the Harris matrix and conventional profile and plan drawing may all be replaced: all use low-tech methods to convert a 3-D reality to a 2-D representation, whereas computer reconstructions create a stronger impression of three dimensions. But for the time being profile drawings and the Harris matrix are the basis of understanding chronology.

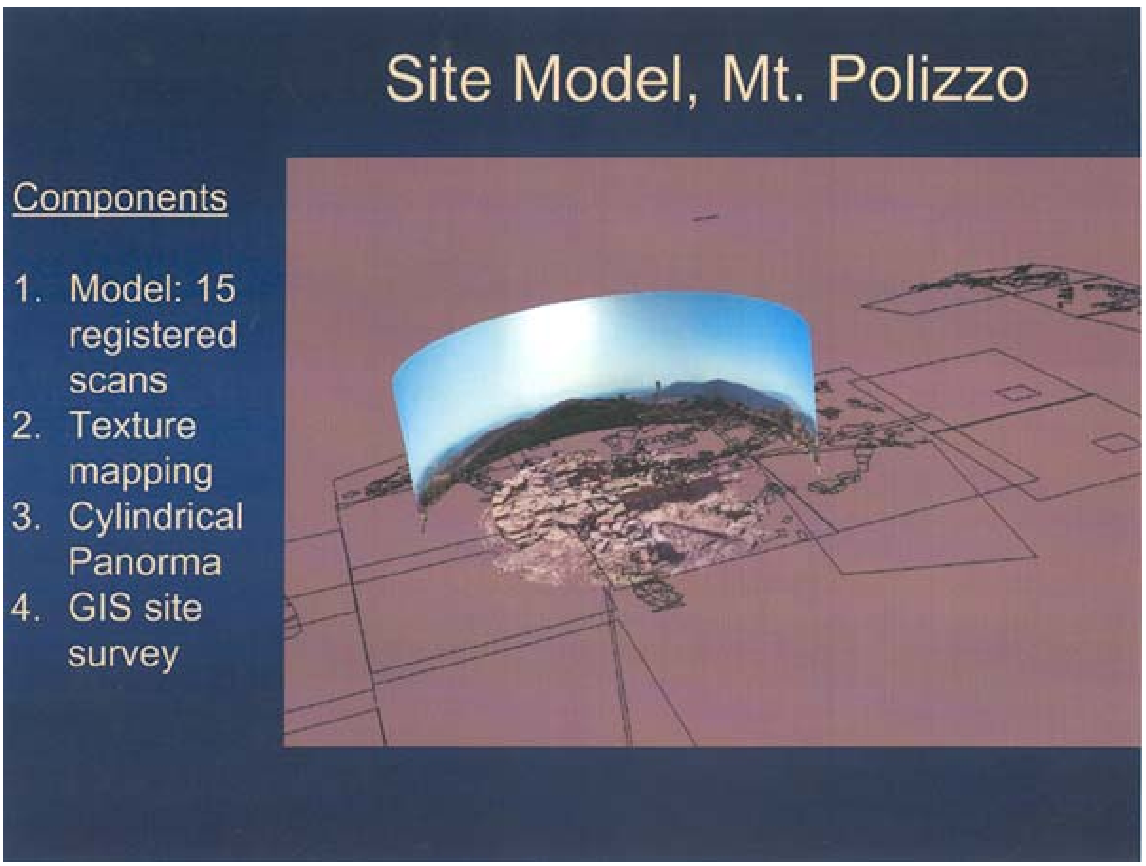


Fig. 7.24 *Alternative, digital methods to avoid reducing 3-D realities to 2-D representations: a team of computer scientists from Columbia University came to Monte Polizzo in 2003 to test new technologies for doing this*

If you've never used a Harris matrix before it sounds very abstract and difficult, but it's not. You'll get plenty of help learning how to do this.

7.3.9 Working with Total Stations

The laser technology in the Total Stations is almost error-free. However, it's only as good as the guidance humans give it. When you ask the Total Station crew to give you an elevation, make sure that they're measuring to the point you want. Work with them to ensure this is the case. If you ask them to record a wall or other feature, check that the points they're entering are the ones that you think are the most important ones. Garbage in, garbage out applies very strongly here. **Constantly check that the elevations they give you make sense**: if they tell you a small find is at 722.34 m but you've written down on the context sheet that the highest point in this layer is 722.25 m, something's gone wrong, and we need to figure out what. Most often the errors come from misunderstandings about which spot is being recorded.

We'll probably have two Total Stations for all our recording needs. They work very hard indeed, frequently coming back up to the site in the evenings, and spending their afternoons entering and cleaning up data. Sometimes they can't get to your trench as quickly as you'd like. Sometimes you just have to stop work and wait; other times, you can mark the spot of a small find, leave a small area around it intact, and continue excavating in another part of the trench. If in doubt, consult with the assistant director or director.

7.3.10 Photography

Photography is an important way to communicate what happened on a site to people who weren't there, and also to document an excavation so that we avoid mistakes. Your trench needs to be spotless whenever it's photographed (look at the site photos in section 6 above). All balks must be absolutely vertical and straight; all loose dirt must be swept up; all little roots, which have a way of looking huge in photographs, must be cut off; nails should be straightened; ratty old pieces of string should be replaced with fresh string; and the area around the trench should be swept. All tools must be carried away out of the camera's sight. For examples of the standards we're aiming for, look at figs. 14 and 15 in Wheeler's book. You'll need to spend a lot of time—sometimes hours—preparing the trench for a photograph.

You need to get information about every photograph that's taken of your trench, and enter it on the context sheet and notebook. As mentioned earlier, here are two types of photos—color slide (CS) and digital (D). The conventional slide photos will come with two numbers—a Roman numeral, which is the roll number, then Arabic numerals, for the numbers of the frames in that roll. Write them both down, separated by a dot (e.g., | CS IX. 12-13|), and always put the number in a rectangle for easy visibility. Also write down a brief note of what the photo is of, and the direction it's facing. Digital photos are filed by the date they're taken. Record them just like the slides, but simply write | D.21-23 |. The information about which date they were taken on is already on the context sheet.