

AN INTRODUCTORY GUIDE TO POTTERY

CONSERVATION:

From Excavation to Preservation



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1. Introduction

Pottery finds in archaeological excavations are extremely common across Israel. In fact, pottery sherds usually make up the majority of finds on a site. This is due to the fact that pottery was used as an every day item during ancient times, and because of its make up (non-organic) it remains intact over time (<http://apd.farli.org/home/introduction>).

These sherds are extremely important to the archaeologists studying the area, and provide a lot of different information. Archaeologists can date a stratum, simply based on the sherds found within it (<http://apd.farli.org/home/introduction>). Apart from dating, pottery sherds can also tell an archaeologist about technology, population movements, trade, war and conquests (<http://www.archaeology.org.il/pottery.html>). It is the indicatives (rims, handles, bases, special decorations) that give the most information; for example, identifying when the object was made, or who made it (local or imported) (<http://www.stanford.edu/group/mountpolizzo/handbookPDF/MPHandbook8.pdf>).



Left: Img. 1 Rim sherds, known as indicatives can provide a lot of information about a site, Kowalchuk 2014



Above: Img. 2 A base piece, known as an indicative can tell an archaeologist a great deal about an excavation site, Kowalchuk 2014

Since pottery sherds can tell an archaeologist so much about a site and human history, it is extremely important that the finds are dealt with and treated properly. However, since so much pottery is found and it cannot all be kept, it must be dealt with systematically.

This introductory guide is aimed towards students and will provide the basic concepts concerning pottery conservation, from site excavation to storeroom preservation.



Above: Img. 3 & 4 Pottery conservation from excavation to preservation
<http://web.ncsu.edu/abstract/humanities/tp-petra-excavation/>
http://www.statemuseum.arizona.edu/exhibits/pvia/wall_of_pots/

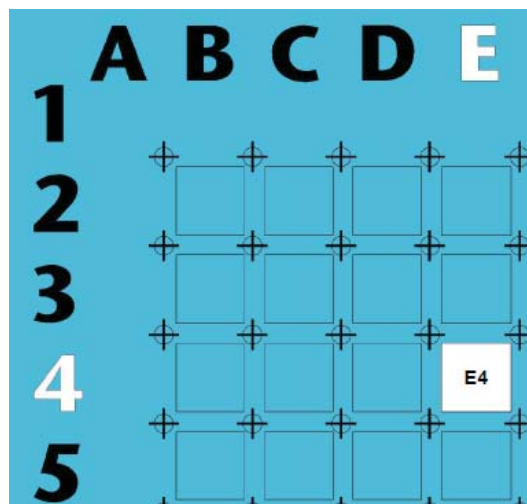
2. Pottery Excavation



Above: *Img. 5* An excavation taking place in Kfar Tavor, Kowalchuk 2014

When an excavation takes place within Israel, the Locus Number System is used to record the different locations of the finds in relation to the stratigraphy and architecture in which they are found (<http://www.tfahr.org/files/LocusPresent40.pdf>). The whole point of the Locus Number System is to give each and every item found a number, and to allow an archaeologist to look at an artifact or architectural feature, and know precisely where it came from at the excavation.

The process begins by mapping out the site and creating a grid, in which the excavation will take place. This is generally done by creating a grid of 5 metre by 5 metre squares. One axis is assigned letters, while the other is assigned numbers. Each square can then be identified by its letter and number, for example, E4 (<http://www.tfahr.org/files/LocusPresent40.pdf>).



Above: *Fig. 1*, Excavation grid of 5m x 5m squares and identification numbers, <http://www.tfahr.org/files/LocusPresent40.pdf>

This identification number (ex. E4) is the first part of the locus number, and all subsequent finds from this locus will have the prefix E4.

After the grid has been laid out, the topsoil is broken. The topsoil is given a locus number, E4, as the topsoil is the first item encountered in the E4 square (<http://www.tfahr.org/files/LocusPresent40.pdf>).

If a piece of pottery (or another object) is found within the topsoil, it is assigned a special number. The number assigned to the vessel begins with the locus number for the topsoil, E4.1. If the vessel is the first item found within the topsoil, its number would be E4.1.1, if it were the second item E4.1.2. This new number is known as the basket number, and connects each find (a basket of pottery, a whole vessel, or small find) to a specific spot on the grid, and its locus number (<http://www.tfahr.org/files/LocusPresent40.pdf>).

The topsoil locus E4.1 will continue until another feature (different than pottery or small finds) is found. Once a new feature is found, the topsoil locus is “closed” and a new number begins, E4.2.

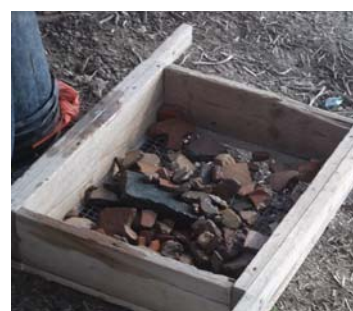
Identification tags are placed with the pottery finds as soon as they are found, and remain with the items throughout the entire process at the excavation site.

After the pottery finds have been located and removed, they are sent for washing. This involves gently scrubbing the sherds from a specific basket, in water with a small brush, such as a tooth brush or nail brush. The sherds are then left to dry, out of the sun so they do not fade or discolour. All baskets from a specific locus should be grouped together. However, it is important never to mix baskets from different loci.



Left: *Img. 6* Different baskets of pottery sherds waiting to be washed, Kowalchuk 2014

Right: *Img. 7* Washed pottery sherds left to dry, Kowalchuk 2014



After the sherds have been washed and dried, they are ready to be numbered. Usually just the indicatives are numbered, along with a few body sherds. The number consists of the permit number, the locus number, and the basket number. This way the archaeologist knows exactly where each numbered item came from.



Above: Img. 8 An indicative numbered with permit number, locus number, and basket number

After all the sherds from a specific loci have been washed, dried, and numbered, they are ready to be sorted. The purpose of this sorting is to determine the importance of the sherds and to decide which will be kept for possible restoration and treatment, and which will be left behind.

The sherds from the decided loci are laid out on long tables, based on their basket numbers. The archaeologist then looks through the sherds and decides what will be kept.



Left: Img. 9 Pottery sherds from a specific loci waiting to be sorted, Kowalchuk 2014

Right: Img. 10 Pottery sherds laid out for sorting, Kowalchuk 2014



If the archaeologist decides the sherds will be restored, all of the sherds from that specific loci will be packaged up and sent to the conservation labs for treatment. If the sherds are not being restored, only the indicatives are kept and sent to storage where they will be sorted and drawn or photographed at a later date.

If the sherds are being kept, they are either placed in plastic bags or cardboard boxes with their identification tags.



Above: Img. 11 Packaged pottery sherds ready to be sent to the conservation labs for restoration, Kowalchuk 2014

3. Pottery Conservation Labs

After the sherds arrive at the conservation labs, the conservator lays out the pieces onto long tables. The sherds are placed by grouping them within their locus numbers, as to recreate how they were found in the field.



Above: Img. 12 Pottery conservation lab with sherds from an excavation laid out, Kowalchuk 2014

The conservator consults with the archaeologist determining how long it will take to treat and restore the sherds. After this consultation takes place, the sherds are packed up once again, and must wait until their turn to be treated.

4. Sorting Pottery Sherds

When the time has come to treat the sherds from a specific excavation, the sherds must first be sorted. The sherds arrive in boxes or bags, based on their basket numbers, which tell where they were found at the site.



Above: Img. 13 Pottery sherds from an excavation, Kowalchuk 2014

The first step is to lay the sherds out onto tables, grouped within their basket numbers. It is important to keep the sherds in their basket numbers, as the location of the sherds can tell the archaeologists a lot about the site.

Begin sorting by laying the pottery with the inside facing up, exposing the interior of the sherds. As the interior of a vessel is less exposed to the elements, such as the sun and wind, it is less likely to change appearance over time. This makes it easier to find joining pieces later on.



Above: Img. 14 Interior of pottery sherds, Kowalchuk 2014

After the sherds are laid out, sorting can begin. The sherds should be grouped based on their defining characteristics: colour, texture, rilling marks, break colour, and indicatives. This will allow for joins to be found easier later on.

The indicatives should be separated into rims, handle pieces, and bases, again to allow for finding joins more easily.



Above: Img. 15 Indicatives (rims) grouped together, Kowalchuk 2014



Above: Img. 16 Sherds sorted based on colour, texture, break colour, rilling marks, and indicatives, Kowalchuk 2014

After the sherds have been sorted, it is possible to estimate how many vessels may be present, based on the number of bases found. In this particular group, there are potentially five vessels.

5. Locating Joins

Once the sherds have been sorted, it is time to look for joins, any pieces of the same vessel which fit together. As the sherds are separated into different groups based on their colour, texture, etc., it is best to begin looking for joins within these groups. If rim pieces are present, it is best to work from the rim down, but of course other sherds can be joined as well.



Above: Img. 17 Joins found from the rim down, Kowalchuk 2014

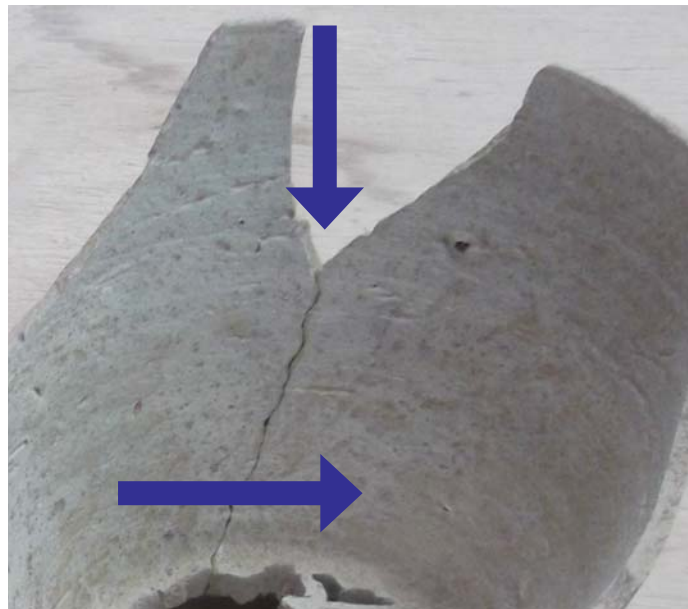
Joins can be found by using the size, shape, and direction of the rilling marks on the interior of the sherds. As these marks are distinct, it can make finding joins much quicker.



Above: Img. 18 Distinctive rilling marks used for identifying joins, Kowalchuk 2014

If a sherd does not appear to have a join, it is important to put it back exactly where it was found, as we work with visual memory. After the sherds within a group have been looked over for joins, it is time to start looking at other groups for new joins. Even though the sherds may appear to be different colours, textures, etc., they may actually belong to the same vessel and have just changed appearances over time.

When a correct join is found, the two sherds will fit together perfectly. The join will sit properly, and feel right. Both the interior and exterior surfaces should be completely smooth when a finger is moved over the join. If the join can be felt, it is not sitting correctly.



Above: Img. 19 When a finger is run along the join in the direction of the arrows, and the join cannot be felt, the sherds are sitting correctly, Kowalchuk 2014

As more and more joins are found, it is important to lay the sherds on the table in the order of their connections, to make gluing and restoration easier later on.



Above: Img. 20 Numerous sherds and their corresponding connections, Kowalchuk 2014

6. Cleaning Pottery Sherds

After as many connections as possible are found between the pottery sherds, the sherds must first be cleaned before they can be consolidated and glued together. Although the pottery is washed at the excavation site, sometimes more work is needed due to encrustation, soil, soot and dust. These various forms of deterioration can begin as early as the manufacturing process, and continue on through burial, excavation, and storage (http://en.wikipedia.org/wiki/Conservation_and_restoration_of_ceramic_objects#Cleaning). Therefore, they must be taken care of properly



Above: Img. 21 An example of soot found on pottery sherd, Kowalchuk 2014

Cleaning of the pottery first begins with manual intervention. This can be done with a tooth brush, nail brush, or other small brush. Varying degrees of brushes are used to suit the need of the pottery. If the sherd is friable, then a gentle, delicate brush should be used.



Above: Img. 22 A typical brush used for cleaning, Kowalchuk 2014

All the break lines must be cleaned, even if the pottery appears to be clean. This will help the consolidates seep into the pottery, resulting in a stronger bond when the adhesive is applied, and prevent any dirt from drawing into the shard, causing further damage. The brush should be used against the break line, and not along with it, to prevent any dust, dirt, etc. from settling on the break, resulting in a weaker connection once glued.

If the brush is not able to remove the dirt, build-up, etc., then a scalpel may be used. This must be done very carefully, to ensure no further damage is done to the pottery, such as breaking off a piece or scratching the surface.



Above: Img. 23 A typical scalpel used to remove encrustation on a pottery sherd (<http://www.drinstruments.com/scalpel-safety-lock.html>)

Needles, small grinders, and other custom tools (sometimes made of wood), can also be used in the attempts to clean pottery of any debris.

If manual cleaning proves unsuccessful, chemical interventions may be needed. Chemical treatments are much harder to control than manual options, so it is never a first resort. Chemical cleaning procedures include using water, solvents, acids, and alkalis (http://en.wikipedia.org/wiki/Conservation_and_restoration_of_ceramic_objects#Cleaning).

7. Consolidating the Breaks

Before the sherds are adhered together and the vessel is reconstructed, the sherds must first undergo consolidation. Consolidation works by applying a new material to strengthen the pottery, either by chemically adhering to particles in the ceramic, or by creating a mechanical support system that does not interfere with the pottery itself (http://en.wikipedia.org/wiki/Conservation_and_restoration_of_ceramic_objects#Cleaning). Pottery found on excavation sites are usually weakened due to leeching their bonding properties, or by absorbing soluble salts, therefore consolidation is a must.

A good default consolidate and adhesive, is [®]Mowital, a polyvinyl butyral (PVB). As [®]Mowital has a glass transition temperature of 65 degrees Celsius, it can remain stable in hot climates, such as those found in Israel. It can also be used without a ventilation hood, making it safe and easy to use. It can be removed with ethanol compresses, though it is impossible to remove 100% of consolidation efforts.



Above: Img. 24 [®]Mowital diluted with ethanol at a concentration of 2.5% used for initial consolidation of breaks, Kowalchuk 2014

For the purpose of consolidation, [®]Mowital is diluted with ethanol at a concentration of 2.5% and 5%. The 2.5% concentration is applied to the break lines of the sherds using a small paintbrush. Different sized brushes can be used depending on the size of the break lines.



Above: Img. 25 Small paintbrush used to apply consolidate to break lines, Kowalchuk 2014

The 2.5% [®]Mowital should be applied to all the break lines of every sherd, even if there are no joining pieces. This will help to strengthen the sherds, and will not be noticeable to the naked eye.

Once the 2.5% concentration has been applied to all the sherds of the vessel, the 5% concentration can be applied in the same way. At this point it is important to be very careful of applying the [®]Mowital to just the break lines, and not onto the surface of the sherds, as staining will result. If there is excess liquid on the surface of the sherd, it can be removed gently with ethanol on a cotton ball.

Although the 5% concentration can be applied directly onto the 2.5% consolidate while it is still wet, it is best to wait until it is completely dry.

It is important to close the lids of the consolidates between each dip of the brush, as it will evaporate quickly. The paintbrushes must also be stored in bottles of ethanol to help the bristles remain soft and ready for use.

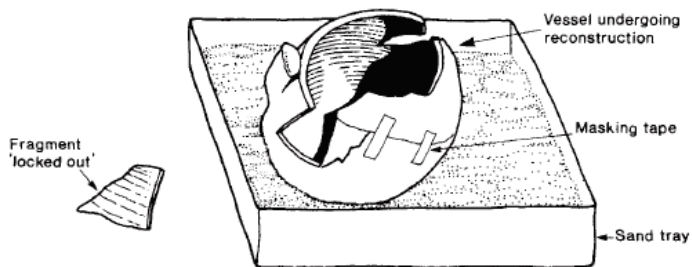


Above: Img. 26 Various sizes of paintbrushes stored in ethanol along side [®]Mowital in concentrations of 2.5%, 5%, and 15%, Kowalchuk 2014

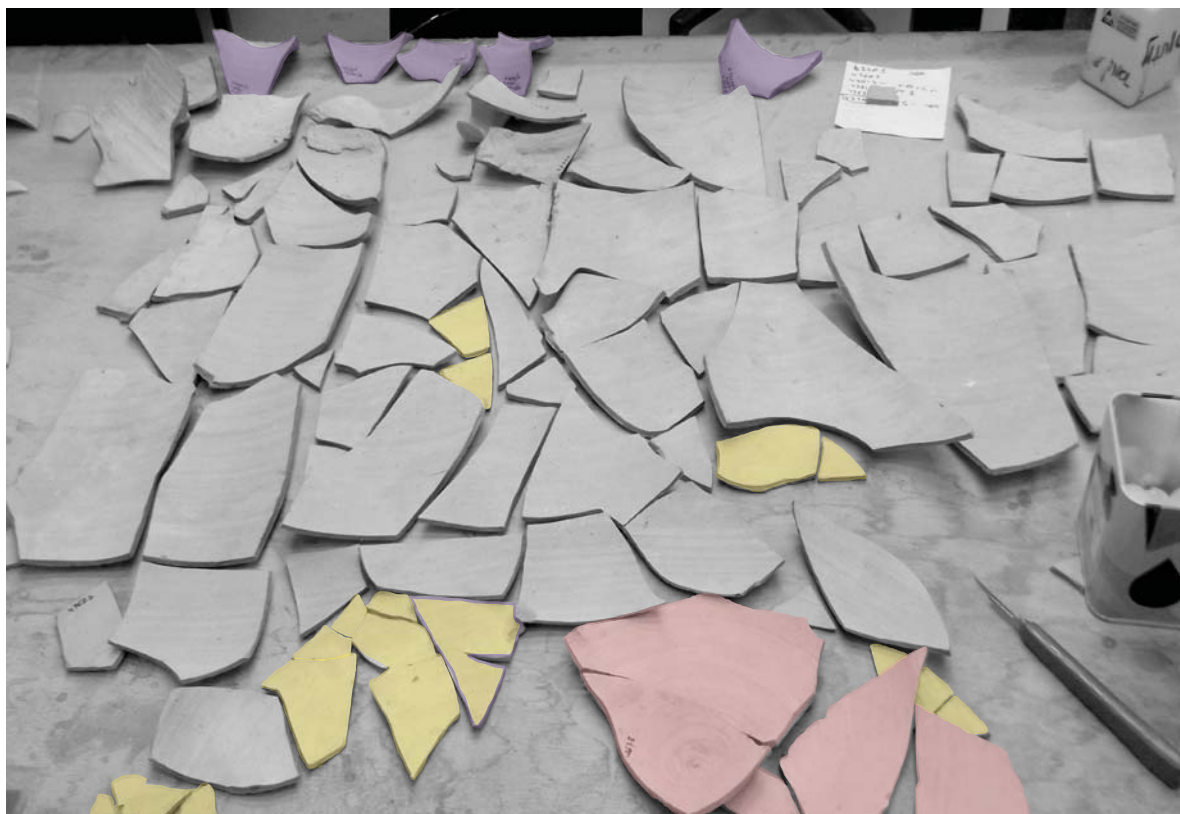
8. Reconstructing the Vessel

Once all the sherds have been consolidated with 2.5% and 5% [®]Mowital, they are ready to be reassembled. [®]Mowital is used as the adhering agent, in a concentration of 15%. Unlike the consolidates, the 15% agent is only applied along the break lines which have adjoining pieces. The 15% concentration will also result in surface staining if it is not applied carefully, so it is important to work slowly and precisely.

Before the glue can be applied it is necessary to plan out the reconstruction of the vessel to achieve the best results possible. This includes deciding if the vessel will be built from the base up or the rim down, in what order the pieces will be glued, and if several sherds need to be glued together before being added as one piece. Poor planning may result in a misshapen vessel, incorrect angles, insecure joins, and undercuts. Undercuts appear when sherds have been added and there is less than a 90 degree angle for a neighbouring sherd to be added (see figure 2). This makes it extremely difficult to add the next sherd to the vessel, and even if it is possible, it will cause other sherds to move and distort the shape of the vessel.



Left: Fig. 2 An example of a “locked out” or under cut sherd which can no longer be added to the vessel without causing damage, Cronyn pg. 158



Above: Img. 27 Planning reconstruction, Kowalchuk 2014



Base sherds, to be adhered first and built upon



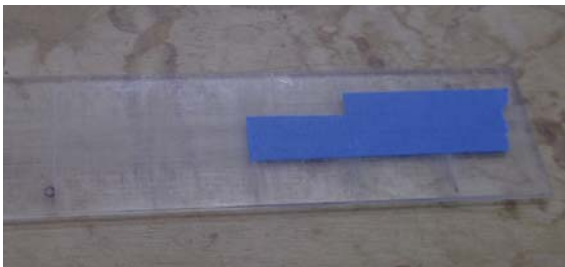
Examples of body sherds which need to be glued together first then added to the vessel as one item to prevent undercuts



Rim sherds, to be adhered last

Whenever base pieces are present, it is best to work from the base up, to ensure stability and preserve the original curvature of the vessel (Cronyn pg 158). If the base of the vessel is missing, begin working from the rim down to retain the integrity of the structure.

Step 1: Prepare the necessary tools in advance so they are easily accessible when needed. This includes 15% [®]Mowital, paintbrushes resting in ethanol, masking or painter's tape cut into small strips, rolls of masking or painter's tape for large areas, ethanol, cotton balls, sand tray, sand bags, and metal clips.



Above: Img. 28 Painter's tape applied to plexiglass and cut into small strips for quick use, Kowalchuk 2014



Above: Img. 29 On the left is traditional masking tape, while on the right is painter's tape, Kowalchuk 2014

Step 2: Begin by applying [®]Mowital 15% along the break line(s) of one sherd with a small paintbrush.

Step 3: Place the sherd with its neighbour and wiggle it into place, so the two sherds sit properly. Pull the sherds apart, checking to see that there is enough adhesive on both sides, and to begin the ethanol evaporation process. If there is not enough glue, apply a small amount onto the break of the neighbouring sherd.

Join the sherds once again, and push as hard as possible without damaging the pottery, securing the join together. As mentioned previously, when a finger is run along the join, it should not be felt. If it is felt, continue to wiggle and jostle the sherds until it disappears.

Step 4: Without moving the sherds or the join, apply a small piece of masking or painter's tape, perpendicular to the join on both the interior and exterior sides. Always apply the tape first to the sherd that received the adhesive, and gently but firmly pull the tape across onto the neighbouring sherd. The tension from the tape helps the sherds to adhere to one another properly while remaining secure.

If there is an excess of glue along the join or on either surface of the sherds, apply ethanol to a cotton ball, and gently wipe the glue away.



Above: Img. 30 Various examples of sherds glued together and secured with painter's tape. The tape is applied perpendicular to the joins, Kowalchuk 2014

Step 5: Place the joined sherds in a sand tray, using sand bags if necessary, with the join out of the sand and parallel to the tray top. Gravity will help the pieces rest and hold in place while they dry.



Above: Img. 31 Several joined pieces resting and drying in a sand tray, Kowalchuk 2014

It is important to let the pieces dry a little so they hold, but they do not need to be entirely dry. It is best to work with flexible pieces so adjustments can be made if necessary.

Only build the vessel up from one point. If a second starting point is attempted, the two halves will not fit or join properly.

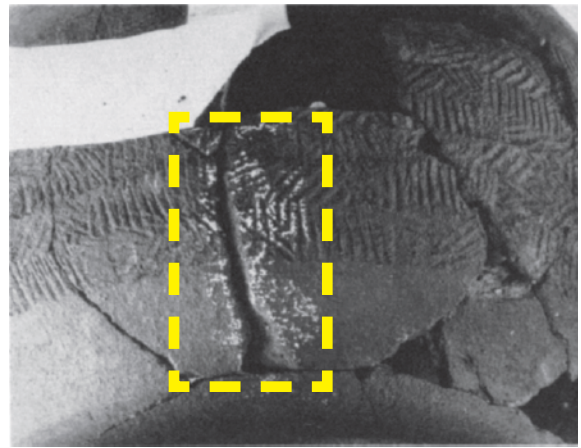
Step 6: Continue building the vessel from the base up, consciously planning out the pieces to avoid undercuts. It is important to build up the vessel equally on all sides (if possible), and work upwards towards the rim. If the vessel is too high on one side it may become unstable and fall apart.

Large strips of masking tape may be used to pull the pieces together and to hold them securely while drying.

Hand vice clamps may also be used to hold sherds in their proper position and angle while drying, as the rest of the vessel is restored.



Above: Img. 32 Partially restored vessel secured with hand vice clamps and masking tape, Kowalchuk 2014



Above: Img. 33 Yellow dashed lines indicate white staining as a result of prolonged masking tape use, Cronyn pg. 155



Above: Img. 34 A restored vessel top, after consolidation, adhesion, and removal of tape, Kowalchuk 2014

Step 7: Remove the masking tape and clamps. The masking tape supports can be removed in as little as four hours, but should be left on no longer than twenty-four. If the tape is left on for a prolonged period of time, some adhesive may be left behind and damage the pottery. Solvents can be used to remove the adhesive as best as possible, but this is to be avoided whenever possible.

9. Filling Lacunas

After the vessel has been reconstructed, it must be decided whether or not it is stable enough to under go transportation and handling. As most finds of an excavation do not produce a complete vessel, lacunas are present. If someone unfamiliar with pottery were to handle the artifact incorrectly, it could easily break. For this purpose, the piece must be stabilized through the use of fillers.

Different types of fillers may be used on ceramics, such as calcium-sulphate-based fillers or synthetic resins based on epoxy, acrylic, or polyester resin (http://en.wikipedia.org/wiki/Conservation_and_restoration_of_ceramic_objects#Cleaning). These materials need to be durable, but also reversible and retreatable.

As excavations produce high amounts of pottery, the best, and often most expensive, products cannot always be used. Plaster of Paris (calcium sulphate) is used for the majority of filling, as it is cheap and easy to use. One of its draw backs however, is that it has a lot of salt, which can effect the vessel over time. The 2.5% and 5% consolidates help to prevent damage to the vessel from the salt.



Above: Img. 35 Plaster of Paris before mixing with water, Kowalchuk 2014

When filling lacunas or stabilizing an object, reconstruction can only be done horizontally. This is because a conservator can presume what the object looked like, based on the material that is already present. If they were to try and reconstruct a vessel's body and base (working vertically), based only off of the rim, they would be fabricating the design on their own. If the situation of the vessel is unknown (ex. whether or not a handle was present), the lacuna should not be filled with plaster.

Step 1: Masking tape must first be applied to the surface of the vessel, around the break lines. It is important to get the tape as close as possible to the edge of the break line. This will prevent any excess plaster from staining and damaging the surface.



Above: Img. 36 Masking tape is applied along the surface of the vessel, as close as possible to the break lines, Kowalchuk 2014

Step 2: Apply masking tape as a backing for the plaster fill. The tape must be applied across the lacuna from the interior side, and be strong enough to support the weight of the plaster. This can be done by criss crossing the tape. The tape needs to be under the inner surface of the vessel so as not to create a loss.



Above: Img. 37 Masking tape backing applied to vessel, Kowalchuk 2014



Above: Img. 38 Masking tape applied in a criss cross fashion to provide adequate support for the plaster fill

Step 3: Apply a thin layer of white PVA glue along the break lines to ensure the plaster will adhere to the pottery. This can be done with a small paintbrush.

Step 4: Pick a colour of plaster close to the original vessel, but different enough to tell it is the filler. Prepare the tools needed for mixing, filling and working the plaster so they are ready when needed.

Plaster of Paris comes in a white powder format. Since white attracts the eye, it must be coloured using natural oxides.



Above: Img. 39 Tools used for mixing, filling, and working plaster, Kowalchuk 2014

Step 5: Take a bowl filled with a small amount of water and slowly add the plaster. Watch as it is absorbed into the water, and keep adding until the water is gone and small “plaster islands” form.

Mix the plaster well with a small spatula, until all the streaks disappear and the colour is even. Pop any air bubbles that develop during mixing.

Step 6: Using the spatula, apply the plaster along the break lines. Make sure the plaster is firmly applied to the sherds and no spaces are left along the edge.

Next, begin filling the lacuna with the plaster. It is important to fill the entire space first, then build up the height of the plaster after.

It is important to work quickly and cleanly, as the plaster dries very quickly.

Step 7: Once the plaster loses its sheen and is no longer tacky to the touch, the tape can be removed, and the plaster can be worked from the inside.

Using the different tools, smooth and shape the interior of the plaster to match that of the original vessel. The outer surface may be worked on once it is completely dry (24 hours).



Above: Img. 40 A filled vessel after the masking tape has been removed, Kowalchuk 2014



Above: Img. 41 The interior of a vessel after plaster fill has been worked, Kamaisky 2014

Step 8: After the plaster has completely dried, the outer surface may be worked. Various grater tools are used to shape the plaster. A flat grater is used along the surface, and must be used working in different directions, to avoid having plains and uneven surfaces. A round grater is used to work the edge of the plaster.

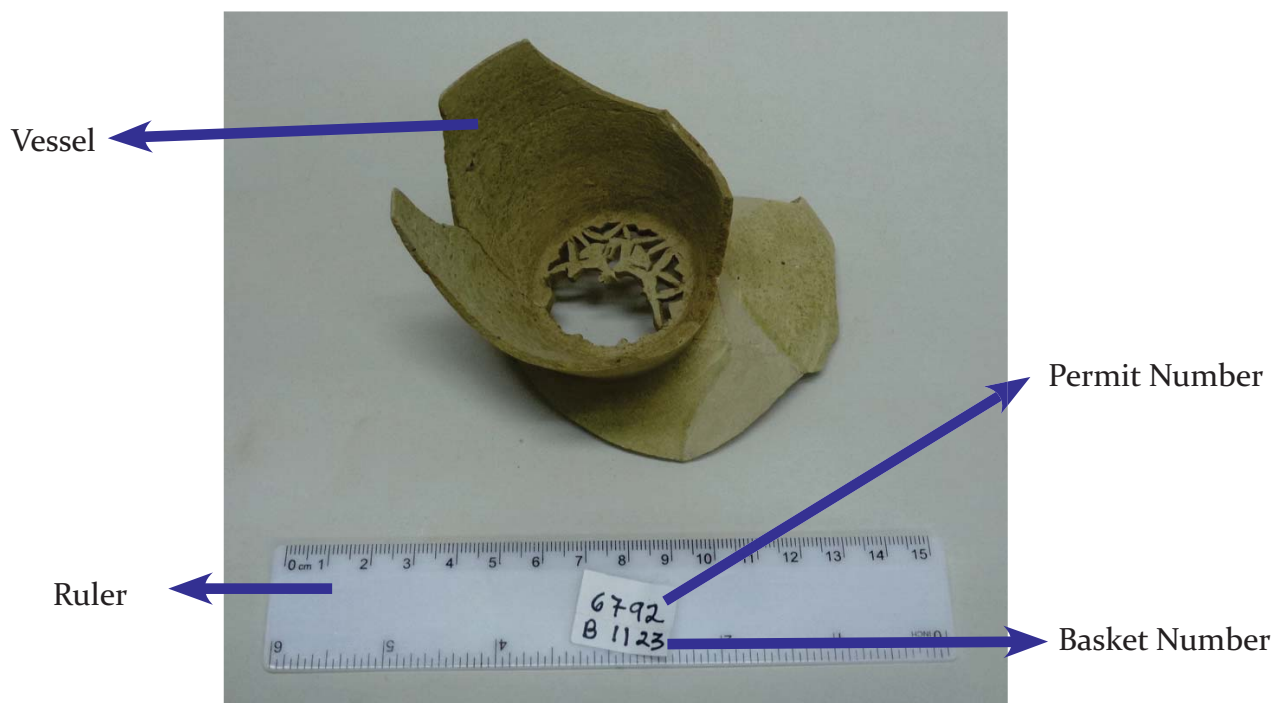


Above: Img. 42 A restored vessel, Kamaisky 2014

10. Preservation

After the vessel has been treated it will be photographed or drawn for cataloguing purposes. The photograph or drawing must include the vessel, a ruler/scale, the permit number, and the basket number.

The vessel should be photographed or drawn from different angles, showing various features.



Above: Img. 43 A proper photograph of a vessel after treatment, Kamaisky 2014



Above: Img. 44 The same vessel photographed from a different angle, to document various characteristics, Kamaisky 2014

A profile drawing of a vessel should provide both an exterior view as well as a section cut of the vessel. The identification information is written on the drawing, as well as a scale.



Above: Img. 45 An example of a profile drawing, http://www.tfahr.org/files/PotProf_40.pdf

After the vessel has been photographed or drawn it is stored until the archaeologist from the excavation submits a final report. Once the report is submitted, the vessel is packaged securely and transported to the National Treasures Storerooms, in Bet Shemesh, Israel.



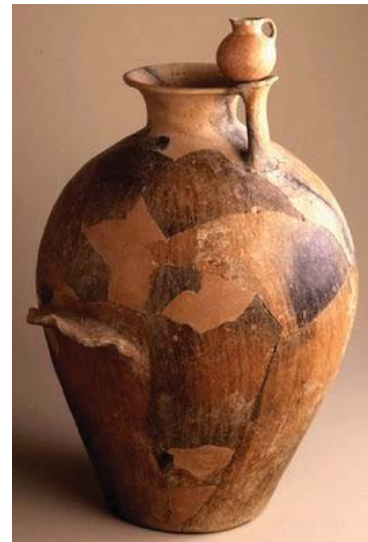
Above: Img. 46 Treated vessels stored at the National Treasures Storerooms in Bet Shemesh, http://www.antiquities.org.il/article_Item_eng.asp?sec_id=53&subj_id=245

Once at the storerooms, the vessels are arranged by excavation, both chronologically and geographically. Both temperature and humidity are monitored to ensure proper storage conditions (http://www.antiquities.org.il/article_Item_eng.asp?sec_id=53&subj_id=245). If the items need additional treatment later on, they will be sent back to the IAA labs for further work.



Above: Img. 47 Storage facilities in Bet Shemesh, http://www.antiquities.org.il/article_Item_eng.asp?sec_id=53&subj_id=245

The items are held at the storage facility in Bet Shemesh, and from there are sent to both permanent and temporary exhibits in Israel, as well as around the world.



Above: Img. 48 A jar with a dipper juglet on display at The Land of Canaan permanent exhibit at the Israel Museum., provided by the IAA, <http://www.imj.org.il/imaginer/galleries/viewItemE.asp?case=2&itemNum=365435>

Before a vessel is sent from the storage rooms in Bet Shemesh to an exhibit, it is prepared for the display. This includes re-treating the vessel if necessary, and making sure it is secure enough for transportation and display.

Once the vessel arrives at the museum it is in the care of the curator. While on display the vessel will be monitored (temperature, humidity, lighting, etc.) and if any changes arise, the museum must contact the IAA pottery conservationists and seek permission for treatment. The item is then sent back to the labs and treated once again.

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Image 3 & 4: Pottery conservation from excavation to preservation, <http://web.ncsu.edu/abstract/humanities/tp-petra-excavation/> & http://www.statemuseum.arizona.edu/exhibits/pvia/wall_of_pots/

Image 5: An excavation taking place in Kfar Tavor, Kowalchuk 2014

Image 6: Different baskets of pottery sherds waiting to be washed, Kowalchuk 2014

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