

APT [Appropriate Paper-based Technology], Papier-Mâché, Pastes & Glues.

Papier-Mâché - is a paper-based technology with a long and successful history as a strong and very useful method of forming objects or elements.

Renewed interest is now being shown in the further development of this technology - mainly in the following two fields:

- 1: Construction.
- 2: Furniture and disability apparatus.

The following recommended titles may be consulted for further information:

Construction:

- a: Paper Houses - Survival Scrapbook 4: Roger Sheppard et al.
Unicorn Bookshop, Wales UK 1974.
- b: Garbage Housing: Martin Pawley. Architectural Press UK 1975.
- c: Building with Papercrete and Paper Adobe:
Gordon Solberg Las Cruces New Mexico USA 2002.
www.zianet.com/papercrete

Furniture and disability apparatus:

- a: Appropriate Paper-based Technology [APT]: Bevil Packer.
Intermediate Technology Publications London UK 1995.
[this book originally published in 1989 in Harare Zimbabwe is highly recommended] www.itpubs.org.uk
- b: Nomadic Furniture: James Hennessey, Victor Papanek.
Pantheon Books/Random House New York USA 1973.
- c: The World Book of Arts and Crafts for Children: Arnold Arnold.
Pan Books/Macmillan Books London UK 1976/1977

Notes from some of the selected literature on the following pages:

03: Paper Houses:

05: Appropriate Paper-based Technology [APT]:

09: The World Book of Arts and Crafts for Children:

Papier-Mâché etc, - can be preserved and waterproofed by lightly brushing fully dry objects with several coats of shellac, clear varnish, water glass or transparent glue.

a: Shellac - lac dissolved in alcohol

b: Clear varnish - equal proportions of liquid linseed oil, white [clear] vinegar and turpentine.

c: Water glass - sodium silicate

d: Transparent glue - see on the following page nr.10.

Papier-Mâché

The bulk of all papier-mâché in Europe, America, and Asia is made by laminating layers of paper and then lacquering or illuminating the

surface. At one extreme this gives a Chinese urn or a delicate early Victorian cabinet and at the other extreme a crude carnival mask.

The Western European history of the craft (predated by India, China, and Japan) is largely

confined to the hundred years between 1770 and 1870 (in 1772 Henry Clay filed a patent for papier-mâché and started a very famous business). Papier-mâché became very popular in the 1830s to 1850s, and trays, occasional tables and chairs, and mirror frames were among the items perfected.

In the tremendous inventive surge at the time of the Great Exhibition a great future was seen for the industrial use of papier-mâché. Boats, bridges, ships, and houses were planned, and some were even realized. One of the oddest was a prefabricated papier-mâché village designed by C. E. Belfield in 1853 and shipped to Australia. According to the Illustrated London News, it consisted of ten cottages and a ten-roomed villa, all in papier-mâché, and it must surely be the first example of architectural prefabrication on an industrial level.

Some time earlier, in 1800, when Clay was still producing Chinese furniture, a small sailing boat was built of paper and sailed successfully on the lakes of Killarney.

Laminating: High Quality

1. Plaster mold.
2. Fill bowl with 1 pint of water.
3. Shake into cold water $\frac{1}{4}$ pound of size (glue size—not cold water size), stir, and leave for fifteen minutes.
4. Heat to boiling, slowly. Stir—a thick brown liquid should remain with no bubbles.
5. The paper for the laminating must be absorbent. Search around for an absorbent Kraft board of between 100 and 150 grams double crown 65.
6. Tear into pieces of 5" by 4" and dip one at a time into the size, making sure all soak thoroughly.
7. Press each piece under the surface of the liquid until the paper reaches the top of the size.
8. Allow the sized paper to drain off.
9. Make a cold water paste—thicker than that for wallpaper hanging. A stiff flour paste will do.
10. Prepare another size four times the strength of the soaking bath mixture. Heat to

running liquid as before, (If you use 1 pint of paste, you'll need $\frac{1}{8}$ pound of size.)

11. Stir the paste.
12. Add a few drops of salicylic or boric acid or any fungicide. Cardboard is easily attacked by mold.
13. You can now lay your sized paper into the mold, pasting only one side, pressing down the paper with the pads of the hands to prevent air pockets and ensure a tight bond.

Papier-Mâché Houses?

The possibility of using papier-mâché in building seems so obvious that it's surprising so little has happened in this area.

Papier-mâché would provide a cheap material, based on scraps, that would give an amazing amount of freedom in design. The whole field seems to be untouched and wide open.

Things to try:

Use old newspapers for the main bulk of the papier-mâché and experiment with glues to upgrade the material. It could be that the glue provides an effective weatherproofing; otherwise external treatment would be much the same as with card.

When you have developed a satisfactory mix, spread it like concrete over chicken wire stapled onto a frame.

Leave holes for the doors and windows that will go in later. Insulation should be quite high, but if you need more, paste on fluted cardboard to give you more air space. Use really thin single-flute card.

For framing material use scrap lumber, bamboo, etc.

Another idea would be to laminate rather than apply a pulp. The layers could be laid on the top of string. Build up layers until you have the thickness that you want.

These are just a few suggestions. We don't know how well they work, but anyone with some time could probably construct quite a good, workable building system.

Basic APT techniques and processes (Stage One)

11. The time factor

Much work and, therefore, time goes into the construction of an APT article. An extremely important part of APT is organizing the work and finding time-saving methods and devices. However, never take short cuts that reduce strength or quality. One way to save time is to build a supply of long rails and large boards to cut to size when they are needed.

12. Tearing and cutting

Tear paper and card rather than cutting it. Tearing is quicker and leaves a bevelled edge which sticks down firmly. Cut edges make a ridge that easily comes unstuck. Tearing is best done when paper and card is dry but that is not always possible, for example when tearing layered strips. Tear along the grain if possible, but tearing across it is sometimes necessary. If you must tear across the grain, crease sharply where you have to tear, place the crease along the edge of a table and tear downwards. Thin card can be torn across the grain in the same way, but should be scored first. Cutting is sometimes necessary, for example if a straight edge is required, perhaps when decorating. Scissors are usually used to cut paper and a knife to cut card. Cut card on a cutting board.

13. Folding

Note the grain and, as for tearing, fold along it. Card may be scored and bent over a sharp-edged table. If thick card (carton) has to be folded, a deep V shape should be cut or pressed into the card along the line where it is to be folded.

14. Mash (papier mâché)

There are many ways of making mash. Some people use resins or commercial glues to get a very strong, water-resistant mash. APT mash is not waterproof. It is made by the simplest of methods and takes only a few minutes. To make mash, soak pieces of paper or card, for example, newspaper, in water, preferably overnight or longer. Take handfuls of the soaked paper and with a tool, such as a rough stone, rub, grind or pound it to a pulp. The finer you grind it the easier it is to work. Squeeze very hard to expel water. Put the mash in a strong plastic bag. Take a little thick paste or break some old *sadza* into little crumbs and work it into the mash until it has the consistency of moulding clay. Only use a little paste or *sadza* or the finished article may attract weevils.

Using mash

Very small articles, such as jewellery or chess men, can be made just by building them of mash. Normally, an armature is made over which mash is moulded.

To make small mash items using an armature, first construct the armature. It must be hard and tight. Smear paste over it. Press and mould the mash on to the armature and mould into the shape desired. The mash should be 1cm thick, not less. Finish by working the surface all over with pasty fingers.

Dry the mash article with air circulating around it. Check often as it dries. Press any cracks together and squeeze the mash closer on to the armature if necessary, improving the shape as you do so.

In stage two, strengthening and tidying, cover the mash article with at least three layers of cement bag paper, applying them in strips and small pieces.

15. Layering

Layering is used in the production of every APT article. It consists of placing and pressing pasted strips of paper or card on to the surface of an article or a mould. Layering is used to strengthen, tidy and decorate the article. Each complete covering of the object by layering is called a 'course'.

Layering can be used to actually make an item by applying courses of three- or four-layered strips instead of single pieces. This is called thick layering. Important facts to remember about layering follow (refer to grain and stretch/shrink discussed earlier in this chapter):

- Moisten and stretch, that is paste, all paper and card before using it. Except when you are layering decorations, tear and paste large pieces or sheets, single or layered, and tear the layering strips or pieces from these when they have stretched
- On curved surfaces use narrower strips and smaller pieces. Larger pieces can be used on flat surfaces, but extra care is needed during the drying stage to prevent warping
- Work with pasty hands. Press and massage your work quite heavily all the time. If layering coloured paper, handle and mould it through a thin sheet of plastic

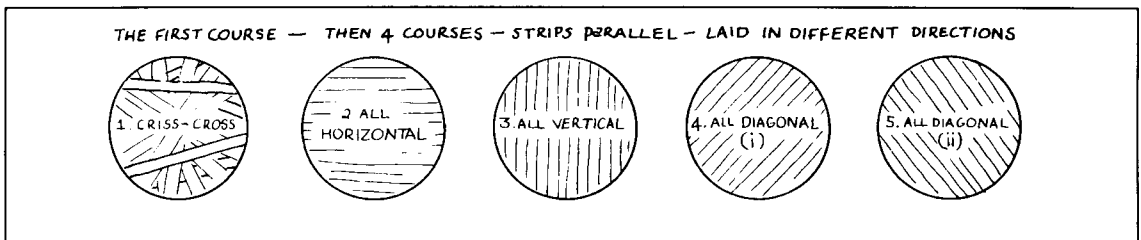


Figure 1.5 The five courses of thick layering

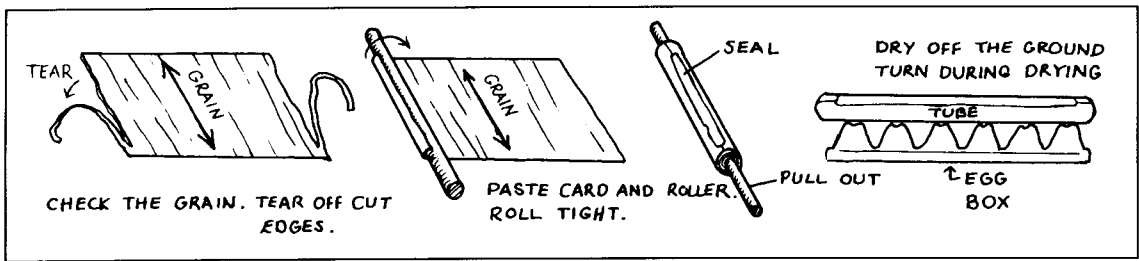


Figure 1.6 Rolling card or paper to make tubes

- Every piece must lie flat. Lift any piece that is not flat and tear into it if necessary to relay it
- Achieve an even surface. Find how to tear into a piece of paper to layer it over a corner and mould it tidily through thin plastic. When tidying tear suitably shaped pieces to get a neat finish, and
- Always be conscious of the grain. Remember that the stretch and pull is in one direction – between the fibres, that is, across the grain. Alternate the grain in successive courses of layering.

The following points are relevant to thick layering. They have been written with the layering of a bowl in mind (see Figure 1.5), but apply generally:

- To build an average-size bowl or similar article by layering you will need 15 to 20 layers of paper. To save time, these are applied as three- or four-layered strips. Five courses are applied to complete the job
- To neutralize the pull of drying, each course is applied in a different direction, that is, one course in which all the strips cross and four parallel courses layered in different directions
- Continually press the work making it tight and squeezing out excess paste
- The number of layers depends on the size of the article, the thickness of the paper and the purpose for which the article is intended. It is better to make the article too thick than too thin, and
- Thick layering can be applied on the inside of a mould, for example a bowl. The process is not difficult and small children can do it. Extra paste usually has to be squeezed out afterwards. A bowl made inside another bowl may not have a good flat base on which to rest.

16. Moulding (and pressing)

Different materials are moulded by the hands. These are:

- Mash is moulded over an armature or mould that is removed
- Soft paper mixed with paste makes a kind of instant mash which can be moulded in the same way. This material dries faster, but moulding it is more difficult than moulding mash
- All layering work involves pressing with the hands to improve the shape and strength of the article or a join. This process is described as moulding, and
- A piece of card can be cut and strapped into the shape desired. then layered over and moulded to complete the item.

17. Tubes

Tubes are made in different sizes and strengths according to their function. Strong hard tubes are used for lampstands, pillars, legs, rails for furniture, for pegs, hinges, axles and bearings and so on. Hard tubes are usually made of card. However, paper and especially the strong outside paper of a corrugated card box can make excellent tubes, although they take longer to dry. Soft tubes of paper or card are used in construction work, particularly to bond and strengthen long angle joints. They are crushed flat while still soft and folded along their lengths to make an angle piece.

Making tubes

This can be simply done using the following method. First, find or make a smooth roller. A broomstick is a good size for a roller with which to make a table leg or rail. Polyvinyl chloride (PVC) tubing is also excellent for the job. If reeds or sticks are used they must be of

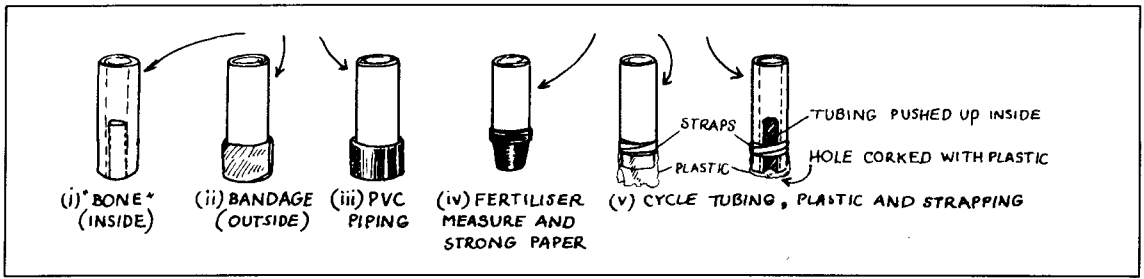


Figure 1.7 Ways of reinforcing and waterproofing tube ends (feet)

even thickness and free from ridges or lumps on the surface.

Next, prepare for rolling. Place the card on a flat, clean plastic surface with the grain lengthways. Preferably, see that the front and back edges of the card are torn and not cut. Smear paste lightly over the card but check that it covers the card to its edges. Paste the roller well.

Then, place the roller along the grain. Roll the card tightly on to the roller and continue rolling it in your hands until the edge of the rolled card sticks down, at which point pull the tube off without delay. If necessary, stick the edge down with a pasted paper strip. Finally, dry the tube off the ground and turn occasionally to avoid the risk of bending. Soft tubes are made of soft card or thick paper and can be rolled without a roller.

Tube-rolling hints

To get a tight roll, especially in the case of narrow tubes, two devices are used. The card is given a practice roll first (either wet or dry). A narrow strip of strong paper is pasted along and underneath the front edge of the card with approximately 1cm projecting. The projecting paper will grip the roller and start the card off correctly.

If the tube does not come off the roller, it has either stayed on too long or the roller was not well-pasted. Try twisting the tube in reverse and pull. If that fails, unroll the tube, find out the problem and roll again.

Paper tubes

Making tubes from paper is feasible. All the original APT furniture has legs made from cement bag paper. Thick business brochure paper is easier to use. Well-made paper tubes

are harder and, for their thickness, stronger than card tubes. However, the process of making paper tubes is slightly slower and trickier than for card tubes.

To make tubes from paper use the following method:

- Use a smooth roller. Wrap a well-pasted thin plastic around it
- Paste and layer five two-layer sheets together, if you are using thick magazine paper. Iron each double sheet flat with your hands. Work quickly
- Roll the sheets around the well-pasted plastic-covered roller, overlapping each new sheet with the previous one. Carefully pull the tube off as soon as it is finished
- Check and turn the tubes during drying to prevent bending, and
- Improve your technique with experience.

Strengthening tubes

To reinforce the ends of tubes, for example stool feet, several options are available:

- To strengthen a tube on the inside, find or roll a hard tube about 10cm long that will just fit inside the wider tube. This new inner tube is called a bone. Paste the two parts well. Screw or force the bone right in the original tube
- To strengthen a tube on the outside find a long strip of card with the grain running across it. Give it a practice roll around the tube. Then paste the card, roll it tightly around the original tube and layer over it
- To make a super-strength leg end, for example, for a push-chair, force a segment of PVC piping over the tube end. Layer over it and bind it to the leg.

23 Making your own adhesives

The following glues can be made easily and require only materials that are found in any home or local shops. They keep well in the refrigerator or other cool place in closed, screw-top jars. If the glue becomes too stiff to use or dries out, it can be restored by the addition of a little water. All except one of the recipes (see 26) are entirely non-toxic, and many are useful for paper as well as for bonding other materials, as detailed in each instance.

24 Flour paste (short-term adhesion)

Tools and materials: flour; water; mixing bowl

Mixed to a consistency of double cream, this is a useful adhesive for paper, cloth and other materials. It is not permanent but the adhesion will last long enough for most pre-schoolers' and infants' purposes.

25 Flour paste (long-term adhesion)

Tools and materials: flour; water; muslin or cheesecloth; glass dish

Wrap a handful of flour in the muslin. Wash and knead the flour inside the muslin bag under cold, running water until the water is no longer milky as it runs off and most of the starch is removed. The remainder is almost pure gluten. Allow to dry in a glass dish. The dry gluten will store indefinitely without refrigeration.

To use, chip flakes off the gluten cake, add a few drops of cold water, and allow to stand for a few minutes. Then knead

the flakes until they become soft and pliant. Add more cold water to thin out to the required consistency.

26 Transparent glue

Tools and materials: 25g (2oz) white gelatine;
150g (5oz) acetic acid (available at chemist's); 175g (6oz) water;
cooking pot

Soak gelatine in water for twelve hours. Then heat the softened gelatine in the same water until it dissolves. Stir in acetic acid and add cold water until the mixture comes to about half a litre (one pint).

This glue is slightly toxic, but strong enough to cement glass. It can be made stronger or weaker by using more or less gelatine. An older child can use it to mount photographs, pictures cut from magazines, or his own drawings on paper, wood or glass. By brushing the adhesive on top of the pictures as well as coating them on the reverse side, they will adhere and be protected at the same time. Wipe off any excess before the glue sets with a cloth soaked in warm water.

27 Cornflour paste

Tools and materials: 2 tablespoons cornflour; $\frac{1}{4}$ teaspoon alum;
1 cup water; oil of cloves; cooking pot

Mix flour, alum and part of the water to form a smooth cream. Add the balance of the water, stir, and cook over low heat until the mixture becomes translucent. The longer it cooks, the greater the adhesive power. Add a few drops of oil of cloves after the mixture is taken off the stove. Keep in closed jar in the refrigerator and stir thoroughly before using. This is a useful adhesive for paper, cloth, wood and thin leather especially.

28 Acrylic adhesives

Acrylic media are a relatively recent development. They are available from art supply stores and school material suppliers. The painting medium itself is water soluble and non-toxic and can be used as an adhesive and, at the same time, as an opaque or transparent varnish and protective coating. When totally dry, it waterproofs whatever it covers. Acrylics are therefore ideal adhesives for collages (see 29) and assemblages (see 30), and as varnish for papier mâché (see 47-57), painting (see 148-71) and sculpting (see 195-9).