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20 August 1971

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

**Expert Group Meeting on the Use of Plastics
in the Building Industry**

Vienna, Austria, 20 - 24 September 1971

SUMMARY

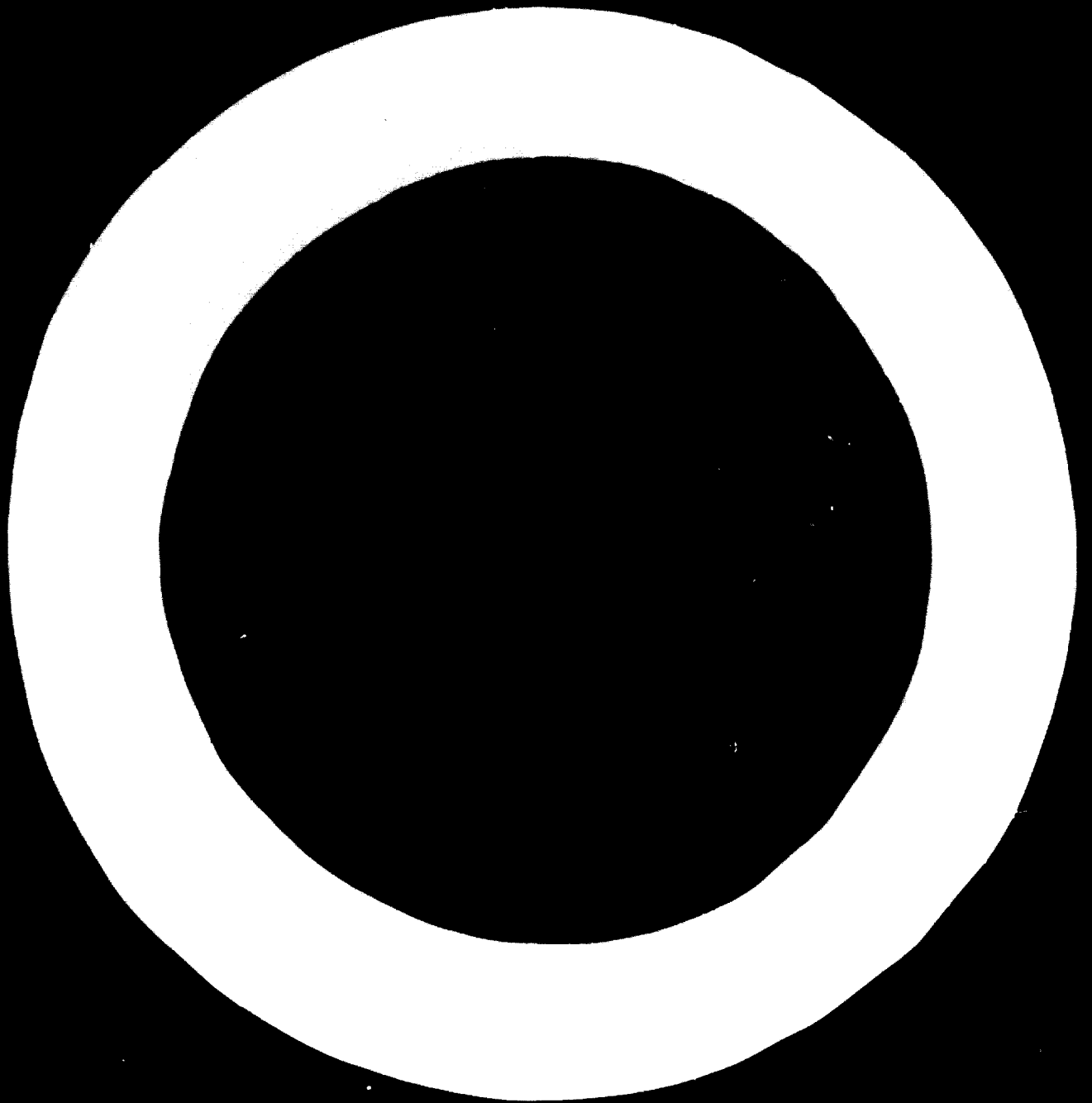
**THE CHEAP PLASTIC SHELTER
IS ONE HOPEFUL WAY TOWARDS LOW COST HOUSING
IN DEVELOPING COUNTRIES
- BUT THERE MIGHT BE BETTER ONES^{1/}**

prepared by

**The Swedish Council for Building Research
Plastics Group
Stockholm**

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U N I D O

United Nations Industrial Development Organization has suggested an expert Working Group Meeting in Vienna on the use of plastics in building for low cost housing in developing countries.

TIME:

September 20-24, 1971

PLACE:

Vienna, Austria

SUBJECT:

The cheap plastic shelter-shell is one way towards low cost housing but other methods might lead more quickly to a satisfying goal.

AIM:

To give the meeting one idea of how to approach low cost housing in developing countries.

It should be stressed that this does not primarily concern emergency solutions after catastrophes such as earth-quakes, floods etc. Neither is the main point low cost housing.

The idea is founded on the thought that sanitary installations are a basic need. It is essential to avoid illness and epidemics which might be widely spread.

Instead of starting with the shelter this idea begins with sanitary facilities.

A SERVICE NET

to which

SERVICE POLES, in the first stage communal, later for each household are attached

and lastly are added

SHELTERS

I. THE SERVICE NET

After study of local traditions and requirements, preliminary ground work and road marking,

a ground net of plastic pipes of a rather large diameter is formed with possibilities to attach vertical service poles (pillars or frames are words which could also be used) at given intervals.

These plastic pipes might be laid out by a mobile pipe-making machine or by blowing coils of pipe into straight lengths capable of keeping their shape under earth pressure.

Through these large diameter pipes plastic pipes of smaller diameters should be pulled for

1. Sewage water. A vacuum system ought to be used. Toilet flushing would be minimized by using less water. It would not be necessary to lay in a grade for natural fall as pumpstations are not needed.
2. Fresh water.
3. Electric wiring
4. Telephone wiring
5. Gas pipes, where cheap natural gas is available.

In areas with heavy rains a water drainage system could be incorporated and in a very advanced stage household waste could also be transported by a vacuum system.

In Sweden a lot of research has been made concerning the use of plastic pipes underground.

II. THE SERVICE POLE

At intervals determined in the lay-out plan (or possibly later at other points by cutting into the pipes) there should be means of attaching a plastic frame - the service pole, which would be a stand for different installations:

fresh water taps, washing bowl, toilet bowl, electrical outlets, telephone outlets, gas-valve and maybe an opening for household waste. Water from the pipes would be taken straight into the stand.

Industrial fabrication in large series should be utilised and the highly advanced service units to be found in the United States and Japan used for information, though certainly not copied.

In the first stage one would distribute only a few service poles for use by everybody in the area. But the goal is to have the equipment gradually attached to every individual households.

In addition a few neighbourhood centres with laundry facilities, shower cabins, toilets, electrical outlets, a public telephone and so on are to be desired.

III. THE SHELTER

Although the shelter is mentioned last we do not underrate its importance. There are a number of good ways in which to use plastics for shelters in low cost housing. Although it might seem like a step backwards, we believe it is practical and for certain individuals and communities desirable that the inhabitants themselves join in the gradual achievement of the complete - if simple - housing in their community. A first shelter could be erected by traditional methods and with traditional materials, such as corrugated asbestos sheet metal, the ancient mud brick etc.

1. Plastic mud brick

This has been used by man for an unknown number of years. We want to suggest adding modern knowledge of polymers. If there is a river within reasonable distance one would pump mud from the river bed to a mobile plastic mud brickplant. The mud would here be mixed with foam plastics pressed through a mouth-piece and the ensuing "foamed mud string" cut into sizable blocks with use of modern brick-manufacturing methods. These bricks would be lighter to handle and more suitable for the use in question owing to their cellular structure.

2. The double bubble-top umbrella

DOUBLE

A building feature well-known in the tropical countries and by users of modern tents, to be seen in any camp.

BUBBLE-TOP

More the shape of an elliptical half sphere than the ordinary umbrella. Something like Mr. Sandman's umbrella in the nursery rhymes.

UMBRELLA

The metal profile could be replaced by a plastic material. The second layer could possibly be supported by a similar construction or from the top layer. The construction as a whole could be supported from the service pole or placed on the prepared floor. The cover would be plastic film reinforced with plastic mesh and coated on the outside with highly reflecting materials resistant to uv-radiation, amongst other things.

Light inlets, ventilation openings, door openings etc. can be arranged with the use of plastic zippers, "burdock bands" etc.

3. The sandwich home

A shell construction consisting of an outer plastic film, a foamed distance material and an inner plastic film.

The foam material could be inserted before transportation to the building site and activated on arrival or filled in between the layers on arrival. On the site the two layers of plastic film would be fastened to the ground and internal pressure would form the structure. When the distance material is activated or put into place the internal pressure could be taken away. Or else a balloon could serve as a support during construction. More sandwich structures could later be added to the home. These may sound as very temporary constructions for emergencies only but ought, we feel, be discussed.

4. Structural folding

At least part of a very elementary building could at very competitive price be made of paper folded in specific ways or a corrugated plastic covered paper.

5. The moulded sandwich outer wall

For this we would use a technique already commercially developed for use in cars, etc, with an outer skin and an inner core. This could be one break-through towards a highly industrialized process. A house would be built up by frames that are collapsible for easy transportation and storage. The width of each element would be around 10 feet, the length about twenty when folded, in order to fit container measurements and in order to be fairly easily handled in traditional transportation systems such as trains and trucks. These frames, - with floor, walls and roof - are erected on the site. You just add the walls at the ends.

A COMMUNITY IS NOT ONLY A NUMBER OF SHELTERS

A fairly large building could be added containing areas for meetings, educational purposes, physical exercise, medical station and nursery home, to mention a few facilities. An advanced umbrella technique using reinforced plastic materials could be used.

THE NEST

It might be easier to protect oneself from climatic conditions such as humidity and mosquitos in small "nests" for sleeping only, instead of in a more traditional bedroom.



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7 September 1971

ORIGINAL: ENGLISH

Expert ~~Group~~ Group Meeting on the
Use of Plastics in the Building Industry

Vienna, 20 - 24 September 1971

LOW COST HOUSING IN ^{1/}
DEVELOPING COUNTRIES

by

Staffan Berglund

Architect SAR

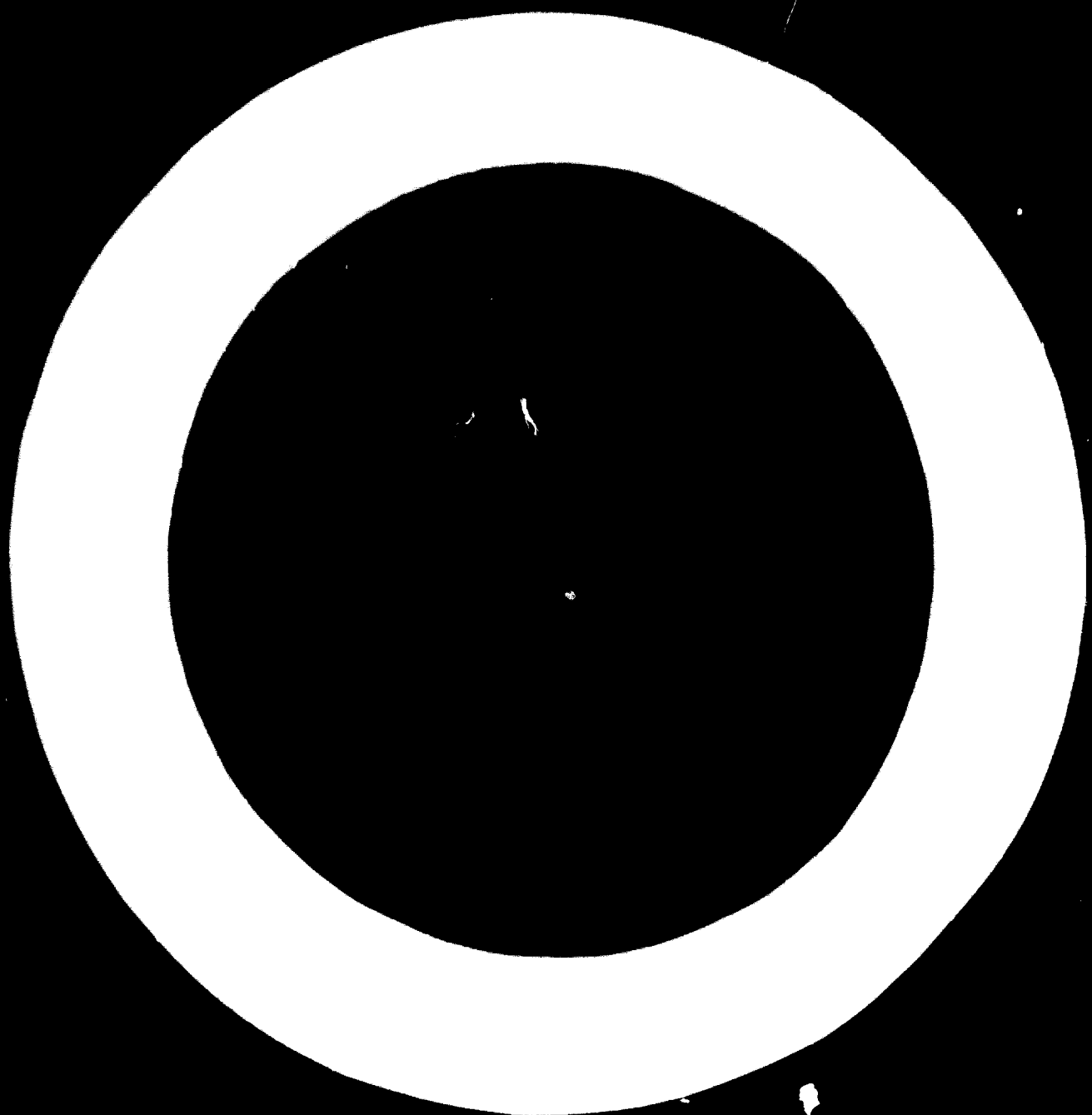
The Swedish Council for Building Research

Plastics Group

Stockholm, Sweden

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U N I D O

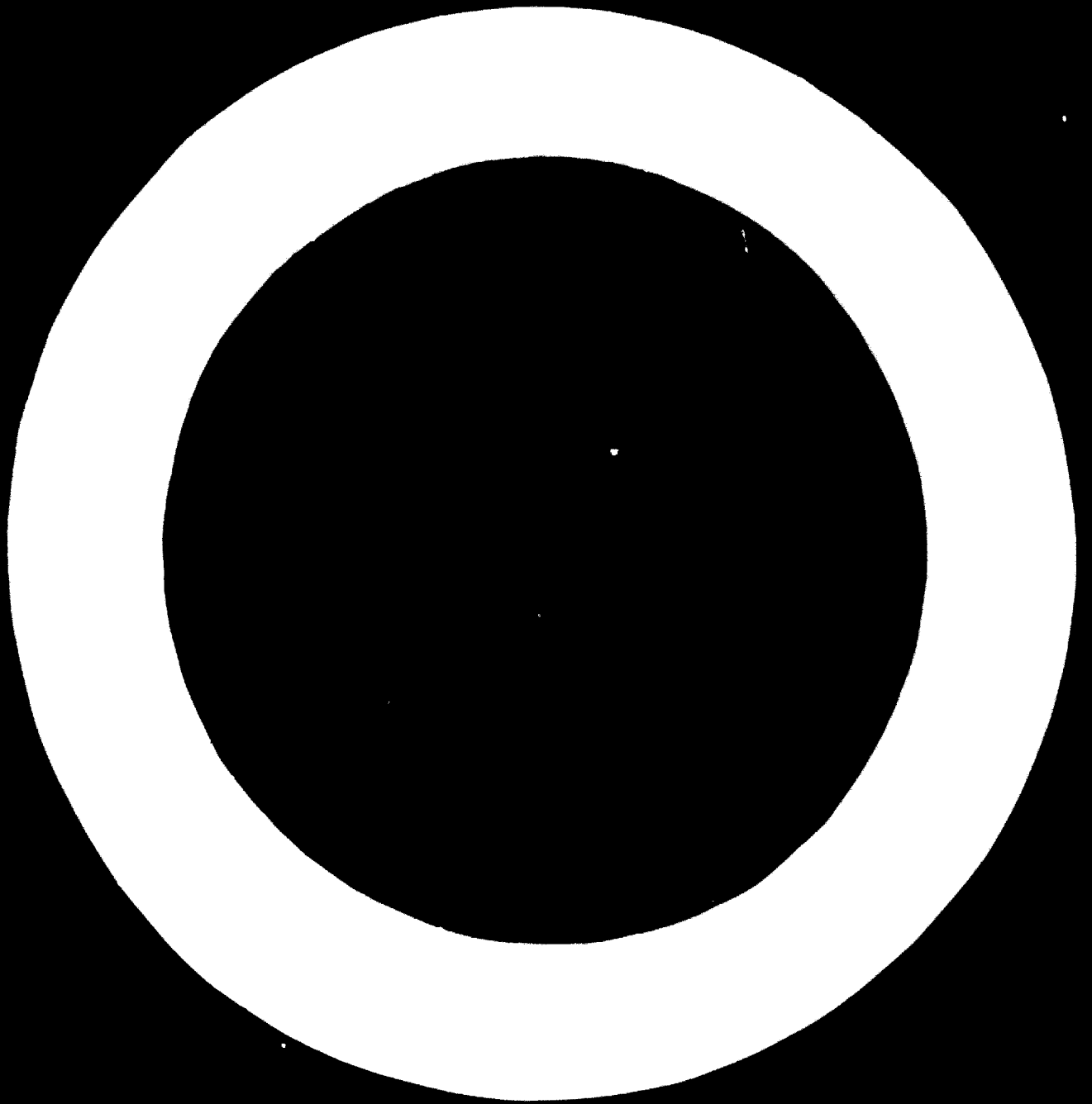
**United Nations Industrial Development
Organization has suggested an Expert
Working Group Meeting in Vienna for
low cost housing in developing countries.
The meeting is organized in collaboration
with UN Centre for Housing, Building and
Planning.**

TIME:

September 20-24, 1971

PLACE:

Vienna, Austria



LOW COST HOUSING IN DEVELOPING COUNTRIES
AN APPROACH FROM "ITEMS"

The idea is to start a community with a base of sanitary and other facilities, the details to be gradually attached, and to build the shell - the house proper - around them.

Reason: It is important that the sanitary equipment functions from the very start, being the base of daily life and work in a home of modern, though humble, standards. Also the presence of sanitary facilities safeguards against sanitary dangers, such as infectious diseases liable to appear in new communities in developing countries, - a protection also of other areas to which diseases might spread. Further, installation of sanitary equipment beforehand is very much easier (read: cheaper and quicker, especially in countries where skilled labour is scarce) than after the house is erected. Production is much facilitated as "shell" and sanitary equipment are installed separately and there is no need for time- and trouble-wasting consideration of the one while putting the other in place.

A SERVICE NET

that will hold sanitary and other facilities and attached to this

SERVICE FRAMES

which are the centre for all facilities.
The whole finally covered by

A SHELL - HOUSE PROPER

to provide privacy and protection from hazards.

1. THE SERVICE NET

After study of local traditions, climate and different requirements, preliminary ground work and road marking should be done. A ground net of plastic pipes or U-shaped profiles of a rather large size to be placed in the ground. To this system vertical SERVICE FRAMES should be placed at given intervals.

In these pipes or U-shaped profiles plastic pipes of smaller diameters should be pulled for:

1. Sewage water

2. Toilet waste

If a vacuum system is used toilet flushing would be minimized. Pipes won't need to lie in a grade for natural fall, and ordinary pump stations are not necessary.

3. Fresh water.

4. Electric wiring.

5. Telephone wiring.

6. Gas pipes, where cheap natural gas is available.

7. Drainage for surface water in areas with heavy rains.

8. At a very advanced stage a vacuum system for household waste could be incorporated.

II. THE SERVICE FRAME

At intervals determined in the plan there should be means of attaching a SERVICE FRAME. This could be made in plastics and would serve as a stand for installations: washing bowl, fresh water taps, toilet bowl, electrical outlets, telephone outlets, gas-valve and maybe an opening for household waste. In a first stage one would use only a few SERVICE FRAMES in each area. The goal would be to have one frame for each individual household.

III. THE "SHELL" - THE HOUSE

Although the house is mentioned last in this description we certainly do not underrate it's importance. Our idea is that the inhabitants should help to erect their house with the aid of people with technical skill. Later on some suggestions on how to use plastics and industrialized methods for low cost housing will be presented.

HUMANISM AND TECHNOLOGY OR TECHNOLOGY VERSUS HUMANISM?

The blinkers that we technicians and architects have put upon ourselves could be a dangerous outfit working with projects in developing countries.

TRADITION

To many the idea of plastics as a base for housing in developing countries may sound too drastic, - as if one were trying to bridge too wide a phase of evolution. It is admittedly necessary, both from a humanitarian point of view and for the sake of better functioning, to take cultural inheritance: social system, housing traditions etc into consideration. All the easier now, with modern communications and give and take between the sciences - and all the more difficult, in a time when precisely these communications, among them mass media, tend to obliterate traditions at a tremendous speed. A girl in the Gambia changes her Victorian style, sumptuous long dress for hot pants in three years. Not to speak of the millions that change their tin-honoured, aesthetically satisfying huts for corrugated iron shelters

of a much lower quality on the outskirts of growing cities.

This rapid change, the obvious social need among people in developing countries to keep something of their traditions, and - above all - the population explosion make the drastic change necessary: the radical practical approach and the use of industrially fabricated plastic materials when shaping the environment of to-morrow.

And precisely the above-mentioned example of the Gambian dress, an example which could easily be followed by dozens of others, shows that especially with right preparation and instruction adaptability is large among the inhabitants of the developing countries. But the change can be made easier to accept and at the same time of help in preserving traditions if materials and construction are chosen after careful study of the area.

CLIMATE

One must not forget the specific climate due to latitude, nearness of water, altitude, prevailing winds etc.

Neither the change between day and night and the changes through the cycle of the year.

Naturally the materials, size and construction of the "shells" or houses must also be carefully chosen to provide for the narrow comfort sector of homo sapiens.

NATIONAL RESOURCES

As a matter of course it is necessary to make detailed investigations on an area's national resources before starting a project. Consider:

1. Primary produce (oil, for the production of plastics)
2. Labour
3. Capital
4. Technic know-how

THE SERVICE NET. A TECHNICAL DESCRIPTION

When climate, tradition and national resources have been investigated a master plan should be made for the development of an area.

In oil-producing countries of course, the natural prerequisites for plastics as building materials will be utilized given the required technical know how.

The actual work should start with preliminary ground work, clearance, earth moving, drainage etc. Following the plan of the site a system, a network of plastic tubes or plastic U-shaped profiles should be placed in the ground. These tubes or U-shaped profiles should be the base (culvert) for sanitary and other facilities in the area. The organization and maintenance of an area should then be much easier.

The production of this tube or U-shaped profile could be done by means of a mobile factory.

As mentioned, the culvert will hold facilities for fresh water, sewage water, electric power, telephone system, natural gas etc.

In Sweden a lot of research on these problems has been carried out at different institutions. This means that we could supply detailed information on plastic pipes in the ground. We would be very happy to submit these results to the participants of this meeting.

THE SERVICE FRAME

At intervals determined by the plan one would attach the service frame to the service net. (With some extra effort it should certainly also be possible to attach a service frame at any location along the service net.) The shape of this could be a three dimensional frame. The frame to be made of plastic using advanced industrialized methods. From the service net one would connect a fresh water tube, a sewage tube, electric wires etc to the inside of the frame. On the outside fresh water taps, wash bowls, a vacuum toilet etc. could be attached. The frame should be designed so that it is easy to add equipment.

When planning a new area, one should first install a few service frames at suitable intervals, later there would be one for every house.

Industrial production in large series should be utilized and highly advanced service units already in production or at the planning stage in the United States and Japan to be used for information.

THE SHELL

The basic idea of this programme is to give each household a SERVICE FRAME and around this one should erect a suitable house using more or less industrialized methods and using plastics and plastic material in collaboration with other materials.

LIMITED RESOURCES

Experience shows that shelters are essential for man and are needed against demoralisation. It is a good idea (and does not lead to chaos, as one might suppose) to let the inhabitants help building their own houses,

This is easier for them without installations in different parts of the house.

THE HOUSE

Below are some ideas on industrialized production of houses. They are not for temporary camps, neither are they to be compared with the housing in highly developed countries. The projects below are listed in order of industrialization.

1. PLASTIC MUD BRICK

The ancient method of making houses of mud brick requires a lot of labour. We want to suggest a more advanced method. Plastic fillers with very low density, polymere binders and adhesives are added to improve and strengthen the mud brick. Fillers, adhesives and binders that have been used not in this way but in similar ones are already on the market.

Polystyrene granules with a dry substance of 3 - 8 % could be used. Closed cells mean hardly any absorption of water.

The plastic mud brick could be produced in a mobile plant. With a river within reasonable distance mud could be pumped to the mobile plant. Polystyrene granules and adhesives or binders should be added at the mixing plant. Using techniques from the brick industry the mixture could be pressed through a mouthpiece and cut into blocks of suitable sizes. The blocks would be lighter, stronger, more exact in size and give better insulation compared to the ancient mud brick. It might be necessary to protect some surfaces from wear, damage and climatic destruction by coating the surface with a plastic emulsion.

2. THE DOUBLE BUBBLE - TOP UMBRELLA

DOUBLE

An outer reflecting layer, a ventilated air space and an inner surface is a construction well known in tropical countries. A more familiar example is the modern tent with a double roof found on every camping ground.

BUBBLE-TOP

A word chosen to explain the parabolic vertical and the cylindrical horizontal section. Mr Sandmans umbrella in the nursery rhymes could illustrate this shape as distinguished from our classic picture of the umbrella.

UMBRELLA

To explain the way of supporting the structure:

The supporting rods would be of plastic and hold the outer layer. The inner layer should be suspended through means of radical vertical fins or strings. The material would be PVC or polyethene films reinforced with a plastic mesh. The outside layer must reflect heat and have good

durability against UV - radiation etc.

The design should incorporate "windows", ventilation openings, doors etc. These could be fitted with the use of plastic zippers "burdock bands" etc.

3. BRING THE FILM - FILL THE FOAM

To a site one would bring a manufactured "plastic film package" consisting of one outer and one inner layer. At intervals of about one foot there should be a three inches wide film that connects the outer and the inner layer of the film. When these fabricated "film packages" arrive at the site the package will be put over an inflatable balloon. The next step is to fill each tube or section with a predetermined amount of plastic foamed at the site. As the plastic has hardened the inside balloon could be deflated and taken to the next structure.

Working with plastic foams for structural use one should be aware of the creep in the material. The outside film could be a glass-fibre reinforced PVC-film. It would have to contain a lot of carbon black in order to stabilize the material. The inside could be PVC or maybe polyothene.

4. CORRUGATED VAULT

A construction using corrugated glassfibre reinforced polyester sheeting for the outer layer, very cheap plastic foam as distance material and an inner film of plastic. Construction at the site would include the following steps:

1. Inflate a balloon shaped like the house to be
2. Cover this balloon with a plastic film
3. Place a number of self adhesive plastic cubes on the surface of the film
4. Place the corrugated sheet on top and secure it to the ground
5. Fill the distance between the film and the corrugated sheeting with a plastic foam

6. Deflate the balloon.
7. Add end walls that are made of two layers of plastic film with a semirigid plastic foam in between.

With this construction it would be very easy to incorporate light inlets etc.

If needed the service frame could serve as a primary support for this vault house.

5. STRUCTURAL FOLDING

A number of methods of folding paper for structural purposes have been shown in the last years. Plastic-coating available today is one possible solution towards creating shells at competitive prices in certain areas.

6. COLLAPSIBLE HOUSE MADE OUT OF A MOULDED SANDWICH CONSTRUCTION

This would use an advanced industrial technique. The method requires a complicated machinery. The technique is already commercially developed. In this process the outer skin and the inner core

are moulded at the same time with different materials. The surface could be given some specific qualities while the distance material could be given others. The idea is to make these houses collapsible.

The width would be maximum 10, the length 20 feet to fit the measurement of standard containers which means easy handling on trucks, trains etc. The size of the house is determined by the number of sections used. The sections could be placed in a straight row or slided sideways. At the site the house is "unfolded", supported and locked in position by the service frame or an inner wall.

The end walls would be of "snap-on" type. This could be a double-layer construction of hard panels. Doors, windows and other openings could easily be incorporated in the panels.

A COMMUNITY IS NOT ONLY A NUMBER
OF DWELLINGS

The value of a community could be very much strengthened by developing a neighbourhood unit.

This would be a place for people to meet informally, for educational purposes (maybe using television techniques), for a nursery school, for medical care, for a laundry etc.

In many developing countries this unit could be built with techniques using plastics as building material. There is one example to explain the idea:

The ground would be prepared by using soil binding surface coating and the surface water drained by plastic drain pipes. The roof could be in the shape of one or more hyperbolic paraboloids supported by masts. Under this tent one could arrange "rooms" for activities that call for seclusion. The material for the roof would be reinforced plastic film. This way large areas could be covered at a comparatively low cost.

OBJECTIONS

We do realize that a number of objections could be raised against this approach to low cost housing in developing countries.

It would need a lot of planning, administration and even education.

To let the community grow gradually in this way might lead to a chaotic situation.

It might become a slum already before it is completed.

It doesn't have a standard close to what is desired.

It could look like a camp.

Even though the meeting could come up with still more objections we still believe that this could be one very possible approach as it would make a community function at an earlier stage.

**ARE THE HUMAN PHYSICAL BOUNDARIES
OF TODAY RELEVANT?**

Climate and social pattern are earmarks
for the shaping of our environment.

Close to our bodies we wear clothes,
glasses, hearing aids, gas masks etc
in order to protect ourselves from
the outer climate and to fulfil the
social pattern.

The second, and for most persons the
boundaries proper are the floor,
the walls and the ceiling of our
rooms. Further boundaries are not so
easily defined. They could be the
walls of the concert hall, the
village square or the city back-
yard.

These are just a few examples but
I think that new patterns and techniques
might change our conception of boundaries
in the future.

THE NEST

In a tropic climate there are problems
of heating, humidity, and how to protect
oneself from mosquitoes and other insects.

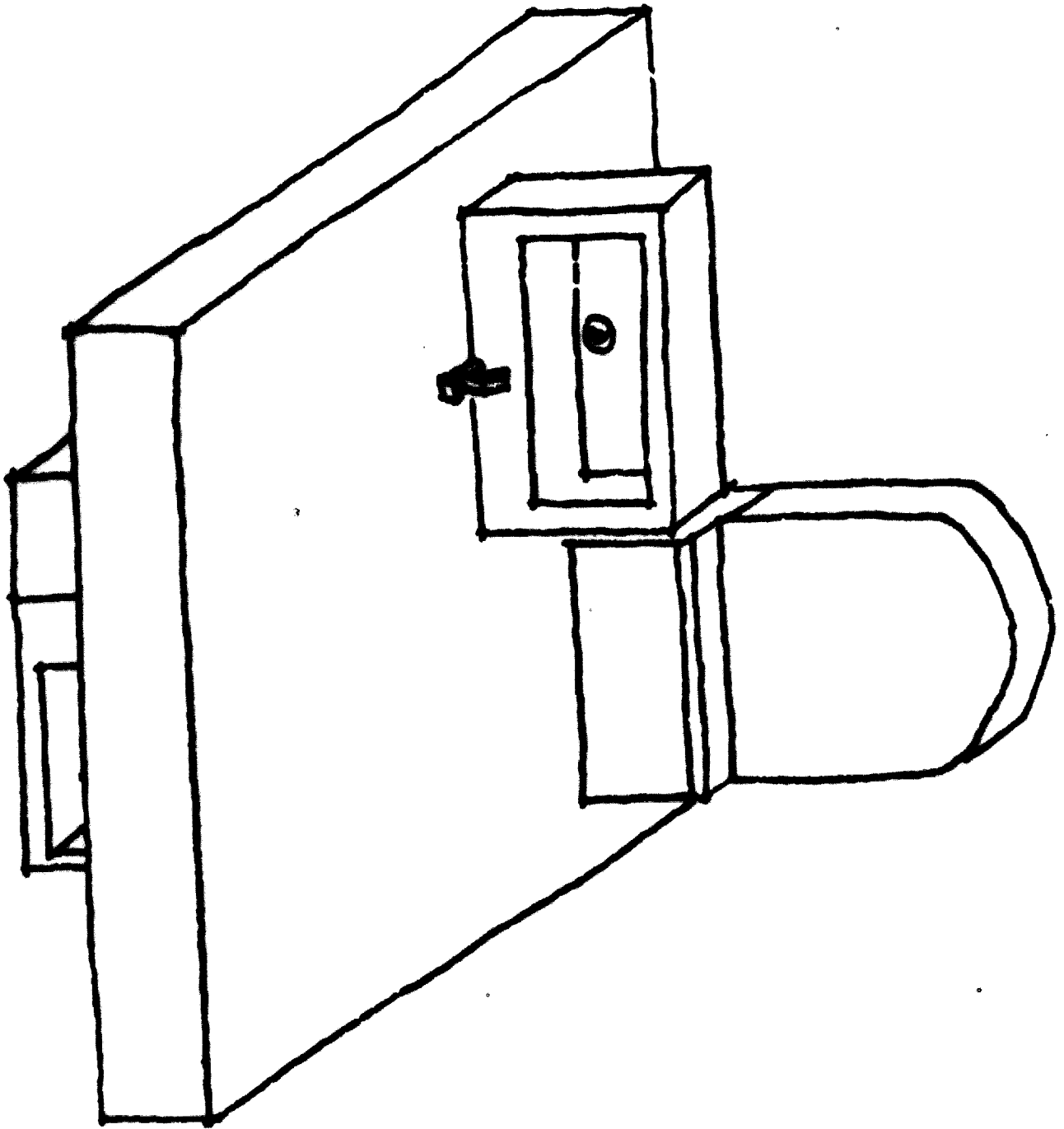
In an arctic climate there is the nightly problem of a limited amount of fuel. The solution to these two problems might be the small "nest". This could easily be done by making a small room out of plastic film.

The problem of creating low cost housing could probably be solved along lines that we do not know today. With the use of flexible boundaries and an open mind however, we might have the chance of arriving at these solutions. Here I think one could stress repeatedly, the adaptability of people in the developing countries, - their capacity of quickly making an amount of progress that has taken us a very much longer time. The transistor radio, available to almost anybody in the world is one example of this. Nobody finds it frightening or strange! It is completely accepted and no one ever expects it to be made out of the traditional materials such as wood or clay.

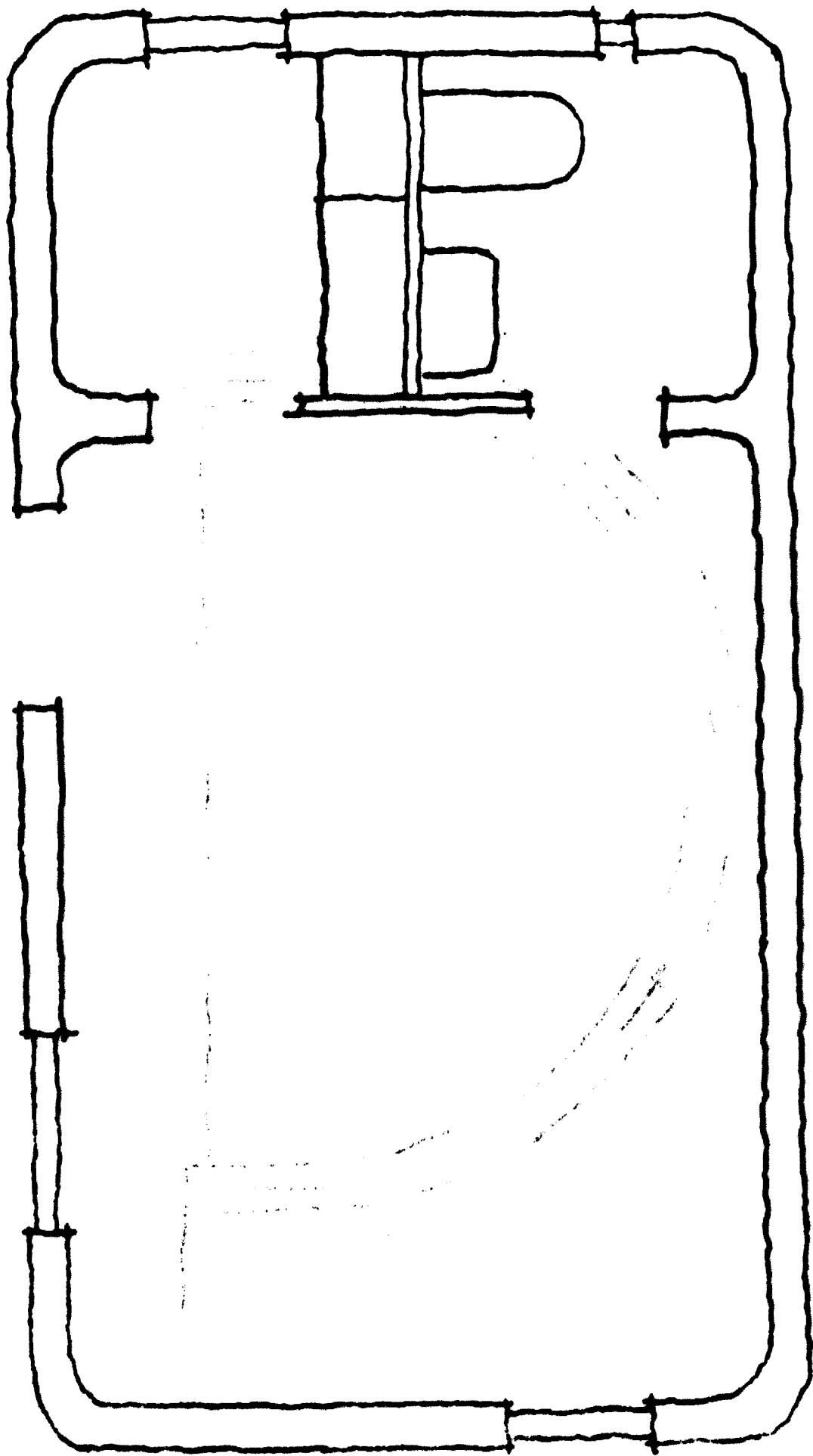
The future will show which of the above suggested ideas for plastic housing, chosen in flexible-minded discussions with the aid of specialists, will prove worthwhile to carry out.

A union of the old and the new, the traditional village and the latest in building development could - I think - lead to results which could be conceived as new themes of the frozen music which is architecture.

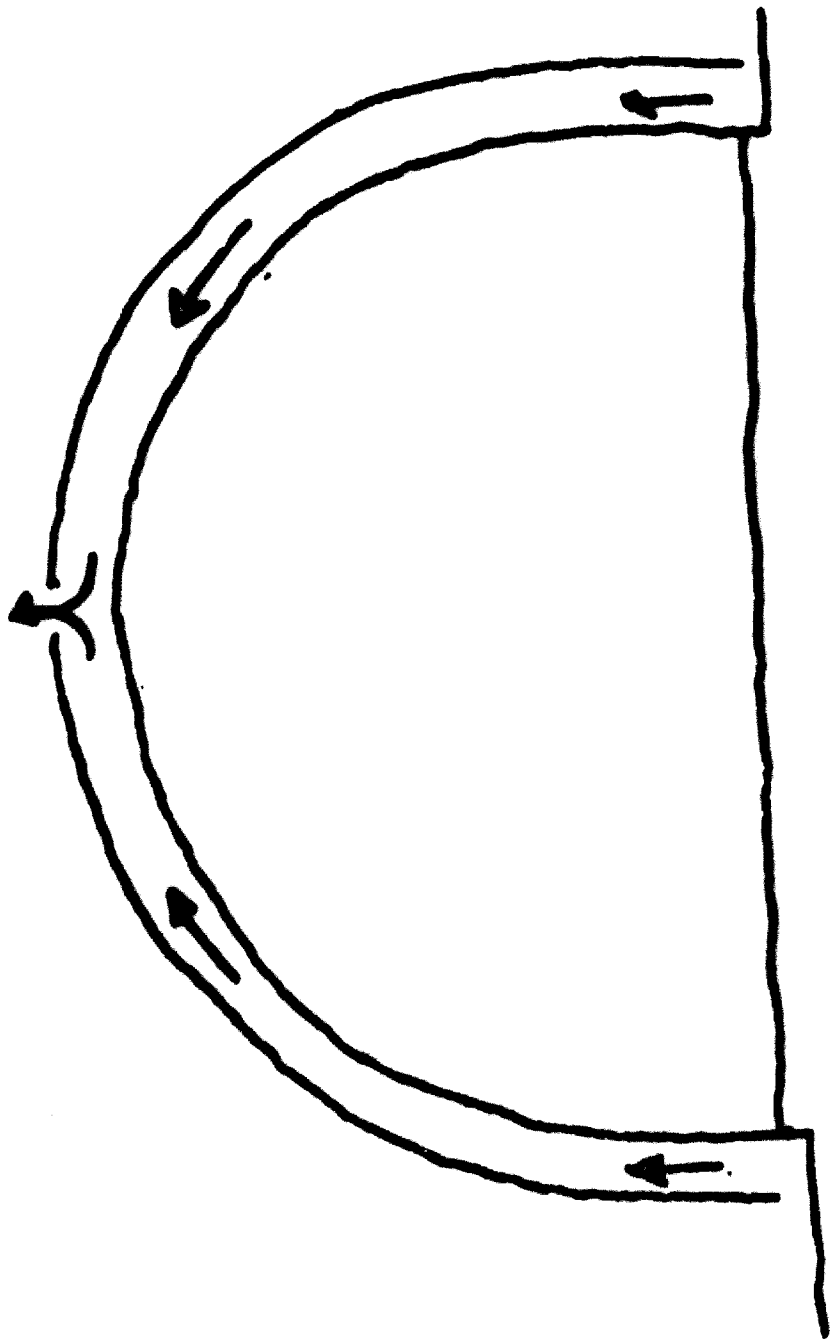


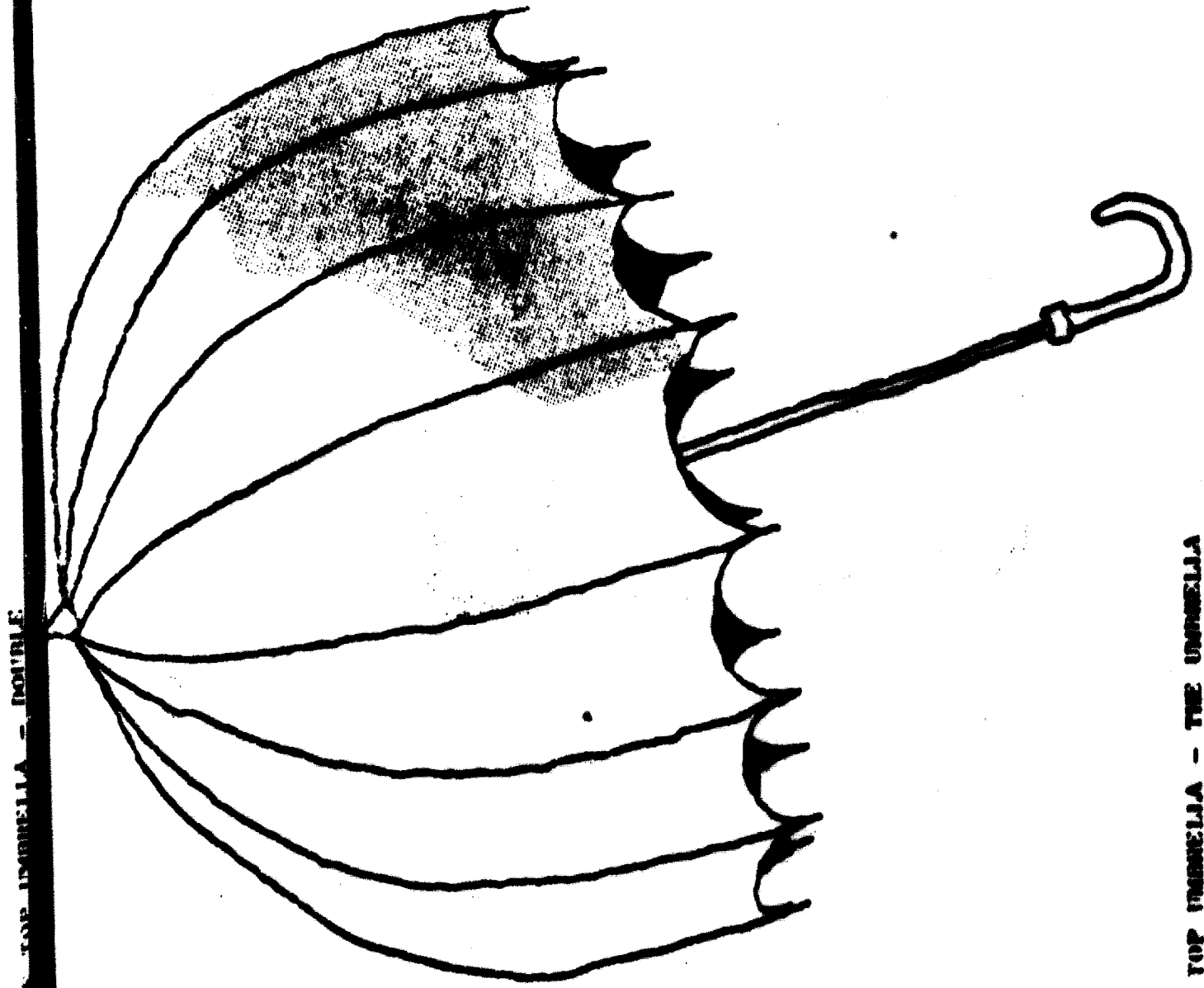


SERVICE FRAME - INDIVIDUAL HOUSEHOLD



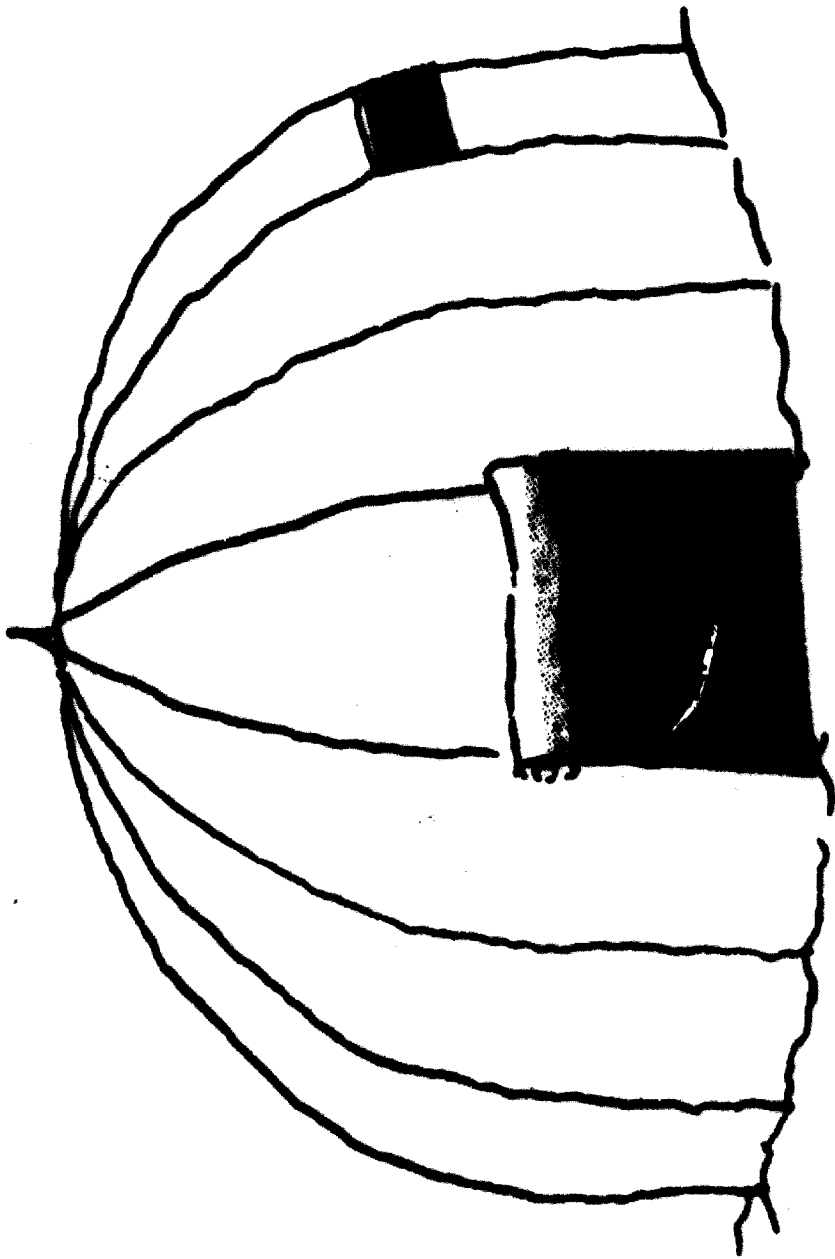
PLAN OF HOUSE - HOUSE PLAN





DOUBLE TOP UMBRELLA - UMBRELLA

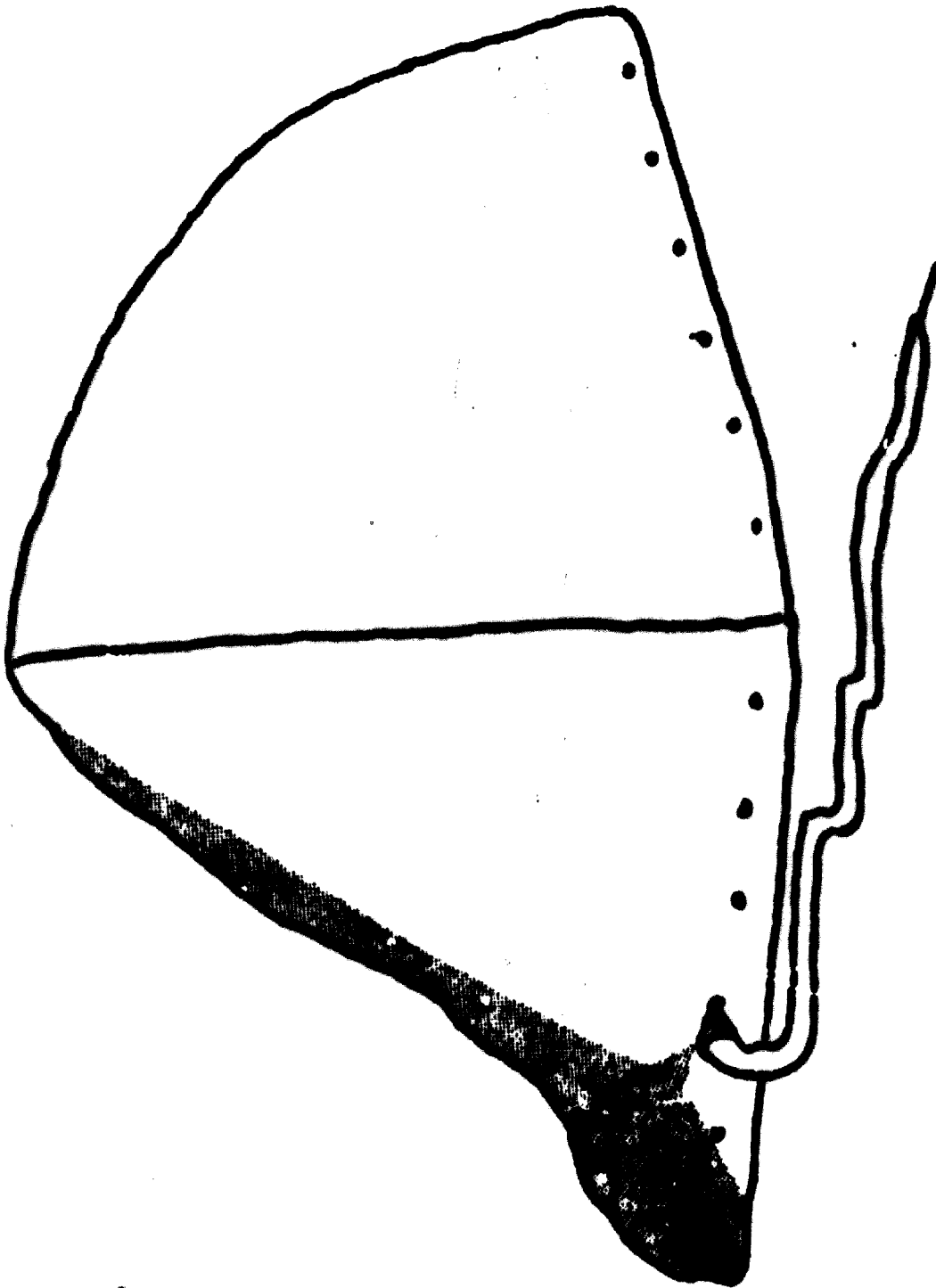
2.2 THE DOUBLE UMBRELLA - THE UMBRELLA



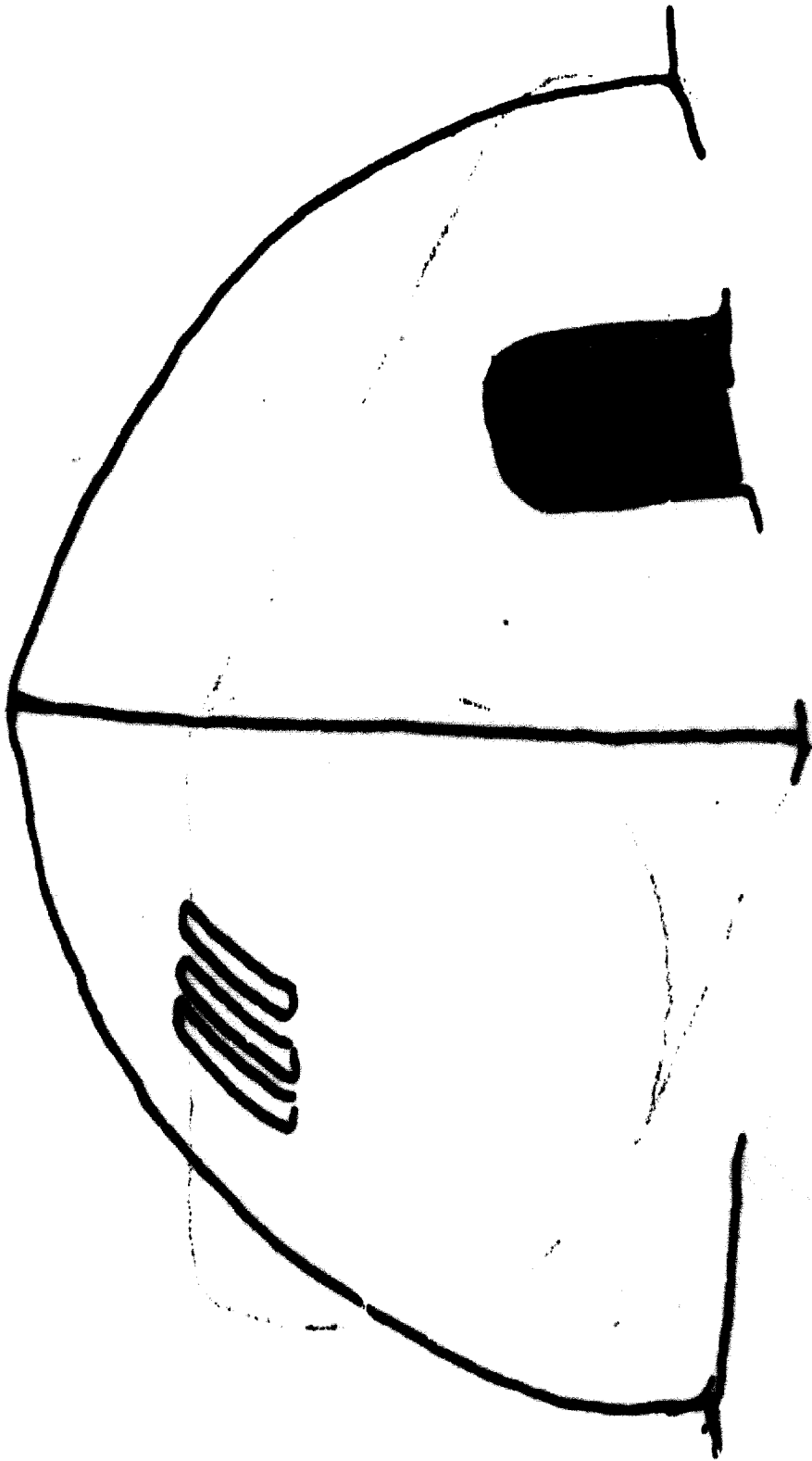
2-3 THE DOUBLE BUBBLE TOP UMBRELLA - BUBBLE TOP



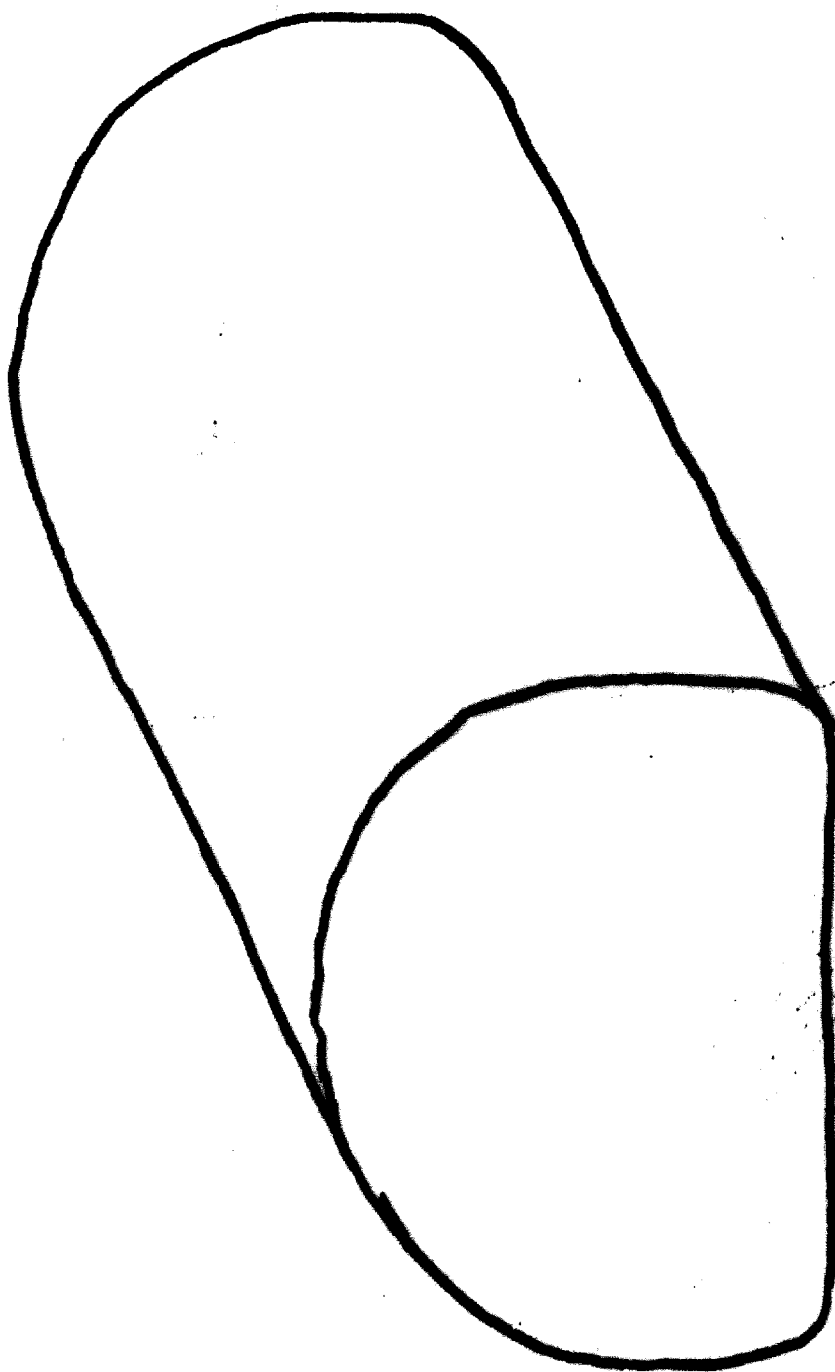
3.1 showing the film pill. The man - at the site



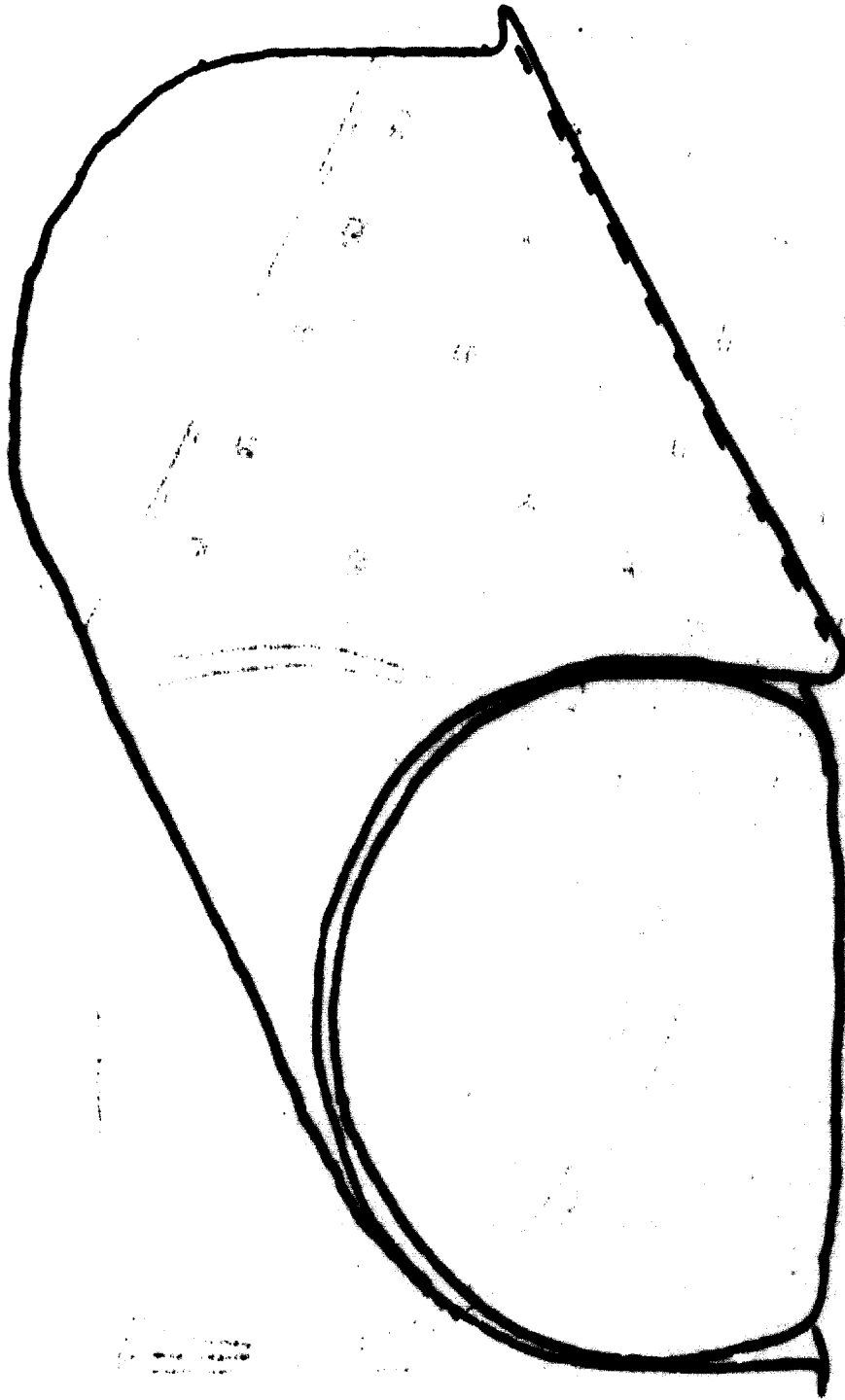
4.2 BRING THE FILM FILL THE FOAM -- INFLATING



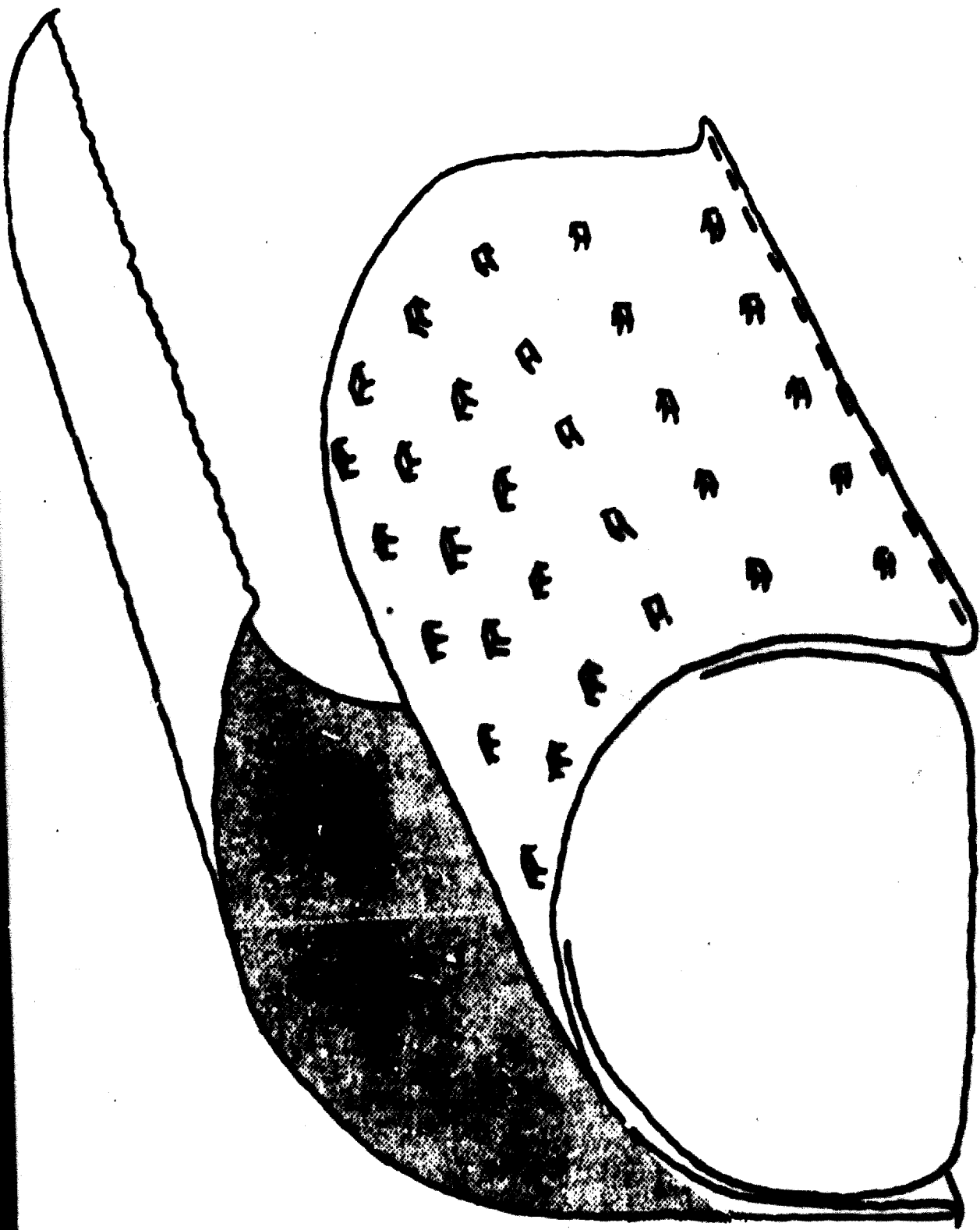
1.3 BRING THE FILM FILL THE PUNCH



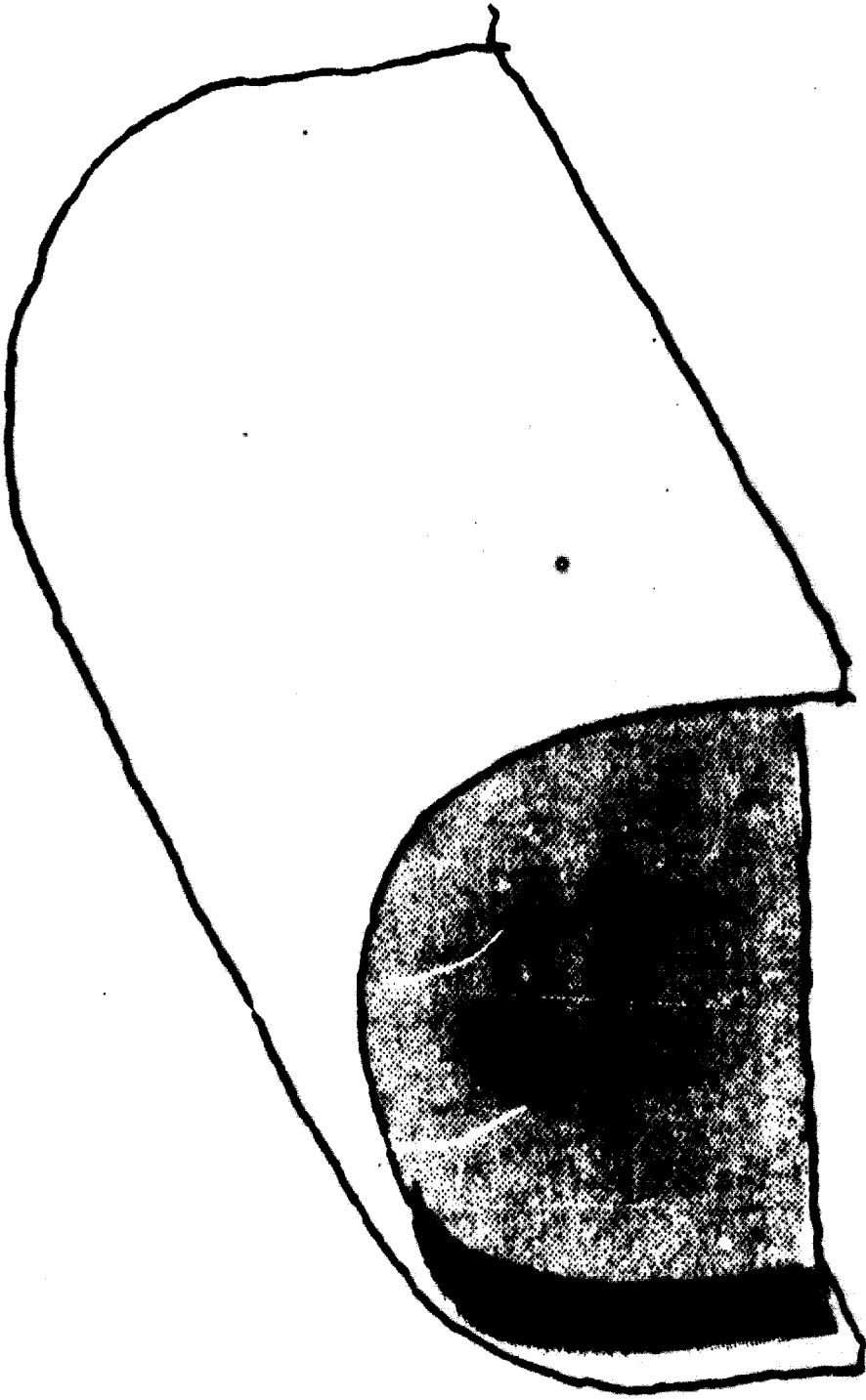
4.1 CORRUGATED VAULT - THE INFLATED BALLOON



1.2 FIRE CORRUGATED VAULT - PLASTIC FILM

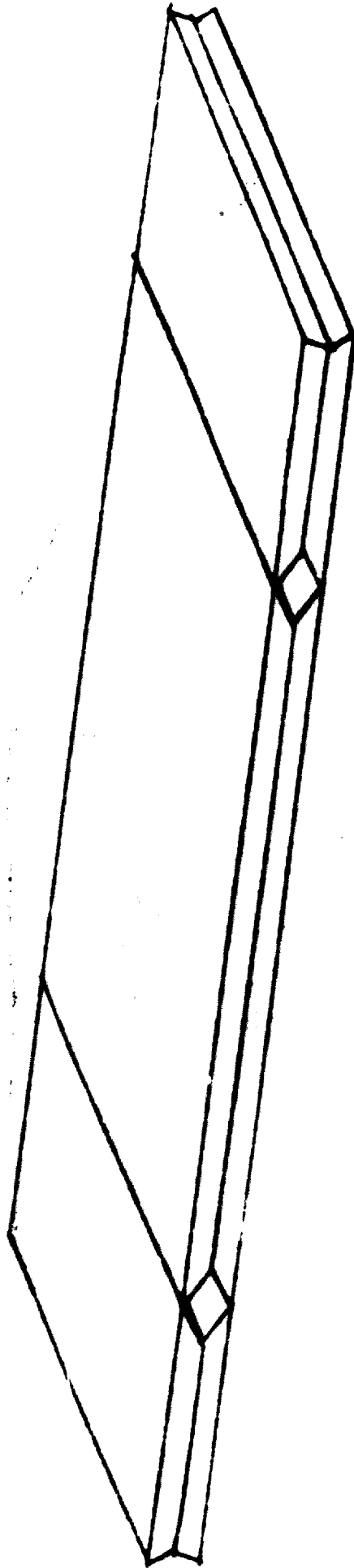


CELLULOSE



1.1 310 CORRUGATED VAULT - COMPLETED SHELLS WITH FOAM AND GALLS

NON-CORRUGATED VAULT - SELF-SUPPORTING CURVES



6.1 COLLAPSIBLE HOUSE A MOLDED SANDWICH CONSTRUCTION - THE FOLDED PACKAGE AT TRANSPORTATION

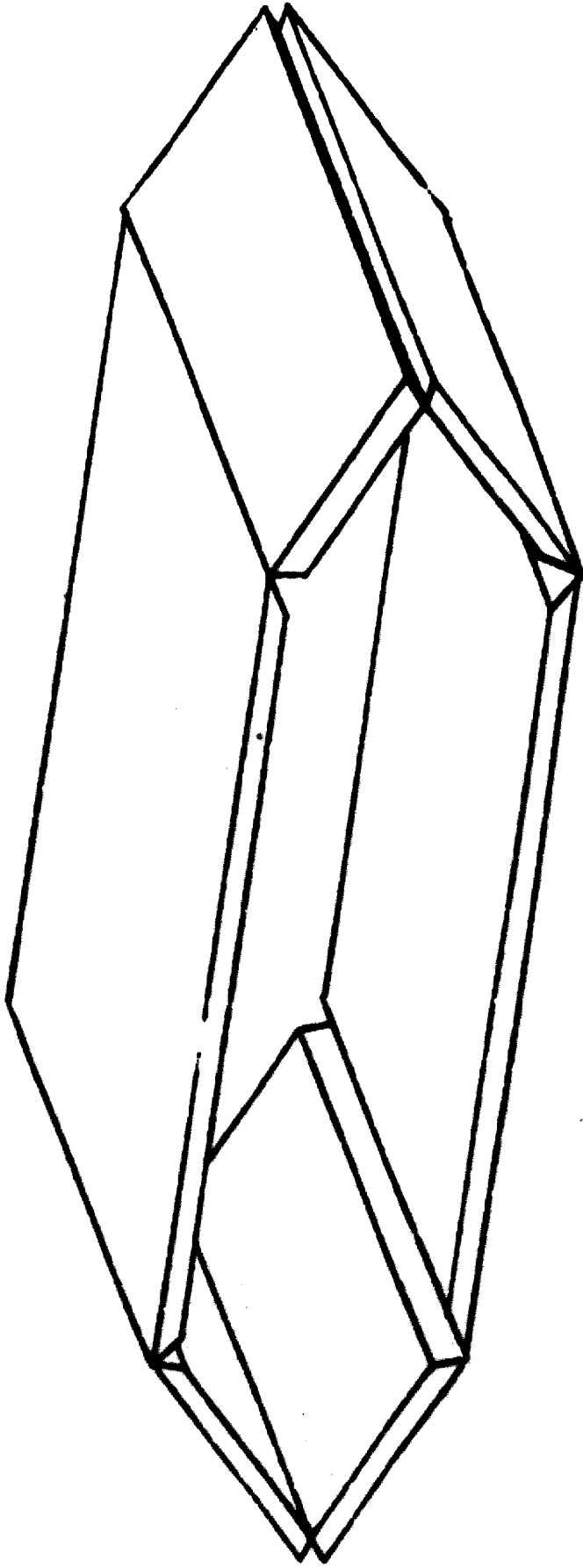
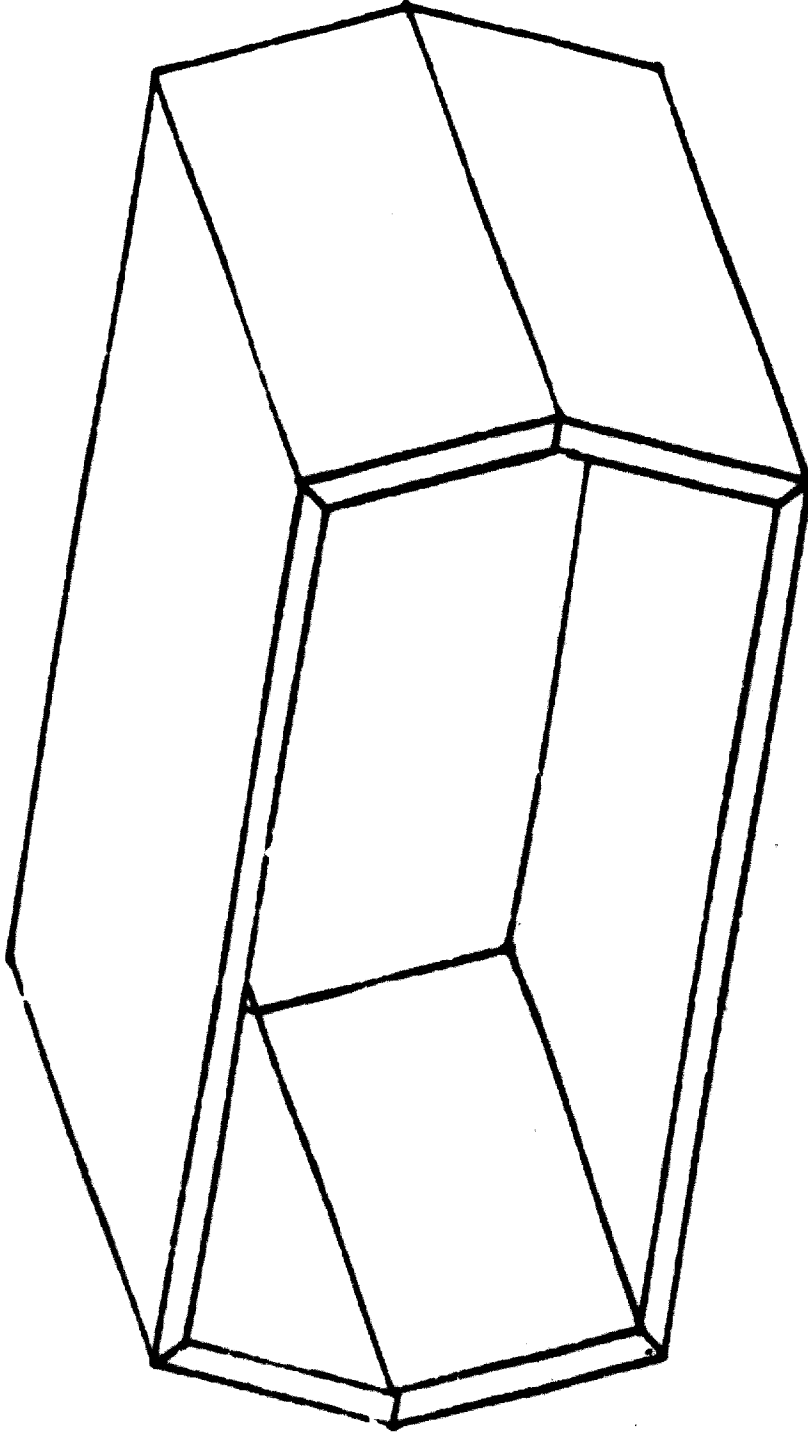
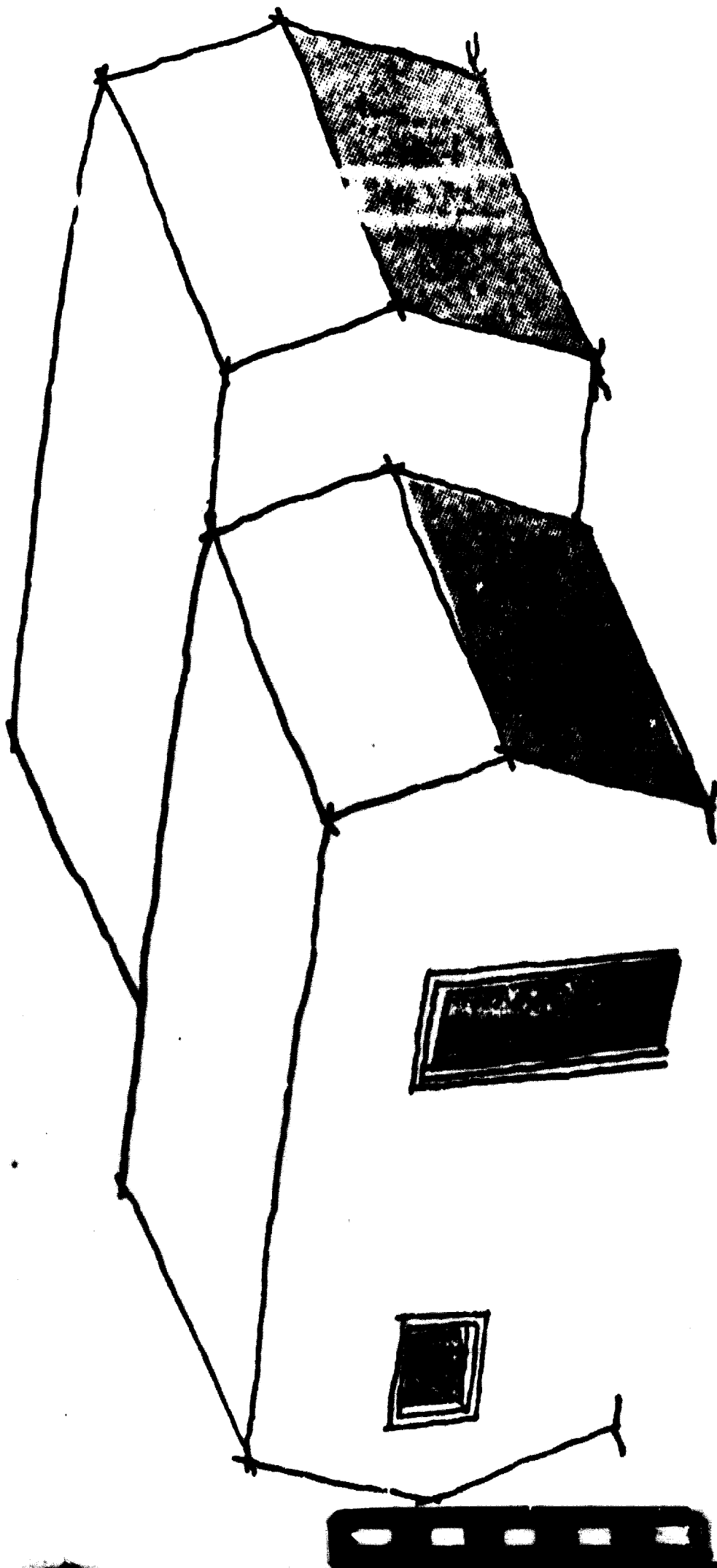


FIG. 2 COLLAPSIBLE HOUSE: A MOULDED SANDWICH CONSTRUCTION - AT ERECTION ON SITE



6.3 COLLAPSIBLE HOUSE. A MOULDED SANDWICH CONSTRUCTION - THE SECTION COMPLETED



6.4 COLLAPSIBLE HOUSE A MOULDED SANDWICH CONSTRUCTION - EXAMPLE OF HOUSE MADE OF TWO SECTIONS



4. 2. 74