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Less Smoky Rooms

by Andreas Bachmann

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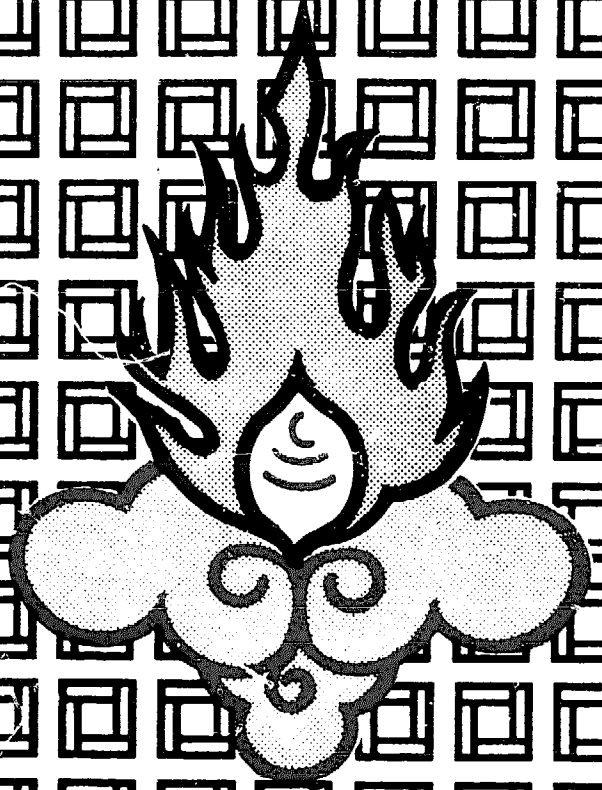

LESS SMOKY ROOMS

LESS SMOKY ROOMS

WITH WOOD-FIRED STOVES

FOR:
- COOKING
- ROOM HEATING
- HOT WATER PRODUCTION

With the help of improved stoves
and proper chimneys

IMPROVEMENT OF LIVING STANDARDS

THROUGH:
- LESS SMOKY ROOMS
- FUEL EFFICIENCY
- SAFETY

With special reference to the Himalayan region
(Bhutan and Nepal)

ANDREAS BACHMANN

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FOREWORD

Thanks to the late Rev. B.R. Saubolle -who was a pioneer in these mini technologies- several of his experiences could be included in this booklet: taken from an earlier publication: Mini Technology, I + II. Other solutions shown in this volume were collected from different places, mainly from Nepal and Bhutan, but also from previous activities in Switzerland.

Not so many years ago wood fired devices were considered as "old-fashioned" utilities. Yet it is recognized that most of the world's population is dependent on them. This will remain unchanged for many years.

Many countries are worried about their fuel supply for cooking in near future. One solution is the conservation of existing resources. With fuel wood this means energy-saving devices, e.g. doing the same job but with less fuel consumption. Charcoal stoves are not being covered in this booklet. One reason being that quite a lot of information is already available, another is that normally practizided charcoal production in developing countries is a wasteful, fuel-inefficient process. Realizing that charcoal is convenient, it will also be hard to stop - even when the environment is severely endangered.

The aim of this booklet is to inform interested persons in possibilities of fuel efficient devices in less smoky rooms. A lot of the information deals mainly with some of the principles to be followed during the *installation* of stoves and chimneys.

It is hoped that the technology of improved devices, properly fitted and maintained, will soon be improved (for reasons of efficiency, function and safety) for many households and small-scale enterprises in urban and rural areas.

INTRODUCTION

With the improvement of life styles, cooking and room heating devices are being changed. This is of considerable significance in countries where wood is the main fuel. Several reasons for this include:

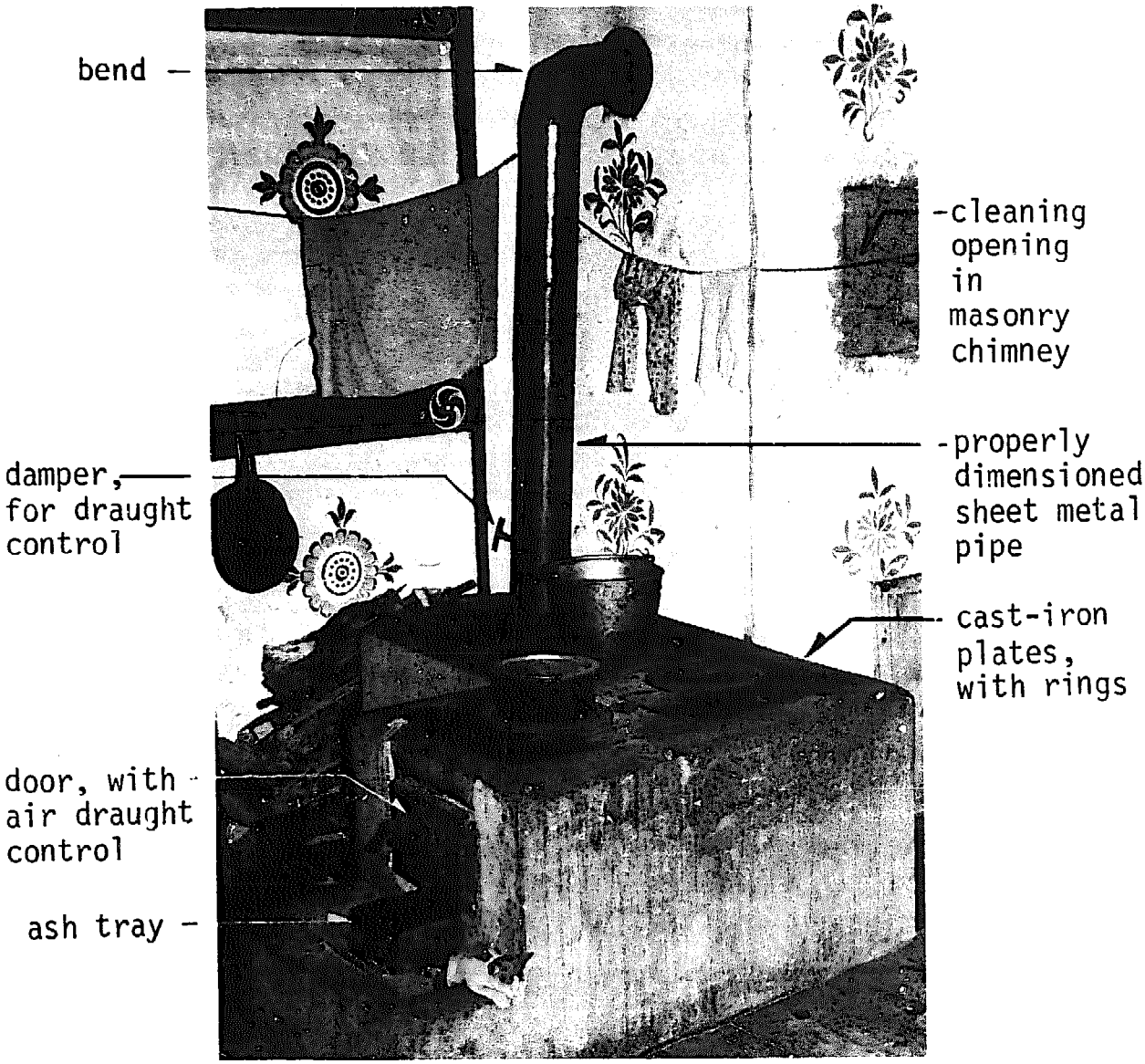
- smoke reduction in rooms
- fuel efficiency of stoves
- fire hazards

During the last few years efforts have been directed towards more efficient and smokeless stoves. Of course, these devices need proper knowledge -to some extent at least- to give satisfactory and safe performance.

Programmes at the national levels mainly take care of the rural family's needs. For this the prefabricated stoves, made of fired clay, have emerged as the most successful solution here in Nepal. Of course, the same device can also be made with rammed earth, or with mud as used traditionally. This stove is locally made, at reasonable cost, quite foolproof, fuel efficient and smokeless and most importantly, widely accepted by many households in rural areas. The activities of rural stove improvement are several years old and more information is available from the organizations involved.

Now people are asking for other improved fuel efficient and smokeless devices. It has also been recognized that for institutions, hostels, etc., larger stoves are required. Now more experiments have been made and new devices are available.

The increasing demand in such new devices not only proves that people are interested in having less smoky rooms and improved fuel efficiency, but also that much can be achieved through direct and practical approaches, local skills and small-scale manufacturers. This technology and its products have aroused interest in many places and in several countries.



A "super cooking stove" in Bumthang, Bhutan. This stove, with its proper installation and incorporated cast-iron parts, provides fast and fuel-efficient cooking in a smoke-free kitchen.

SOLID STOVES WITH CAST-IRON PARTS

Many people in urban and rural areas would prefer to have more convenient and longer lasting stoves. Stoves made of cast-iron have been around for a long while. Cast-iron is a durable material; it can be used for wood and coal firing, and once a pattern has been developed it is easy to produce standard pieces by casting. In Western countries such stoves are available from shops, but since they are solid, they cost quite a bit.

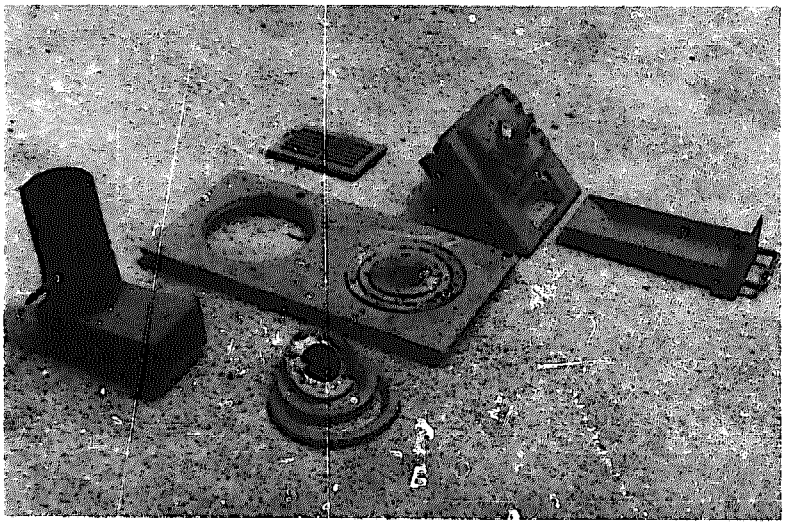
Recognizing the various needs of people it was necessary to develop modules of standard sizes. To start with, one set of cast-iron parts was brought from Switzerland and a prototype stove was made here in Kathmandu. Nowadays it is possible to get "stove construction kits", consisting of necessary metal parts: stove plates with rings, grate with door frame, ash tray, chimney connection with incorporated damper for draught control. These items can be assembled at home by a skilled mason.

Two of these cast-iron sets were taken to Bhutan and firstly installed at Bumthang. At the same time people there also designed a new chimney block, which can be cast at the site with a simple mould made of wood. These blocks have hollow spaces for insulation. The prefabrication of blocks enabled chimneys to be quite quickly constructed and gave very satisfactory performance.

These ideas caught on speadily in Bhutan. Several such stoves and many chimneys were made within a few months. They were fitted at the Forestry Training Centre's main kitchen, staff quarters, as well as in several private homes. People in general are very happy with this convenient stove. It also became obvious, however, that stoves must be supplied with all the necessary parts. For example, at one or two places the ash tray was missing, causing too strong air draught in the stove. This increased fuelwood consumption! It is also important to instruct the owners how to use such stoves properly.

In Nepal several institutions have installed these new stoves; for example, UNICEF-assisted feeder hostels, in Dhankuta at the Community Medicine Auxiliary Training Center (Nepal-Canada Project). Different sizes have been developed to meet the needs of the community as well for domestic requirements.

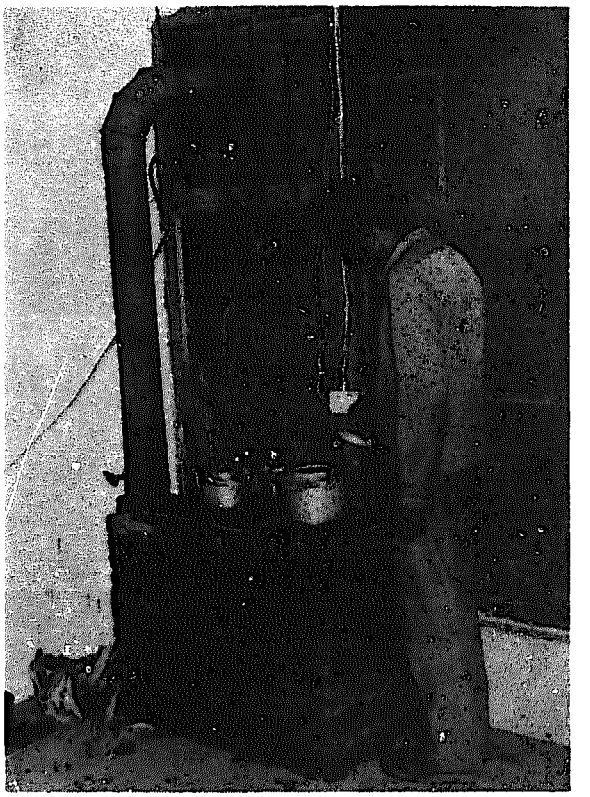
Correct stove installation is vital. Stoves need to be properly located, and need a well designed and carefully constructed chimney. Recently a complaint arrived from Trisuli, where a pilot stove was fitted, that the stove produced too much smoke. After a brief inspection at the site it became clear that the stove and the chimney simply needed cleaning! This was done and the stove again worked properly.



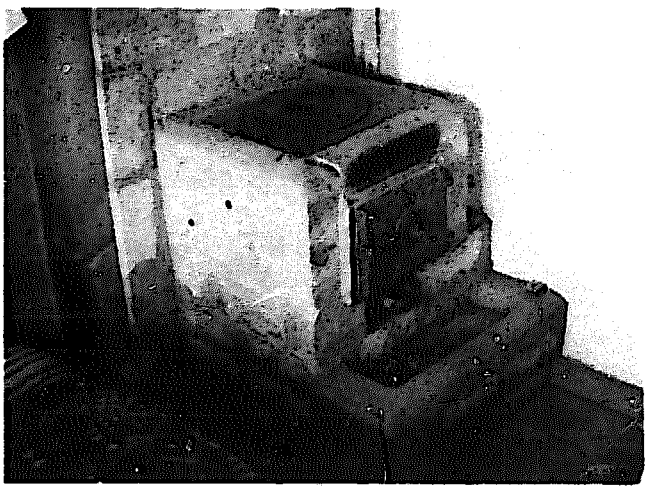
Metal parts for the construction of a cooking stove, as developed by the National Structure & Engineering Co., in Patan Industrial Estate, Kathmandu.

The cast-iron modules can be assembled in many different ways. In addition to cooking, there are also possibilities to have hot water from a small container, a baking oven, or a system to provide hot water from the tap. This all provides more convenience for cooking with wood, and longer lasting stoves! Certainly, such metal parts mean that the initial cost is not low, but they will provide good service for many years.

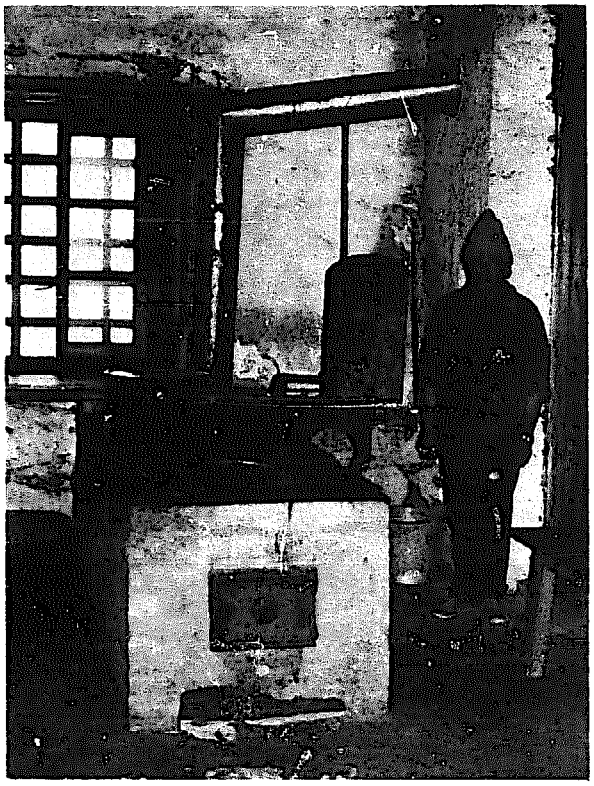
A newly made cooking stove at Bumthang/Bhutan, with cast-iron parts and chimney pipe fitted to masonry chimney.



A demonstration unit at Patan Industrial Estate.

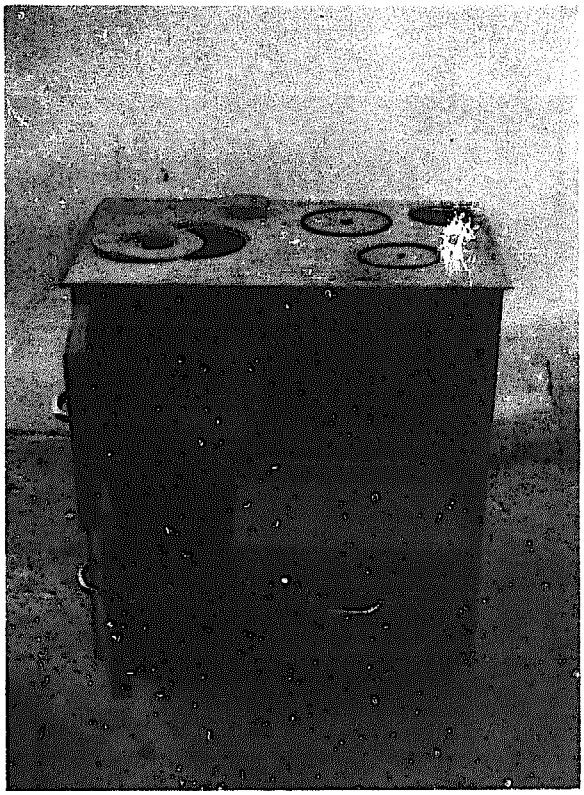


Stove for a single pot; a combination of room heating and little cooking.

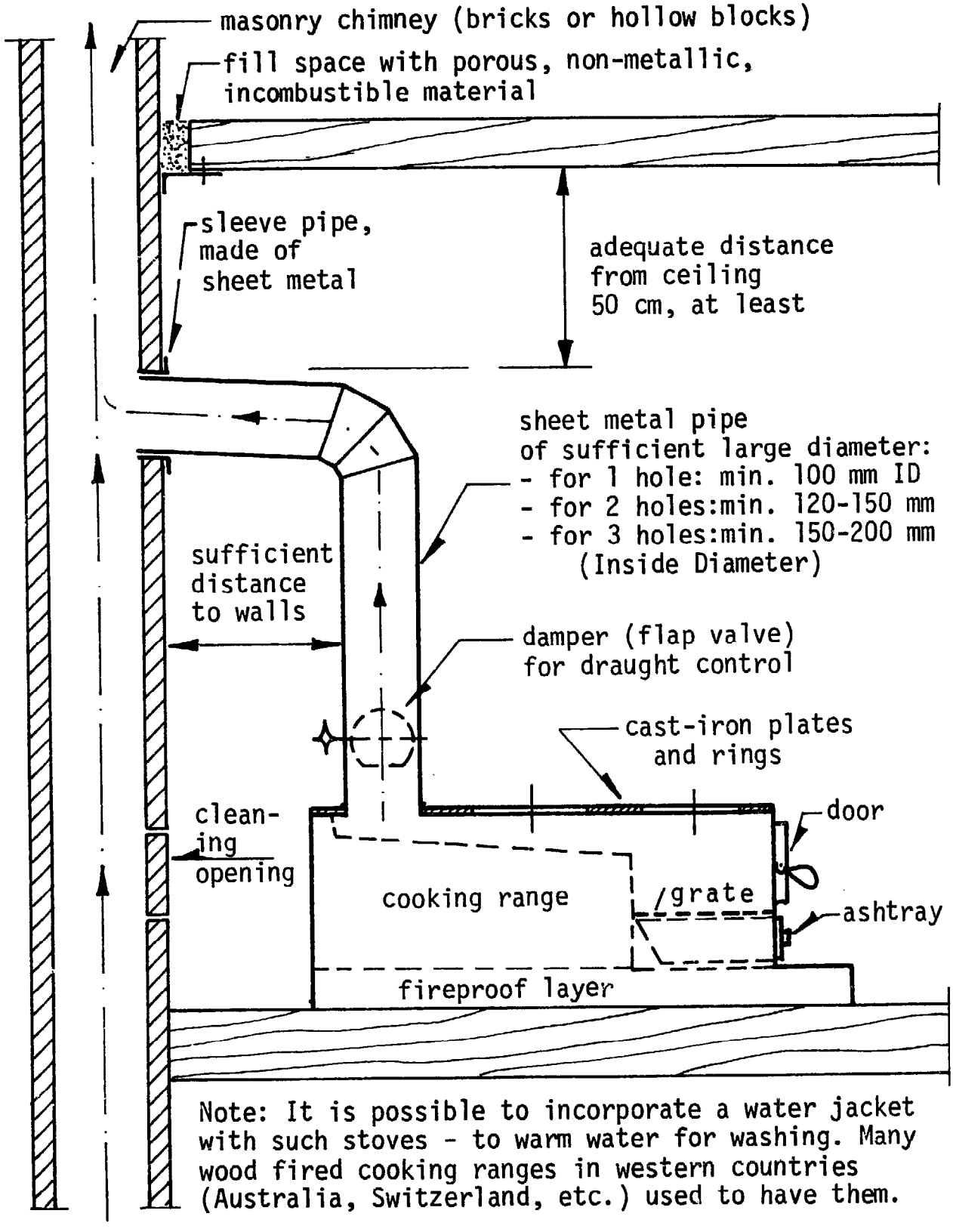


A larger sized cooking range at the Forestry Training Centre in Bumthang. It's cooking capacity is for about 30 trainees, and provides some hot water through a hot water jacket, incorporated in the stove. The hot water container is in the corner.

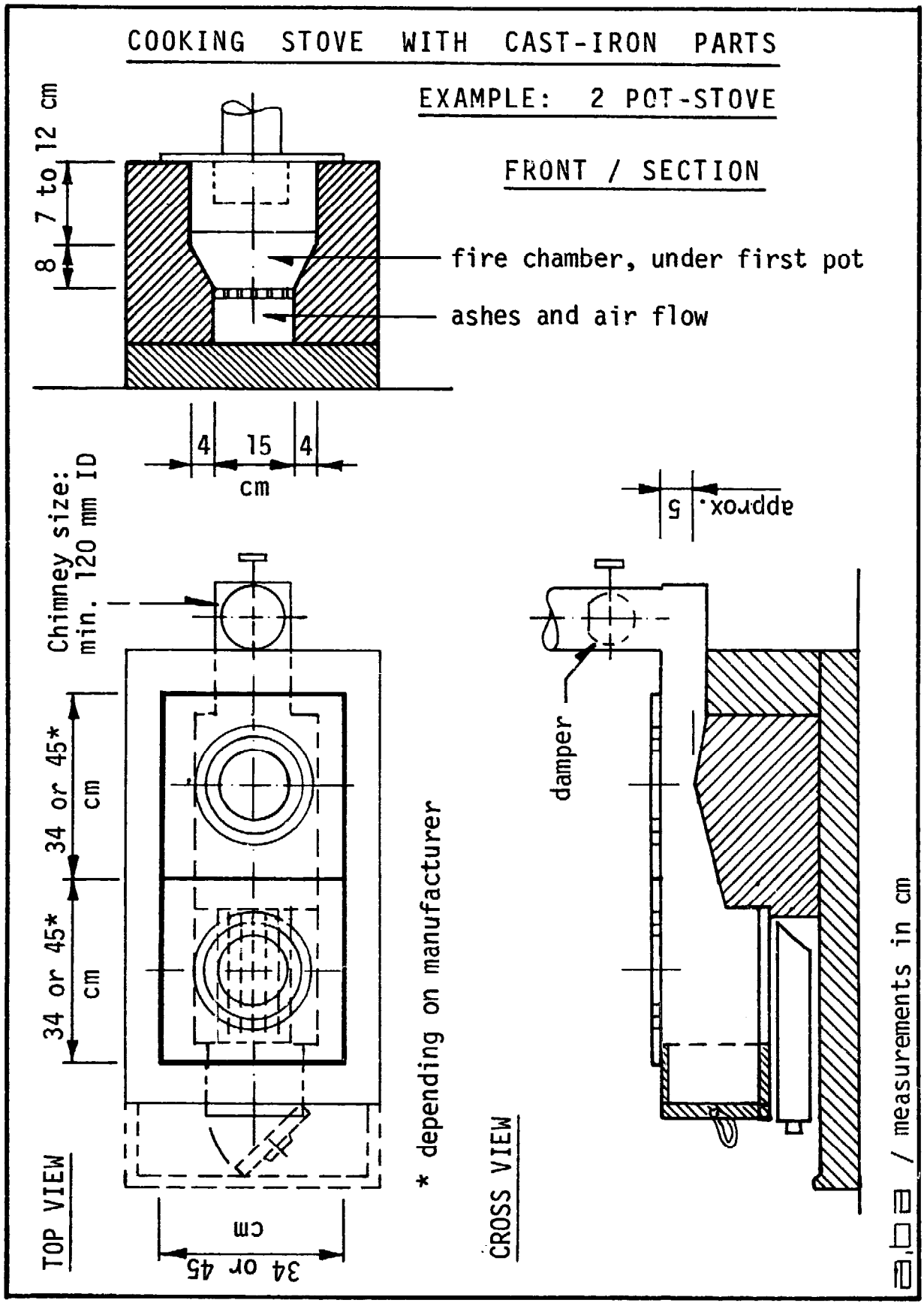
A prototype construction of an advanced cooking range, with baking oven, developed at the Kharbandi Technical Training School in Phuntsholing.



COOKING RANGE INSTALLATION (SAMPLE)

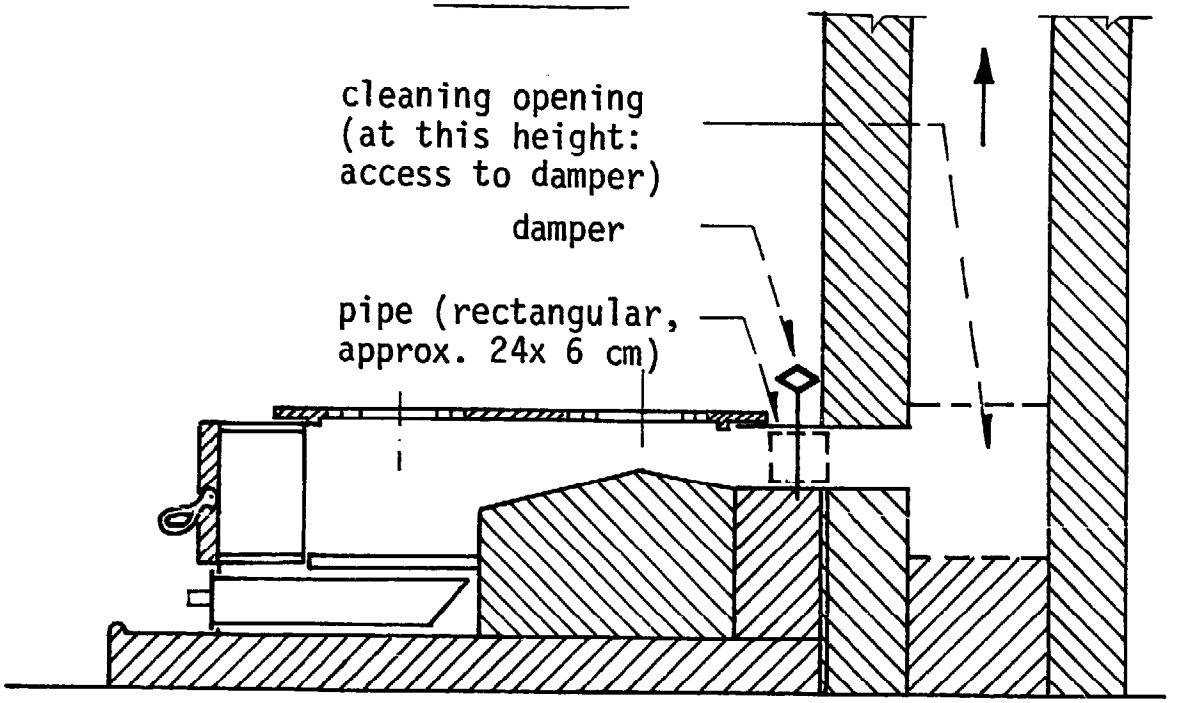


Note: It is possible to incorporate a water jacket with such stoves - to warm water for washing. Many wood fired cooking ranges in western countries (Australia, Switzerland, etc.) used to have them.

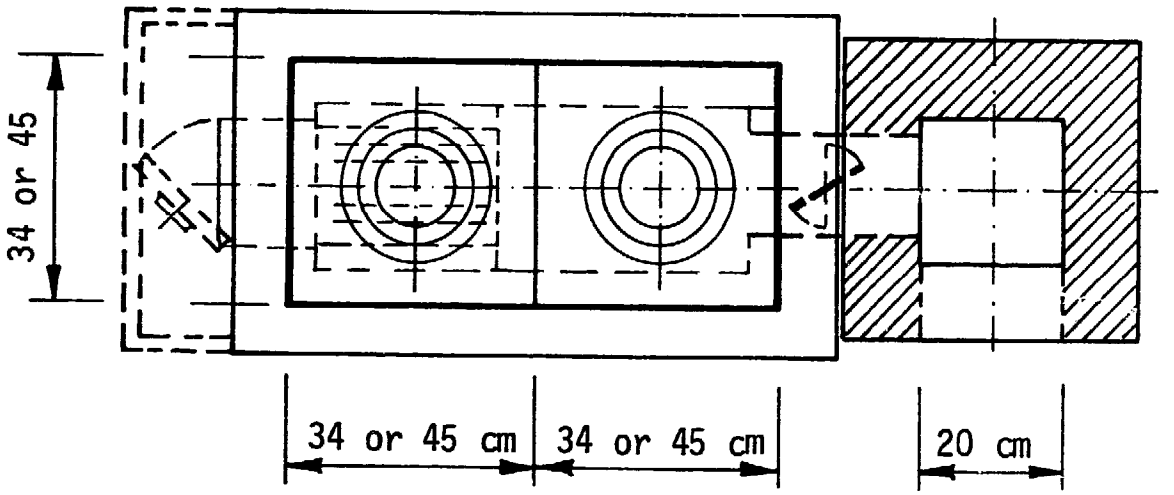

COOKING STOVE WITH CAST-IRON PARTS
EXAMPLE: 2 POT-STOVE
FRONT / SECTION
8
7 to 12 cm
fire chamber, under first pot
ashes and air flow
4
15
4
cm
approx. 5
Chimney size:
min. 120 mm ID
34 or 45*
cm
34 or 45*
cm
damper
TOP VIEW
CROSS VIEW
* depending on manufacturer
measurements in cm

COOKING STOVE WITH DIRECT CHIMNEY CONNECTION

SIDE CROSS



TOP



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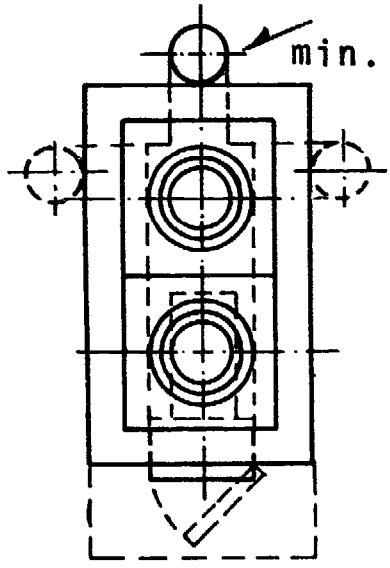
COOKING STOVE WITH CAST-IRON PARTS

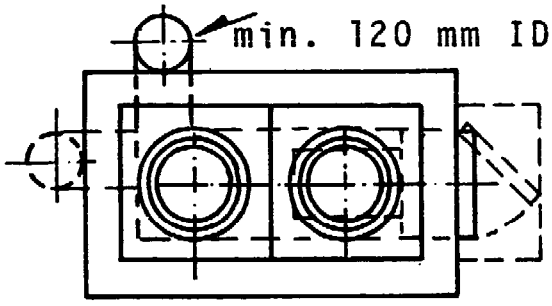
TOP VIEWS

TWO POTS STOVE

"FRONT FEED"



"RIGHT SIDE FEED"



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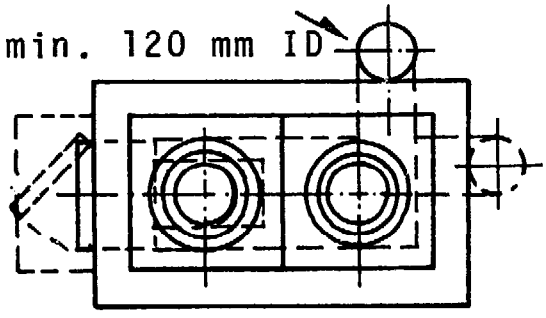
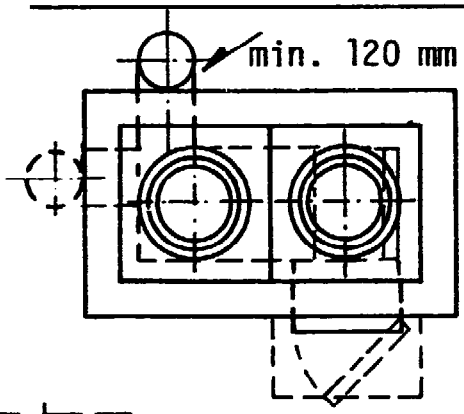


"FRONT / RIGHT FEED"



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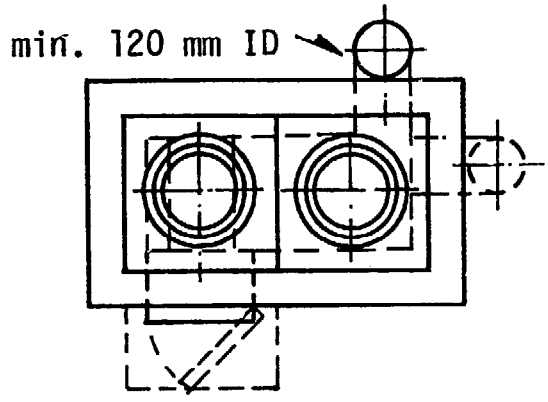

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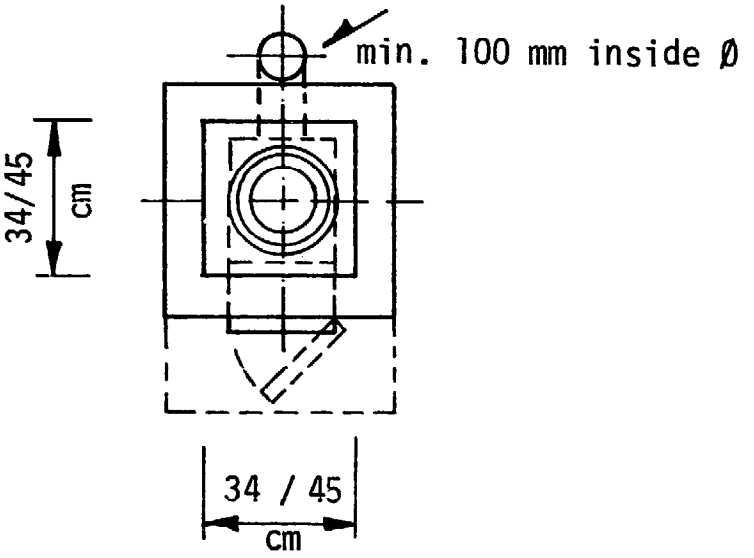
COOKING STOVES WITH CAST-IRON PARTS

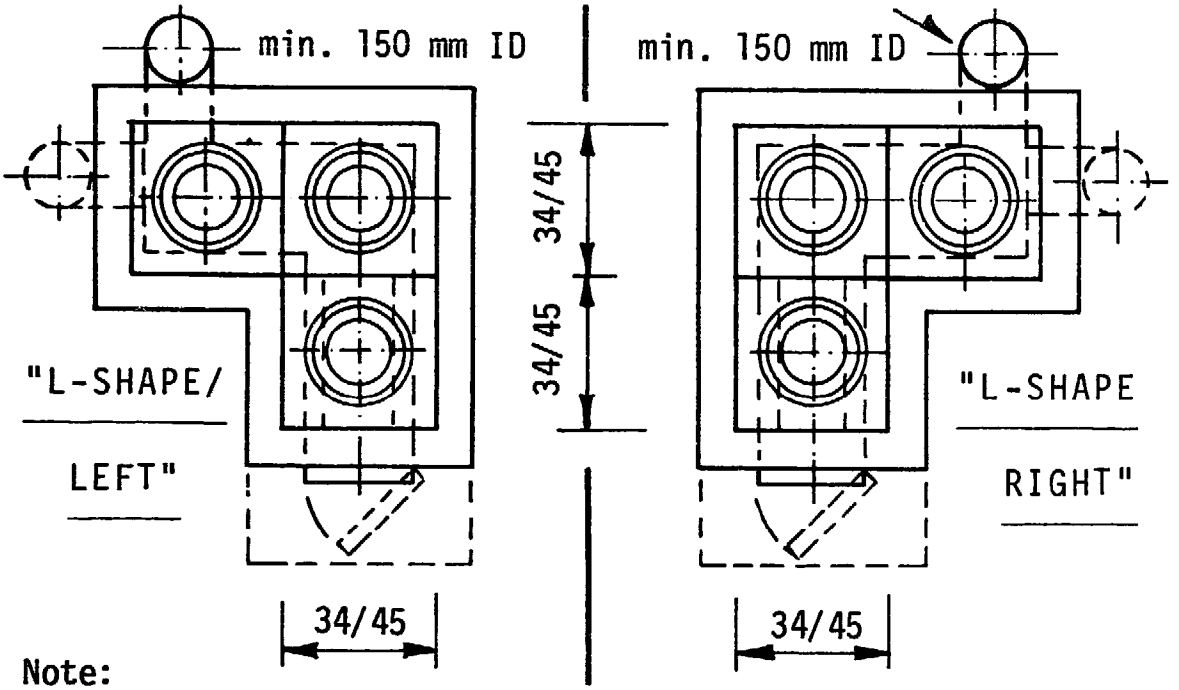
TOP VIEWS

SINGLE POT STOVE



Note: sizes of cast-iron parts depend on manufacturers' supply

THREE POTS STOVES



Note:
Three pots stoves can also be made in a straight line (in the same way as the two pots stoves). The third hole serves mainly for lower temperature cooking.

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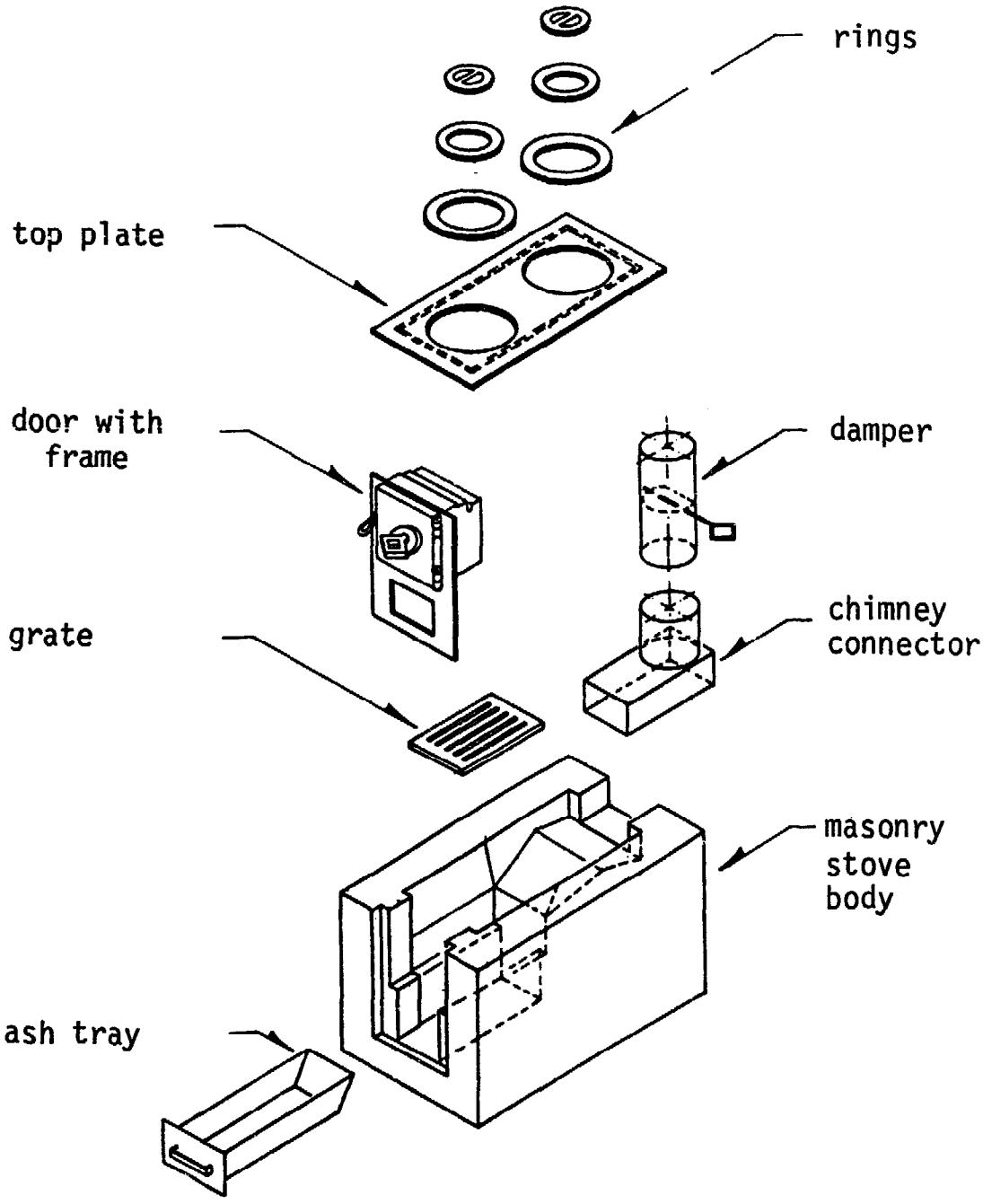
COOKING STOVE WITH CAST-IRON PARTS

EXPLODED VIEW



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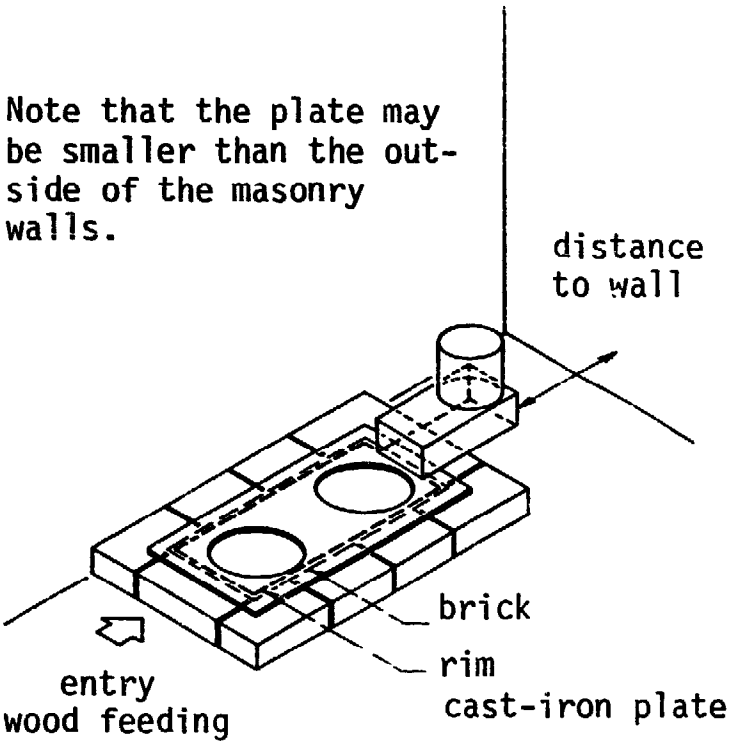
CONSTRUCTION OF STOVE WITH CAST-IRON PARTS

STEP ONE

Have all the materials ready for the stove construction: cast-iron parts and construction materials. (e.g. bricks and mud)
The measurement of the foundation depend on the cast-iron top plate. First, place the plate on the floor, together with the smoke-exit piece and arrange the masonry work. Figure out where the door will be fitted, (it should be positioned in line with the center of the first cooking hole.

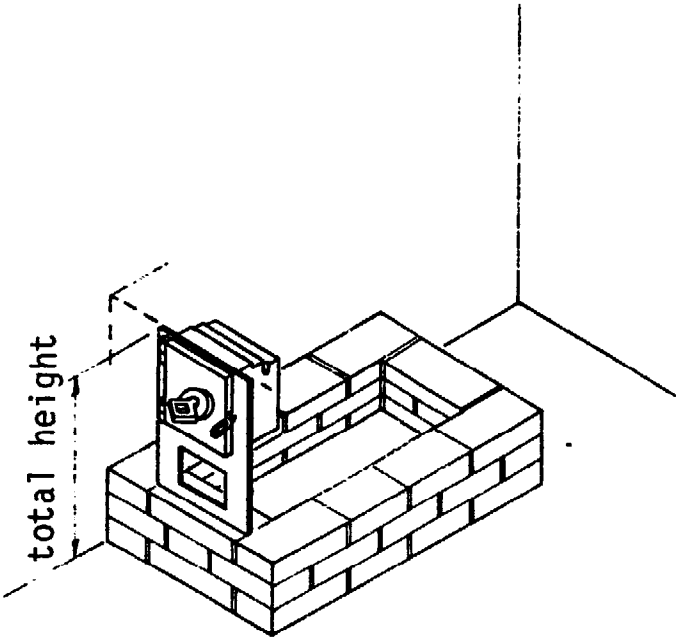
Note that the plate may be smaller than the outside of the masonry walls.



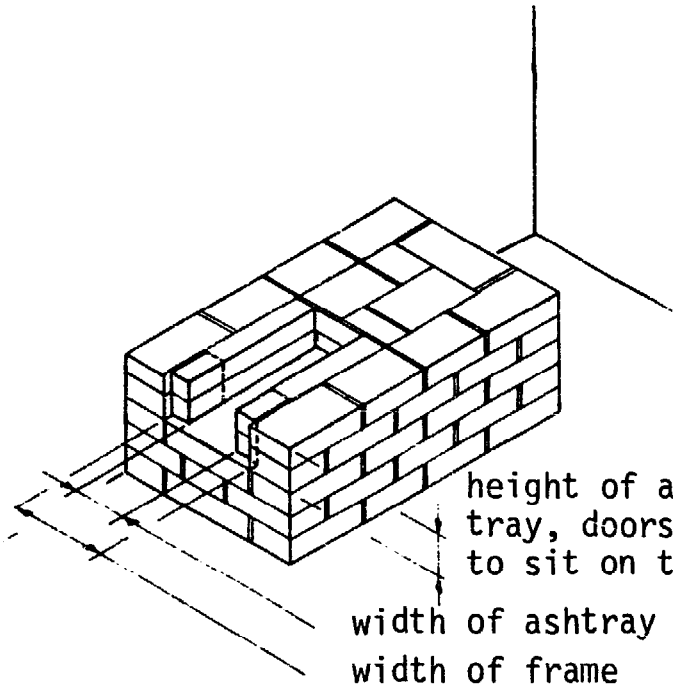
STEP TWO

After the first layer of bricks is placed estimate the final level of the top of the stove.

Build up as many bricks as needed and fill in the space inside the walls with bricks, stones, up to the same level.



CONSTRUCTION OF STOVE WITH CAST-IRON PARTS



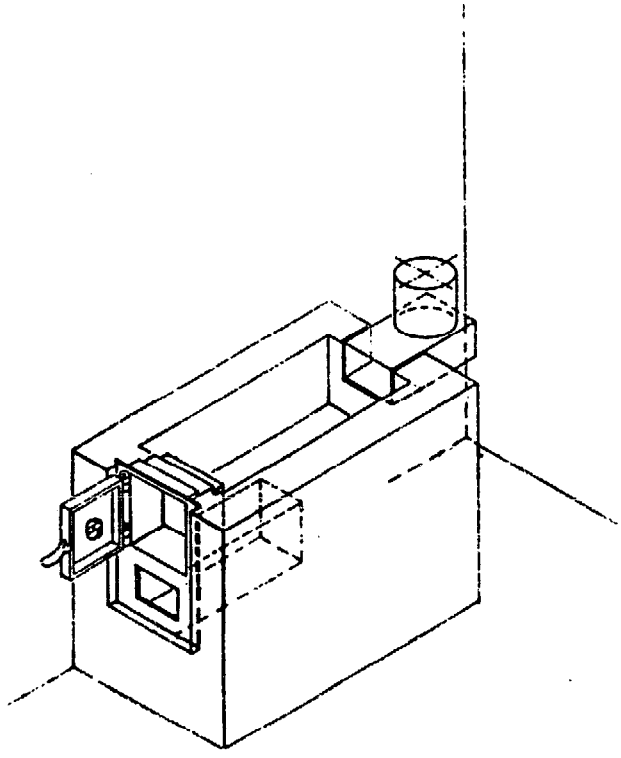
STEP THREE

Place the cast-iron door frame in the structure and make sure it is lined up with the first cooking pot hole. Arrange its support, so that the ashtray will have its proper place, as shown.

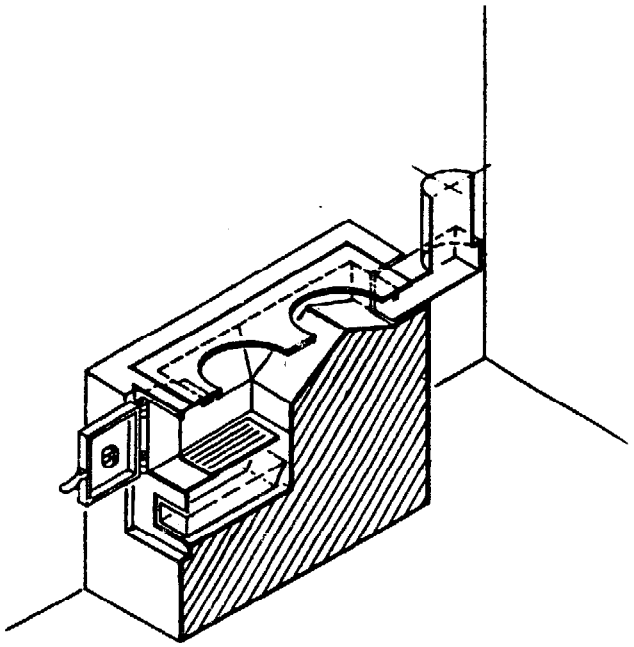
Be aware that the door frame may be inside the front wall construction (so that the top plate will fit into the groove of the door frame - and hold the frame firmly in position).

STEP FOUR

Build the walls to flush with the top of the stove and fix the chimney connector to the end. Place the top plate in position for a trial: the rim on the bottom of the plate should probably fit into the groove of the door frame (this depends on the design of the manufacturer). Then place the fire grate.



CONSTRUCTION OF STOVE WITH CAST-IRON PARTS



STEP FIVE

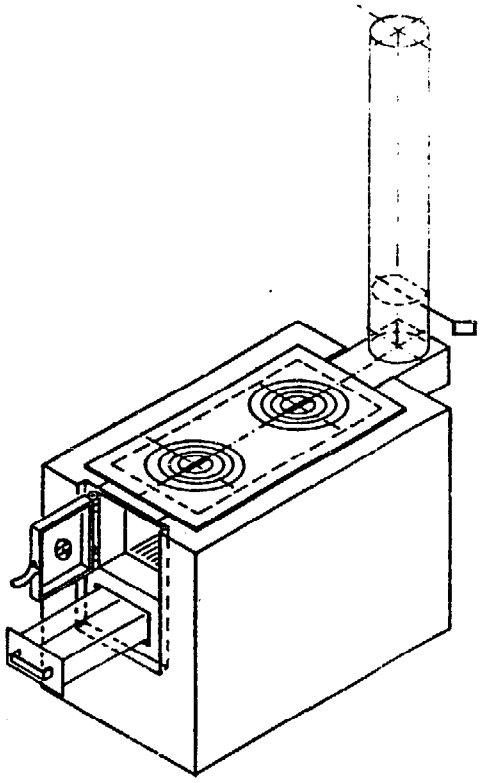
Construct the sides and structure below the second cooking pot hole, as shown. The gap should be approximately 5 cm.

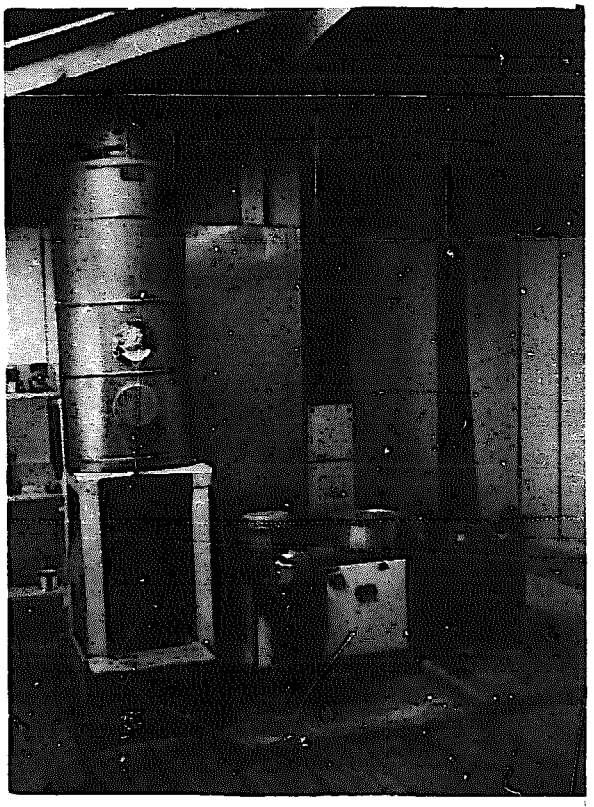
Provide a good layer of mud inside the stove, as usually done in traditional stoves.

STEP SIX

Provide a finishing layer to the outside (cement plastering), and connect the stove to the main chimney.

Before the first cooking is done the structure needs to dry for a few days. for a few days.



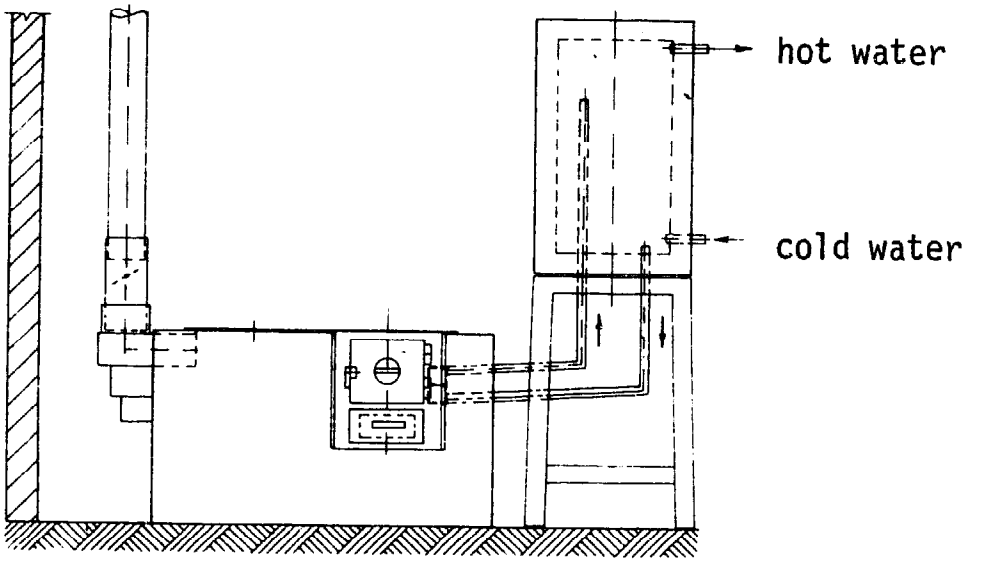


Cooking stove combined with hot water production. The heated water circulates by thermo-syphon and water is kept hot in the insulated storage tank. This system has been imported from New Zealand.

A prototype construction of a cooking range with a "water ship" incorporated. The rectangular water tank at the end is heated during the cooking process and conveni-ently provides hot water.

SOLID STOVE WITH CAST-IRON PARTS COMBINED WITH HOT WATER STORAGE TANK

FRONT



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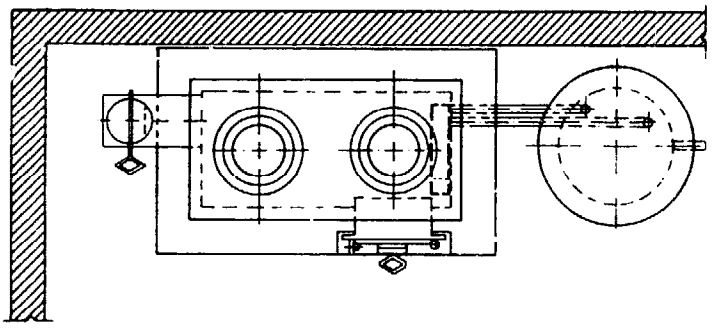
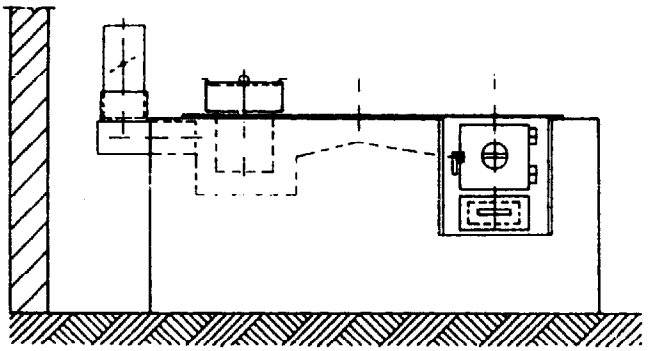


SOLID STOVES WITH CAST-IRON PARTS

WITH HOT WATER SHIP

FRONT



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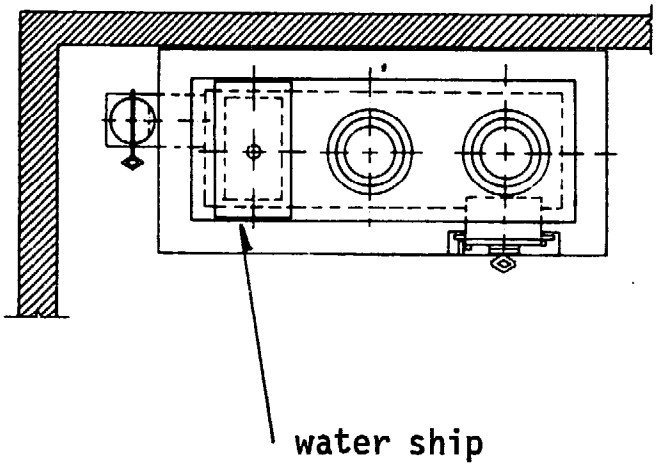
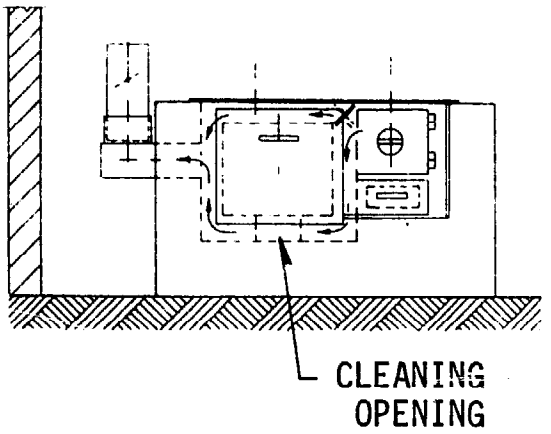


WITH BAKING OVEN

FRONT



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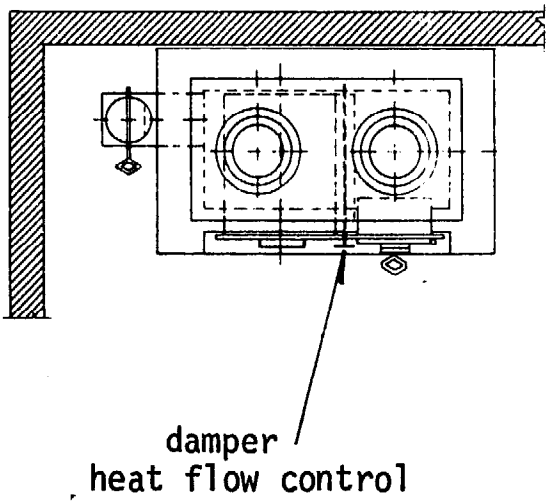


ANOTHER NEW NEPALI CHULO

(Modified "Magan" System)

Although many improved household stoves have been made over the last two decades in Nepal this kind of technology keeps on developing.

The common goals of people involved in improving household stoves are generally the improvement of fuel efficiency and creation of healthier environment for the inhabitants, both human beings and animal. Other goals are the use of local materials, low cost, easy installation, easy understanding of operation and last, but not least, the social acceptability.

The latest designs are based on a traditional technology -the prefabrication of stove components- by local potters and installation in homes by stove constructors.

Improvement to the traditional stove are more efficient internal dimension, a baffle to increase the heat efficiency and a chimney to lead smoke out of the house.

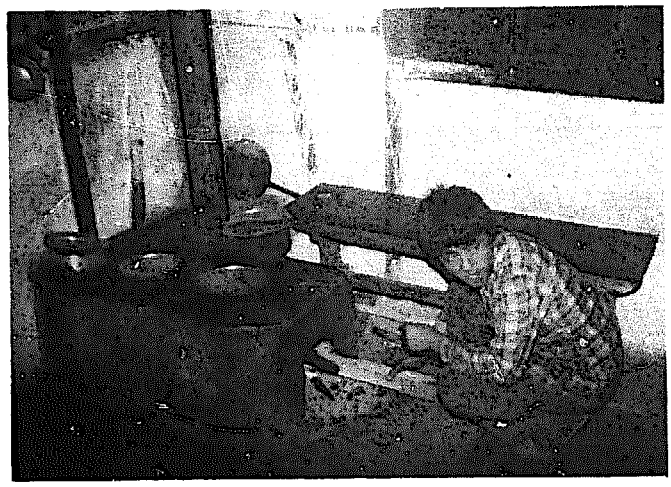
From the outside, the finished, improved stove does not appear different to the traditional stove, because the prefabricated parts are surrounded by local bricks or stones and coated with a layer of red mud plastering. The new stove made from burnt clay parts is three centimeters lower than the traditional stove. This leaves space for a thick toppening of clay, that can be applied in such a way that holes for the cooking pots can be shaped to fit the pots closely.

Such an installation can be completed in a few hours, provided the materials: stove, clay pipes, etc., are made ready in advance. A set of these items costs at present approx. Rs. 100/- (U.S.$ 7/-), not counting the transportation charges.

It is hoped that after the stoves are widely accepted the house owners will then build stronger chimneys of bricks or stones.

The cook will of course have to learn a little to operate these new stoves efficiently. Experience shows that this takes only a few days and that these new chulos are quite acceptable and are being recommended by the users to many others.

It is convenient and efficient to have fired clay parts, but where not available farmers already have copied this design successfully by using mud as construction materials.



After returning from Nepal a member built his own stove with rammed earth in the staff quarters of the Bumthang workshops. The chimney is in the corner.

For efficient and comfortable cooking several points have to be followed:

- Dry wood cut in thin pieces should be used
- Slow cooking process is preferable
- Lids should be kept on cooking pots
- The damper should be closed as far as possible. However, for proper functioning the chimney should be at least handwarm.

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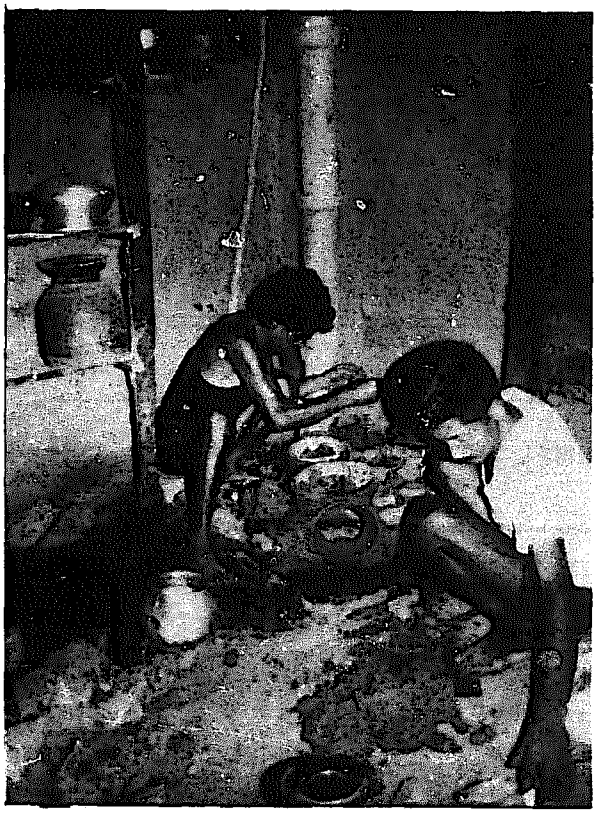
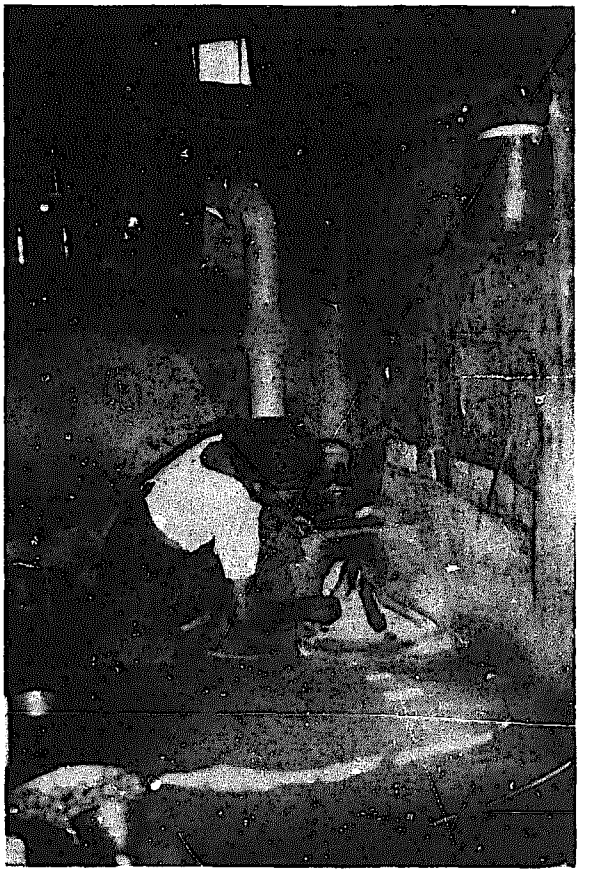
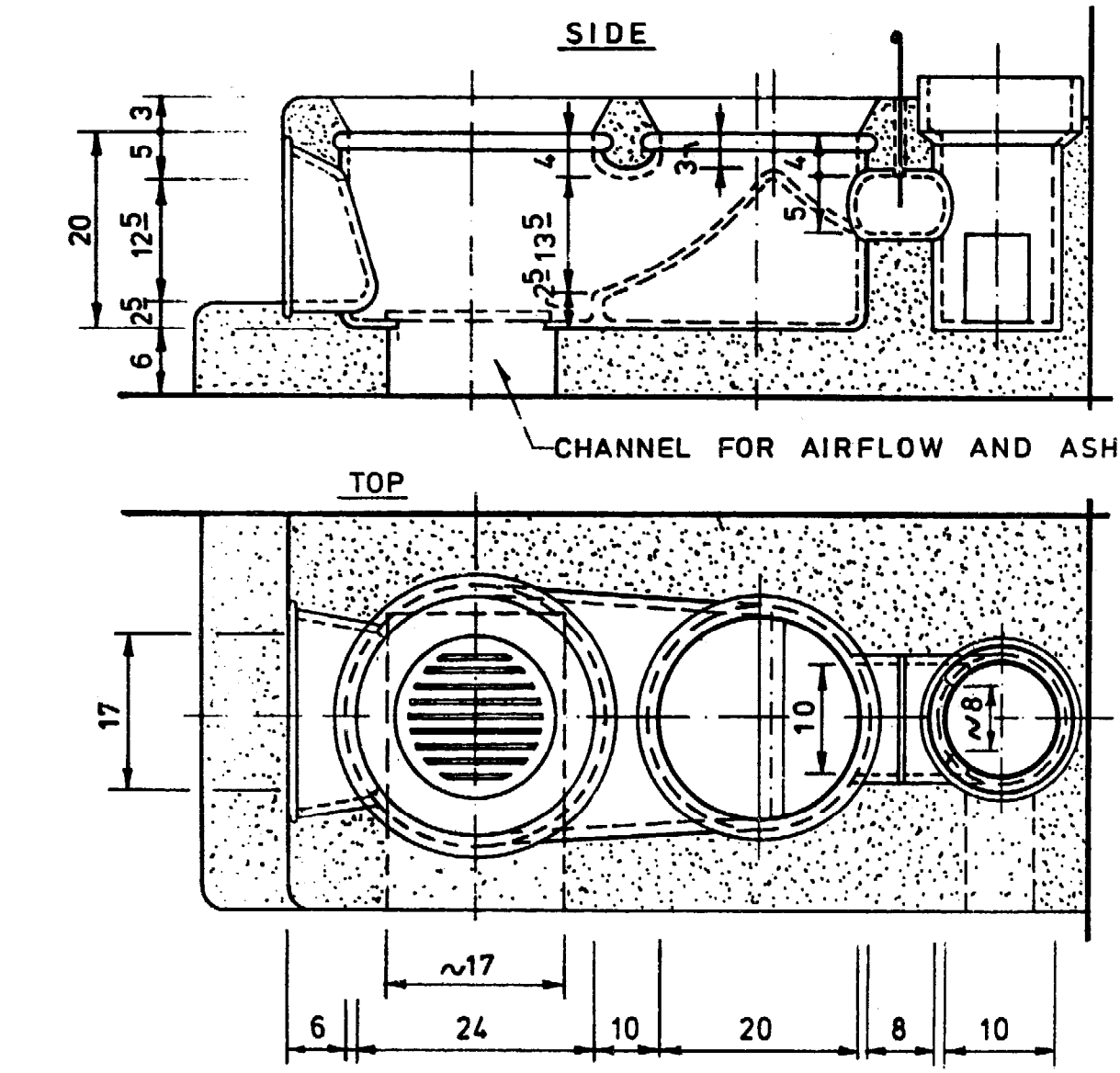
* Further information on such stoves may be obtained from: UNICEF, P.O. Box 1187, Kathmandu/Nepal, ask for booklet: "New Nepali Cooking Stoves".



Installation of a "New Nepali Cooking Stove".



Cooking on a New Nepali Cooking Stove; it is fuel-saving and quite smoke-free.



NEW NEPALI CHULO

(IMPROVED MAGAN SYSTEM)

Construction of an improved cooking stove using bricks for the stove-walls and the chimney.

The interior of the stove is lined with a mud-sand mixture.

Finished stove, with damper and air flow/ ash removal from the side. Note the chimney opening at the bottom for cleaning.

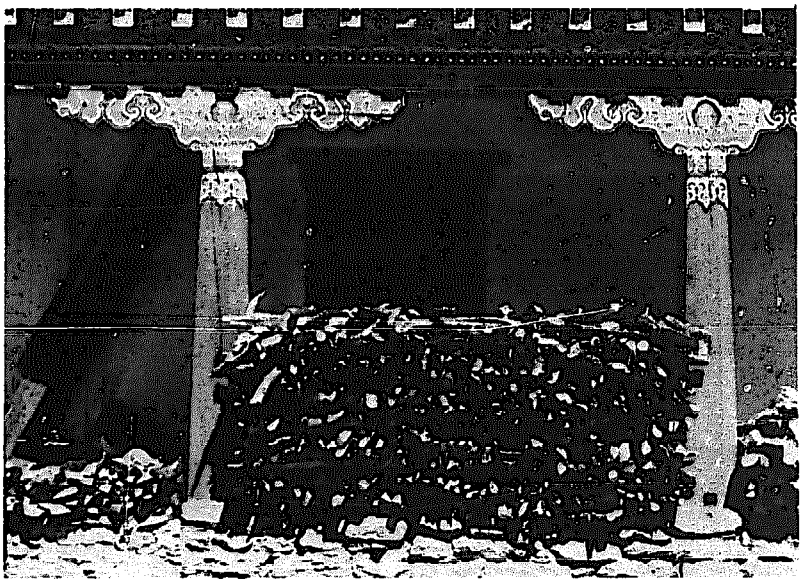
COOKING AND FUEL EFFICIENCY

Beginning to cook on new types of stoves require some small changes in cooking methods. Smaller wood pieces may be required and the cooking process needs a little patience in the first few days.

At the start the damper near the chimney has to be opened fully. Once the fire is burning properly, the front door has to be closed and the damper (flap valve) turned until smokes comes out; then open it a little again. Further adjustments are needed with the ash tray and the air flow from the lower part of the fire box: when completely closed the fire will extinguish. In this way the fuel efficiency can be further increased.

After cooking is completed, the wood can be removed. It is advisable to close the damper and keep all the top holes closed. This way the stove can remain warm for several hours.

Cleaning: The ash needs to be removed regularly, from the ash tray as well from the fire chamber.

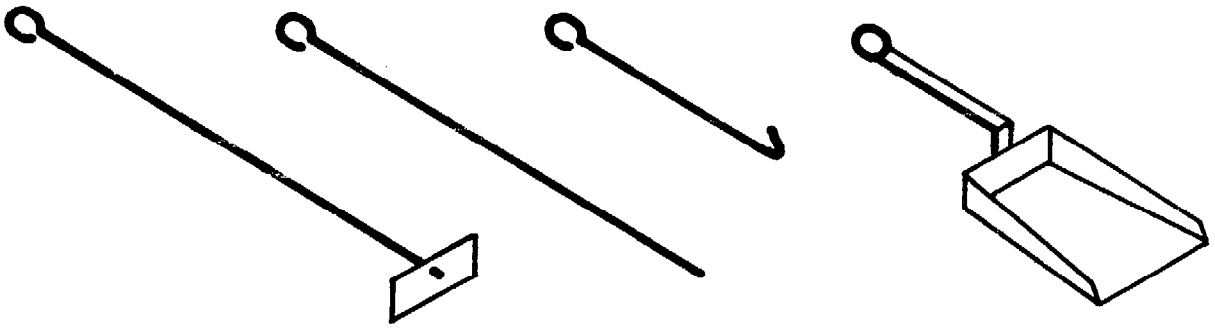


Use dry wood!
Drying at the Lame Gompa in Bumthang.

Operation:

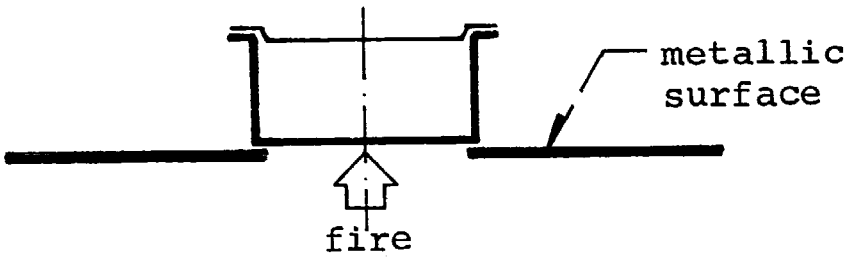
- make sure that the cooking pots sit snugly on the cooking stove.
- keep the damper closed as much as possible.
- use small pieces of wood.
- use dry wood.
- keep the fire small and cook slowly.
- keep covers on the pots.
- use metal pots, and where possible use pressure cookers.
- keep doors and windows closed in cold climates.
- remove ash, charcoal and unburnt wood when cooking is finished, extinguish them with water and keep outside the house in a safe place.
- keep all top holes closed, but on one, place a pan with water, and close the damper after cooking. This will keep the stove warm and warms the water.
- keep the stove and the chimney clean; arrange for regular checks and cleaning.

USEFUL TOOLS FOR STOVE'S OPERATION

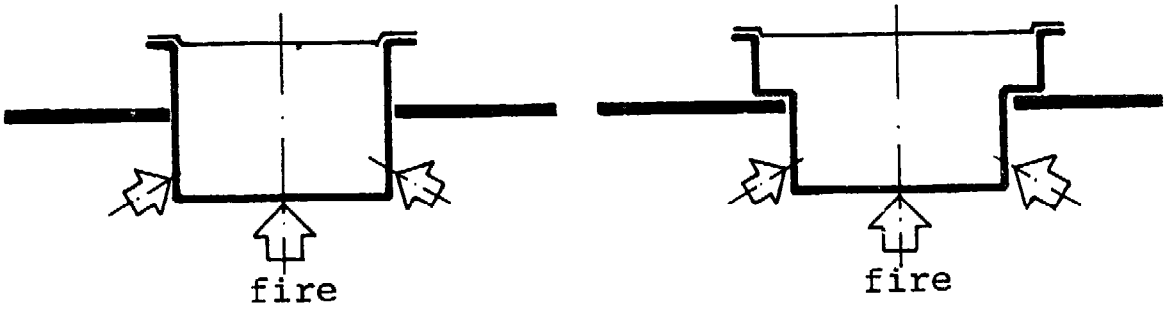


COOKING POTS FOR WOOD-FIRED STOVES

For conveniance and fuel efficiency, it is important to have the kind kind of cooking pots. Nowadays many people are using metal pots. Note that exposed surfaces of pots be kept clean, and tar deposits removed (this acts as a heat insulator).



It is essential that much of the bottom (and possibly also the sides) is exposed to direct heat.

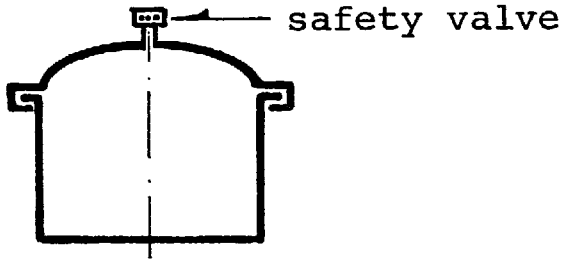


For a smoke-free room and for proper functioning of the stove cooking pots should sit snugly on the cooking stove. It is very useful to have rings, made of cast-iron, to enable adjustment to the different diameters.

-For fuel efficiency keep the top of the cooking pots covered as much as possible.

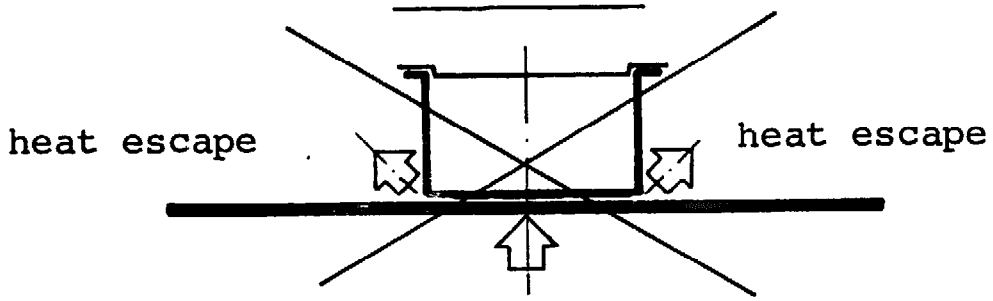
A pressure cooker is a very good investment - it saves fuelwood and reduces cooking time.
Note: this is of special great significance at high altitude, where in normal atmospheric condition the boiling point is extremely low (and therefore cooking needs much more time and fuel).

PRESSURE COOKER



DANGER: NEVER BLOCK THE SAFETY VALVE!

W R O N G



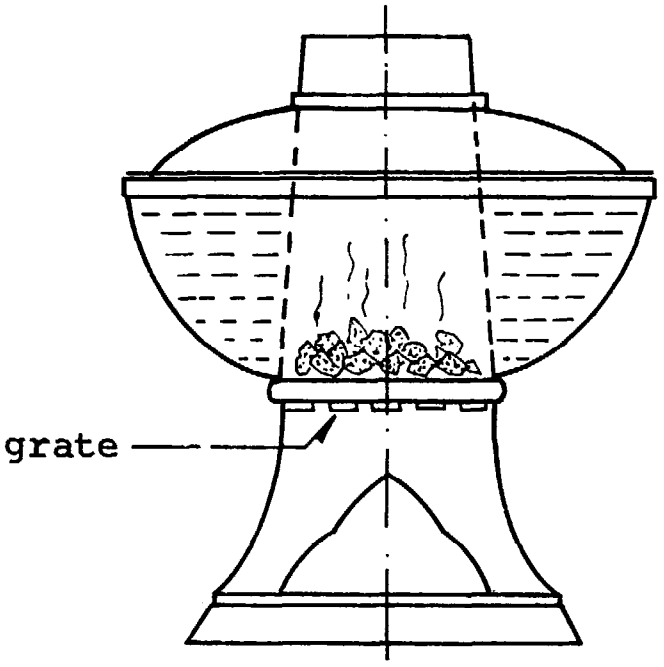
W R O N G

Placing ordinary metal pots on the metallic surface is a very inefficient way of cooking because of poor heat conductivity (which is enormous with thin pots and uneaven bottoms).

THE HWOGWO

Who has not heard of the *samovar?* It's the Russian appliance for preparing tea. What is not commonly known, however, is that the fuel for boiling the water is right "inside" the water pot. Or looking at another way, the water is all around the stove. This is very efficient, because heat radiation from the sides of the stove is not lost on the air but is utilized in heating the water.

The same principle applies in what the North Chinese and Mongolians know as the *hwogwo*. The word simply means "cooking pot", the most ordinary kind of cooking pot used by the common people living in those parts. Some Tibeteans in Kathmandu also use the hwogwo, but they call it *jakok*.



The simpliest way of describing the hwogwo or jakok is to call it a sophisticated *karai* with a chimney in the middle. A karai, for those who do not know the Nepali word, is a pot shaped like the segment of a globe. It is generally or iron or aluminium. To convert a karai into a hwogwo, cut a 10 cm hole in the bottom and weld

it to a conical tube or chimney tapering to a 7 cm hole on top. The cover too has a hole in the center to allow the chimney to protrude some 3 to 5 cm above it. Of course, the hwogwo does not *have* to look like a karai. It could very well be shaped like almost every cooking pot.

Inside the chimney, at the very bottom, comes a grating to support bits of charcoal, coke, wood chips or other similar fuel. The fire is lighted in, and is totally contained by, the chimney, thus applying all its heat to the very center of the food being cooked. The pot rests on a stand with an opening in front through which the fire draws the air it needs. Some hwogwos have artistically decorated stands.

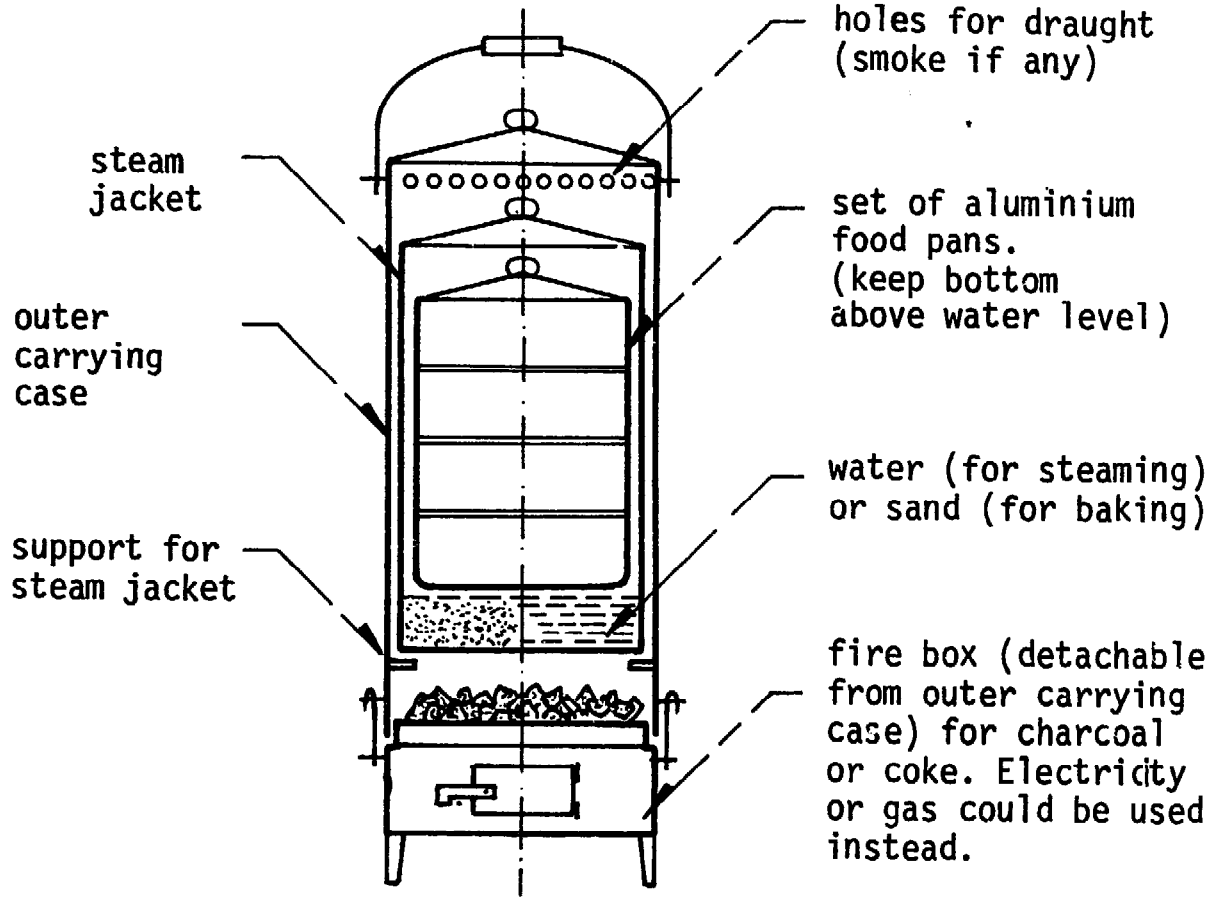
The little heat that passes straight up the middle of the chimney without touching the sides need not be wasted. With a samovar it is standard practice to place above the chimney a pot containing tea concentrate, which can thus be kept hot all day long. Nothing prevents one from supporting a small kettle above the hwogwo chimney, so that no heat whatever be lost.

THE IC-MIC COOKER

About the time that the 19th century became the 20th, a little before or a little after, Father Saubolle did not know exactly, a Bengali invention came on the market by the name of The Ic-Mic Cooker. It was so successful and so much in demand that two or three other manufacturers copied it. They copied not only the appliance itself, but slavishly copied even the instruction booklet, misprints, grammatical errors and all!

The Ic-Mic is a pressureless steam cooker, extremely economical on fuel. It will thoroughly cook four pots of food on approximately one liter of coke, charcoal or walnut-size balls of charcoal dust bound with a thin slurry or cowdung. Gas or electricity must also be used.

Once the raw materials have been put into the pans with all necessary seasonings, and the cooker closed and lighted, no attention whatever is needed. The food is well cooked, very tasty and nourishing, and even after the fire is burnt out, the cooker keeps the food warm for up to six hours. This is ideal for campers, travellers and picnickers: they set up the cooker, go about their business and return when they please to a hot, well-cooked meal.



For steaming the food, the steam jacket holds 2.5 cm of water below the pans, but not touching them. For baking, the water is replaced by sand. Obviously baking and steaming cannot be done together. All frying, e.g. of onions or spices for curry, must be done separately before setting up the food in the cooker. There may be some limitations to what the Ic-Mic will do, but the advantages are enormous.

It is quite normal to cook meat in one pan, vegetables in another, desert in a third and soup in a fourth, all at the same time, without the aroma or flavour of one dish interfering with that of another, without any dish being over-cooked, and without your having to fan or blow or rake up or replenish the fire once it has been lighted.

Recipe books for use with the Ic-Mic are available in India, but any resourceful housewife will soon learn to manage the cooker successfully. Rice cooked on the Ic-Mic is delicious. Put one measure rice into 1½ measures water. When cooked, all the water will have been absorbed into the rice; so no nourishing elements are thrown away. The rice is clean. The grain fall separate, and don't stick in one clammy lump.

HAY - BOX COOKING

Have you ever cooked with hay? Now don't get the wrong idea. Poor people often use dry leaves or straw as fuel for cooking; but we are not recommending that we burn grass in our stoves. Hay, after all, is only cut grass. But have you noticed how a pile of cut grass heats up? No, not hot enough of course to cook a meal in a few minutes. But quite hot to help

Poor villagers in Europe have used the hay box for centuries to cut down expenses by saving fuel. New-mown hay is put into a large box, a hole or kind of nest is made in the middle leaving several inches of hay all round at the bottom. Then a pot of food is brought just up to the boiling point, covered, and immediately placed in the nest. A cushion is placed on top to prevent the heat from escaping. After some time, from half an hour to several hours depending on what is being cooked (meat for example takes longer than rice), the pot is withdrawn and the food is ready to be eaten.

Instead of using hay we can make our hay box with any insulating material. First put a couple of sheets of newspaper inside along the four sides and at the bottom. Then put at least 10 cm of insulating material all round and below, leaving a nest in the middle lined again with paper and large enough to hold your pot snugly, but a little deeper to allow for a cushion above. As insulation we may use either fresh hay or dry grass, chopped straw, bits of crumpled paper, coir, cotton, sawdust, or if you can get it, glass wool. Some people use polystyrene, which is perhaps the best?

Fresh hay, besides insulating, generates its own heat, but the other materials named above do not. So with these kinds of insulation it is advisable to place below the pot a flat heated stone or brick. Space for this should be made so that the pot can be well sunk into the insulation. The pot should also be quite full. So the size of the pot to use depends on the amount of food being cooked.

For cooking rice, put rice and water into the pot as usual; bring it just to the boil, then put the full pot covered into the nest with the hot stone below and the cushion above, close the box with its lid, and in twenty minutes your rice will be ready. Meat requires 20 or 30 minutes' cooking on the stove before being placed in the box. If the night meal is prepared in the morning and placed in the box, it will be ready to eat in the later afternoon or evening. Or the morning meal can be prepared and boxed overnight to be ready when you awake next morning.

What is the advantage of a hay box? Well, instead of bringing your rice to the boil and adding more and more fuel while the pot continues to boil till the rice is soft and quite cooked, you put in the hay box and safe all that extra fuel. Or you cook some other dish with the fuel that would have been used only to cook the rice. So the hay box economizes on fuel, and a little saved energy every day means a lot saved in a month; and that is really worthwhile.

A COOKING PLACE FOR LARGE-SIZED POTS

One of the larger firewood consumers is the cottage industry of cheese makers, wool dyers for the carpet industry and others, using large-sized pots for boiling the liquid.

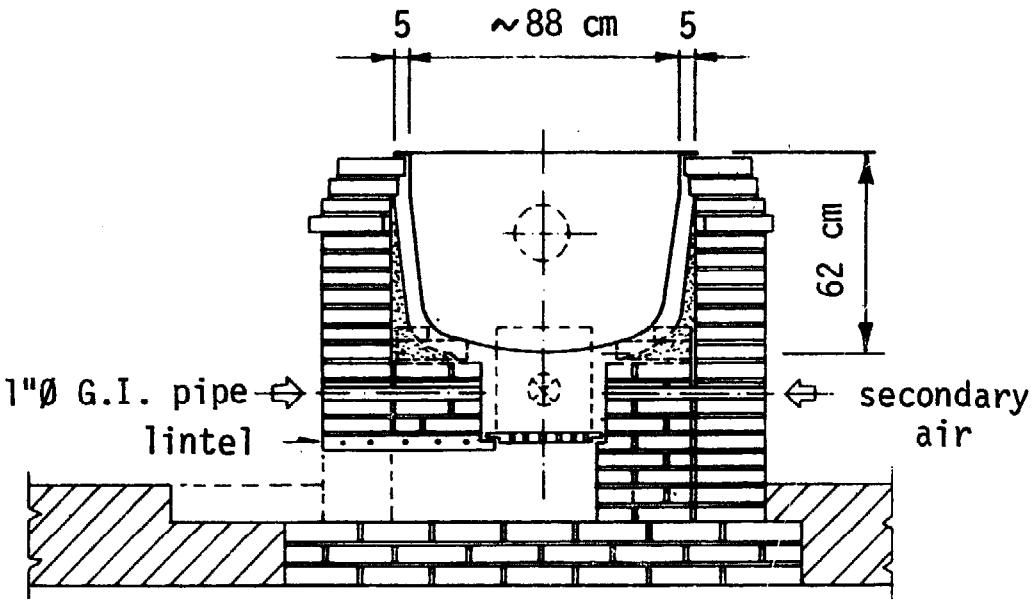
Several attempts have been made to improve domestic cooking devices. For large-sized pots alternatives, using electricity, were studied and projects started, but without much success. After many years it is still not clear what is likely to be the best solution!

More wood is being wasted in large, rather primitive stoves. These stoves have several disadvantages such as: they are smoky and consume a lot of fuelwood. In addition they are often quite unsafe structures for the support of heavy pots with boiling liquids! More and more such cooking places are being built, increasing firewood use. At present few people have access to alternative energy supplies, which in any case will require a rather high initial investment - and will also for this reason restrict their application. A trial on personal initiative has been started at a small carpet factory in Jawalakhel, Kathmandu, and the initial results have been encouraging: several people have asked to have their places improved.

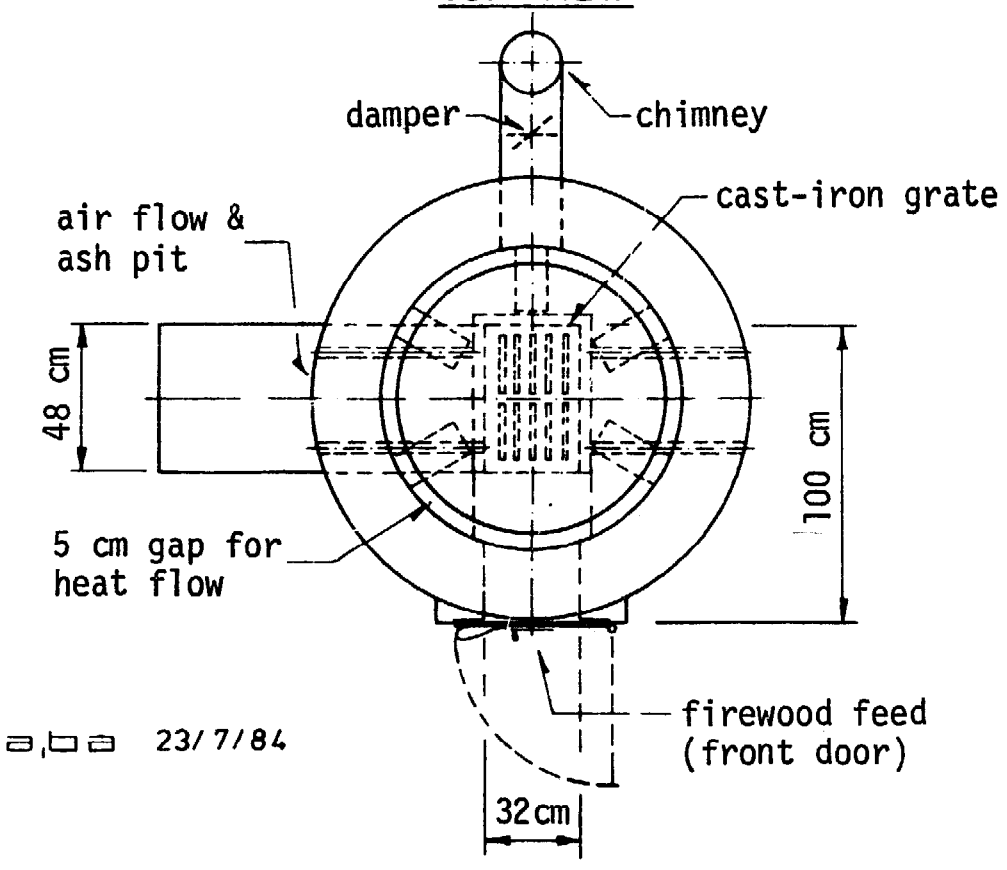
Principle: To meet most of the user's requirements a good cooking stove should satisfy the following requirements: safety; reduced fuel wood consumption; less smoky rooms; convenient handling. For safety reasons the heavy pots need to be placed on a solid base. A chimney is necessary to enable smoke to flow to the outside of the house.

Reduced fuelwood consumption can be achieved through careful construction and by having certain essential parts incorporated. Very important is the draught control in the chimney pipe - a device which often is forgotten (and the fuelwood consumption is even increased)!

FRONT / CROSS SECTION



TOP VIEW



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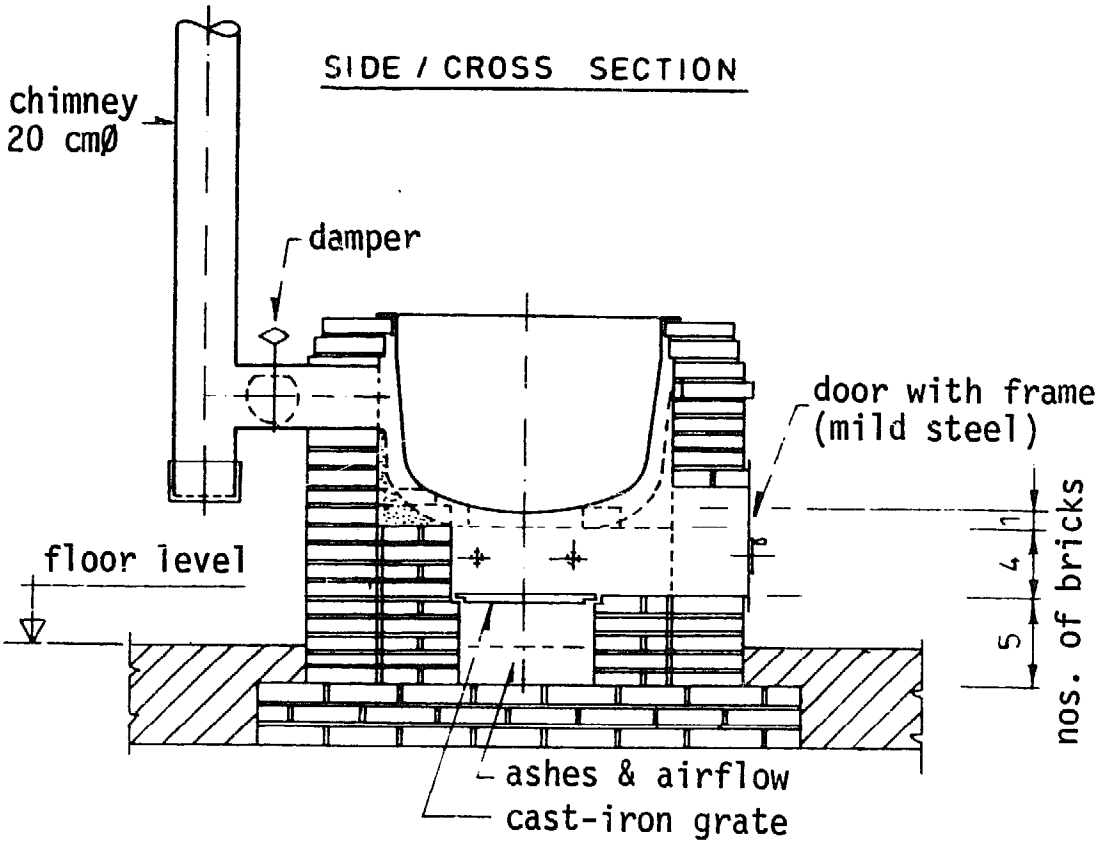
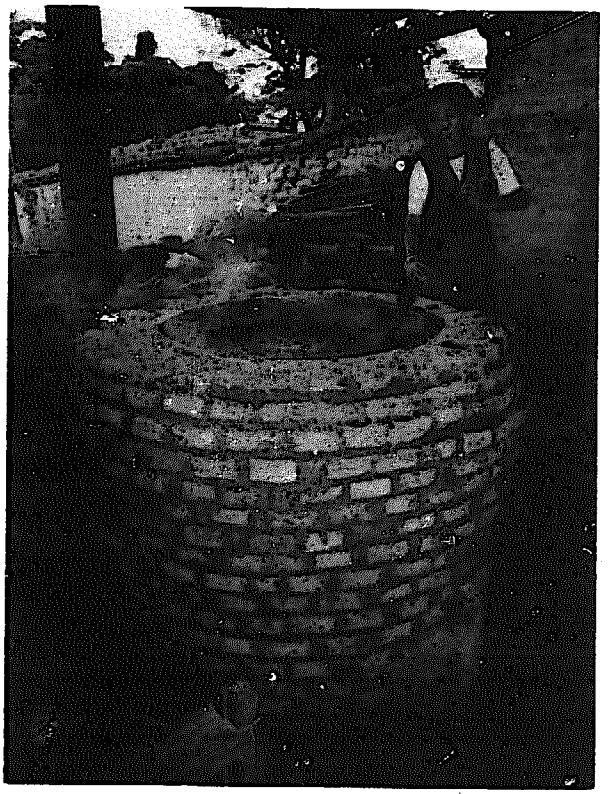




Convenient, fuel-efficient and safe wool dyeing with a newly-constructed large-sized stove.

WOOD-FIRED COOKING PLACE

FOR

LARGE-SIZED POTS

The critical components of such a stove are: grate, for ashfall and airflow; door, with airflow holes; chimney pipe with damper; properly fitted pot, with gaps on the sides for hot air flow. And it should be designed to burn pieces of fuelwood about 1 m long.

Chimney: A chimney can be made of masonry or of sheet metal. It needs to be at least 2.5 meters long and with an inner diameter of not less than 20 cm. The connection to the stove needs a draught control (= damper). Chimneys need to be cleaned regularly and must therefore have openings at the bottom (to remove soot).

Construction: A new stove will be built according to the size of the vessel. Materials, such as: pot; grate and frame; chimney pipe with damper; approx. 2000 bricks and mud and some other small materials will be needed. Note that it is important to have a good foundation to carry the weight of the entire structure and pot with its liquid contents!

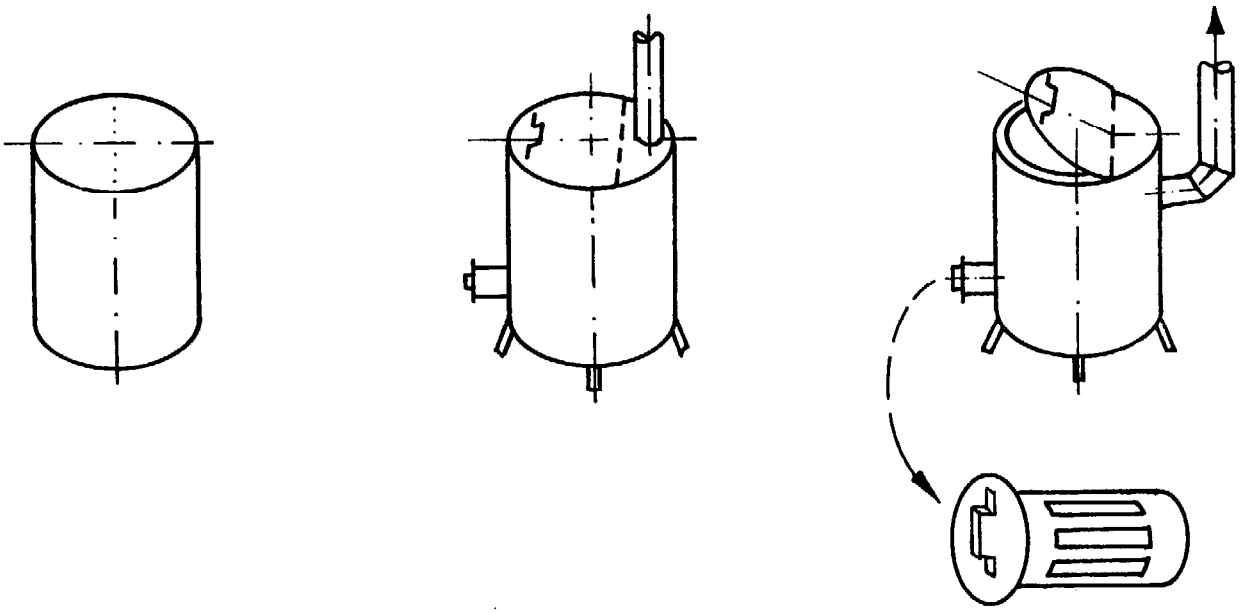
Operation: Use dry, if possible hard wood, cut into thin pieces. To begin with, the damper should be completely open, but little by little closed until fire intensity is satisfactory. During firing it is essential that the wood is moved in regular intervals, so that the ash can fall through the grate and fresh air from below gets to the fire. Note that during the operation the front door should be kept closed.

There are worthwhile achievements: safe and convenient operation of stove and boiling liquids in a less smoky environment; improved quality of wool dyeing. Reduction of fuel wood consumption: previously about 1 kg of fire wood was needed to dye 1 kg of wool. With this new design only about half of the firewood is required: with 92 kg of firewood 200 kg of wool could be dyed!

A SIMPLE WOOD-BURNING STOVE FOR ROOM HEATING

This stove is made from an empty 20-liter paint drum. Cut a hole of diameter 8 cm in the top for the chimney as near as possible to the circumference. Cut out the rest of the top, leaving a 1 cm ledge. Make a flap cover and hinge it at the dotted line. It must rest on the ledge. This allows for loading the stove with kindling and wood.

A WOOD-BURNING STOVE



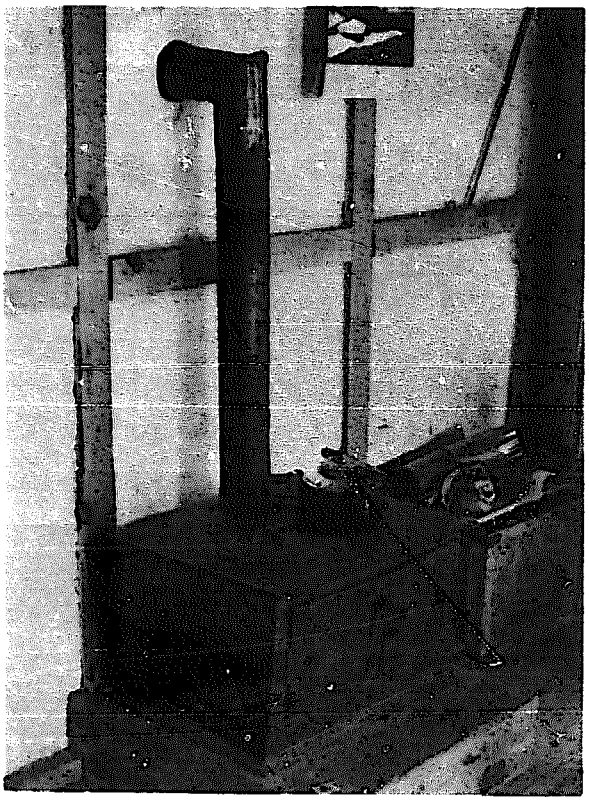
2.5 cm above the bottom make a 7 cm hole. Fix to it a 8 cm long metal tube open at both ends. Make a second metal tube of slightly smaller diameter to slide smoothly into the first. The second (inner) tube is closed at one end and given a handle. Along the length of this inner tube make about six slits 6 cm x 1 cm. This inner tube serves as draught control. Give the stove three legs. Fill the bottom of the stove with 2.5 cm of clay. This is a safety measure: it acts as insulation in case the stove is used on a wooden floor. It also prevents the bottom of the stove from getting red hot and wearing out before its time.

Alternative to putting the chimney on the top of the stove, it could conveniently be placed high up on the vertical side of the stove opposite the draught control. The chimney diameter should be somewhat greater than that of the draught control. A side chimney leaves space on top for a pot.

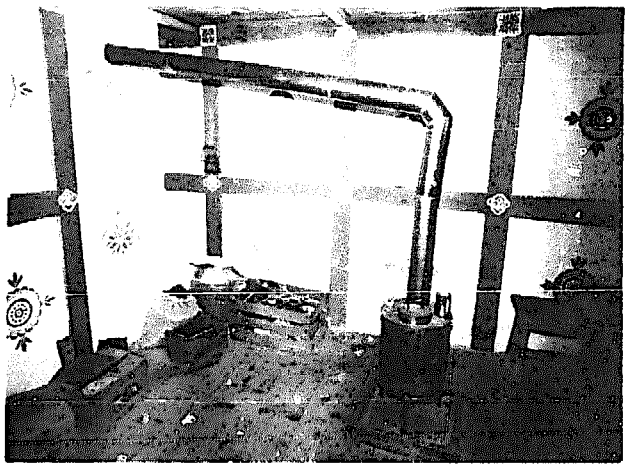
If the chimney is nice and long (4 m) the draught is excellent, and the stove lights with one match. There is no need to blow or fan. Start the fire with much kindling and little wood. Once it is burning well you can fill it up with more wood.

Room heating with a 'Bukhari' in Bhutan.

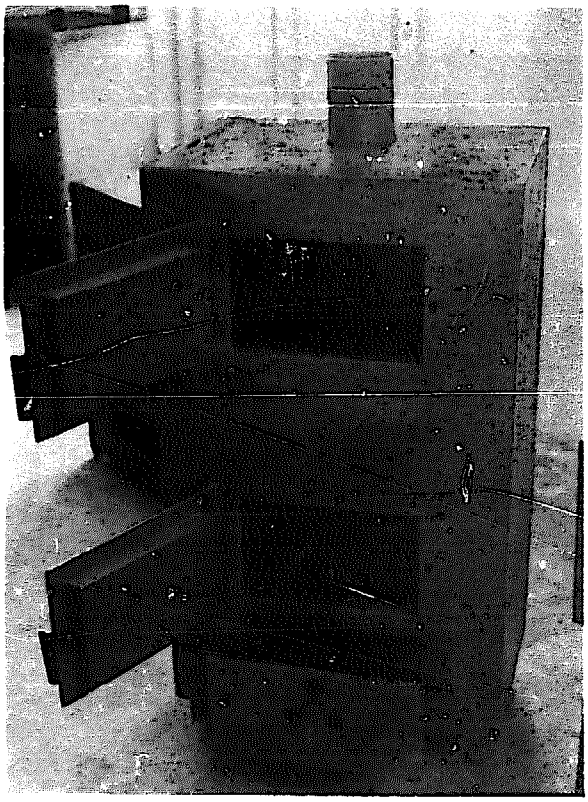
These stoves will work satisfactorily through five or six winters before having to be replaced. Note, however, although these stoves heat very quickly and instensively, they do consume quite a lot of wood. Another disadvantage is that they need constant refil ling as they do not have any thermal mass to store some of the heat.



A low-cost room heater, made of sheet metal. It would be safer to have a larger gap between the stove and the wall!

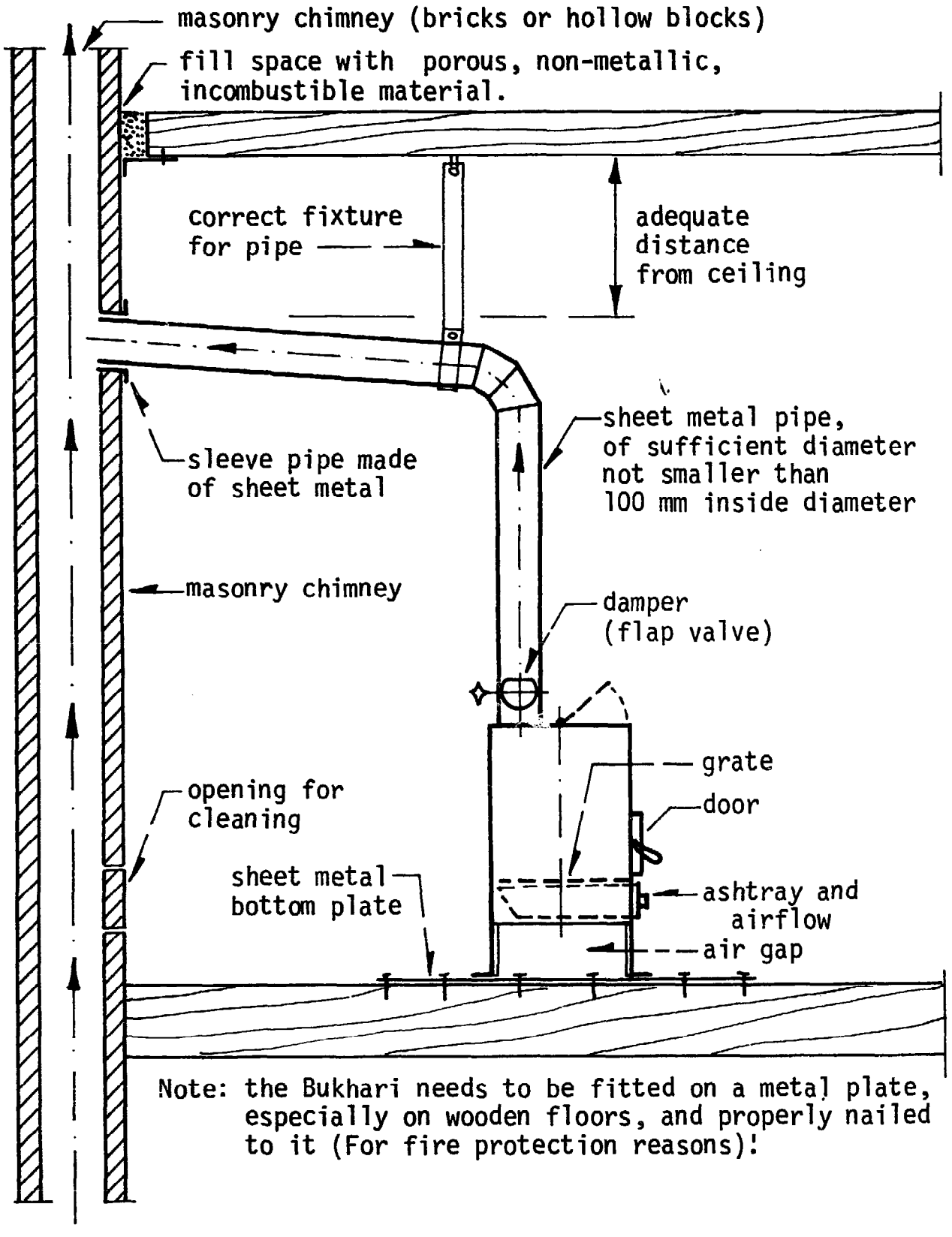


An improved Bukhari installation: a well dimensioned sheet metal pipe with a properly designed bend.



A newly developed room heater; prototype construction of Kharbandi Technical Training School in Phuntsholing/Bhutan.

ROOM HEATING STOVE INSTALLATION (SAMPLE)



Note: the Bukhari needs to be fitted on a metal plate, especially on wooden floors, and properly nailed to it (For fire protection reasons)!

Certainly they have room for improvements:

- fuel efficiency: can be increased, by having a damper (flap valve) in the chimney (metal pipe). With this the draught can be regulated and reduce much of the heat lost through the chimney. In addition the pipes should have a diameter of at least 100 mm inside diameter (ID).

- design: a good stove has a grate, for ashfall and airflow from below, and also an ashtray to remove the ashes.

- safety: these stoves are quite light structures, and should therefore be fitted to the floor, so that they cannot fall. In addition, these stoves should be on a metallic platform, and with this prevent fire hazards. They should have a protecting frame work to protect children from burns, and pipes properly fitted, again to reduce fire hazards.

SAWDUST STOVES

One of the simplest fuels for cooking, and for heating the house in winter is sawdust, a wast product which is usually thrown away and is therefore available free or at nominal cost. True, not everybody lives conveniently near a sawmill or lumberyard; but the same objection applies to many other alternative sources of power. Not everyone has a stream running through his property to generate electricity, or keep cattle to supply manure for methane. We must make use of whatever sources are available to us.

Sawdust will burn properly only in a special constructed stove, which is very simple to make and costs practically nothing. The fuel in such a unit always lights with only one match, and keeps burning for long periods - six, eight or even twelve hours if desired - with absolutely no smoke, except at the moment of lighting, no blowing or fanning and no refuelling. Once lighted, such a stove burns until

all the fuel is consumed. It can then be re-charged and lighted again. Such a device is ideal where steady heat is required for hours on end with no attention, as for instance, to provide day-long hot water, or to keep a sick room cosy and warm through a chill winter's night.

To make a sawdust stove, take an empty paint drum of say twenty liter capacity. Cut out the top and make a 5 cm hole in the middle bottom. Set the container up on three legs, and the stove is ready. The only "tool" you need to make the burner work is a smooth round stick or length of water pipe the diameter of the hole in the bottom, and long enough, when resting on the ground, to protrude ten of twelve cm above the can top.

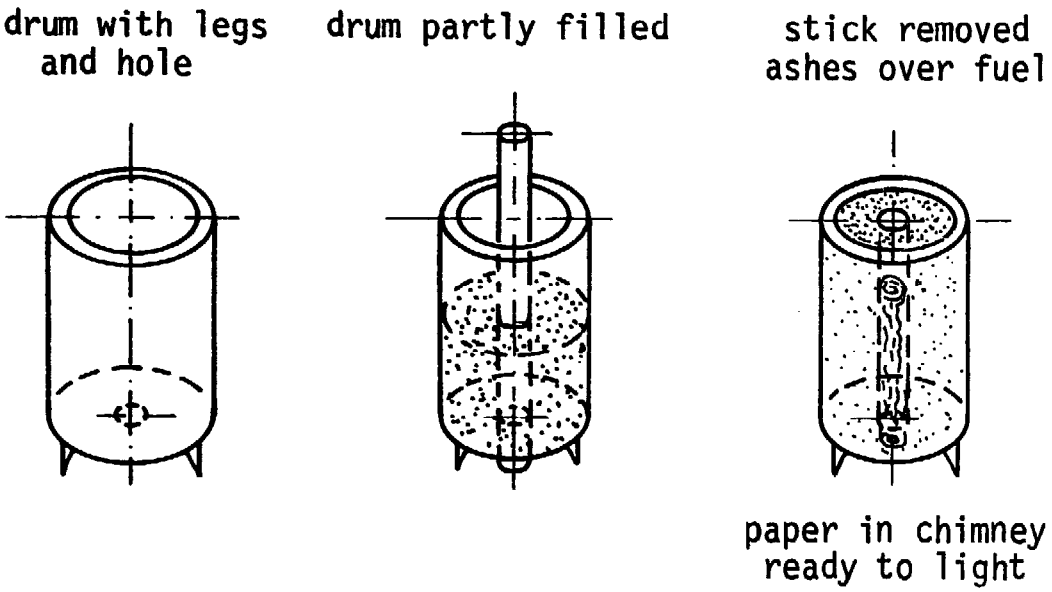
It is absolutely essential that the fuel for this stove be ***bone dry***. If it is slightly damp, it will smoke; and if it is very damp it won't light at all. Dry sawdust burns wonderfully well - some times even with a blue flame - and is entirely smokeless. It does give off some fumes, however, and so the room where the stove is being used must be well ventilated.

To load the burner, insert the stick or pipe through the hole in the bottom, and hold it upright while you pour sawdust around it. Every now and then, as you fill the container, press the fuel down firmly to make it tight and compact. When the drum is full, completely cover the top of the sawdust with a thin even layer of sand or ashes to prevent the flame from creeping over the top and causing smoke. Then twist the pipe as you carefully pull it out of the packed fuel. You will now have a neat hole, which will act as a chimney, right through the mass.

The sawdust stove is easy to light. Just crumple a sheet of newspaper according fashion and push it gentle down the chimney until ot protrudes at the bottom. Put a match to the lower end and the home made heating will require no further attention whatever until the fuel is completely consumed.

The sawdust burns from the center outwards, the hole gradually increasing in diameter until there is no sawdust left and the flame dies out. The rate of consumption is approximately 5 cm per hour (the figure varies slightly with the quality of the fuel and how tightly it is packed). A stove 30 cm in diameter will burn approximately six hours, and one 20 cm across will operate long enough to cook a meal and produce some hot water to wash the pots and pans.

A SAWDUST STOVE



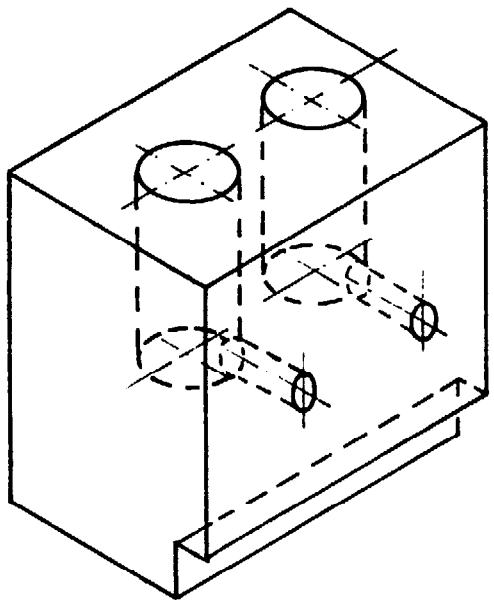
The amount of heat produced is dependent on the depth of the container: the longer the "chimney", the hotter the flame. A tall, narrow stove will become very hot for a relatively short time; a broad, squat model will burn both long and hot. Calculate the dimensions to suit your requirements.

The basic design described above can be adapted to special purposes. For instance, a good sawdust-fired kitchen range can be constructed in either of two ways:

(1) Two or more legless drum stoves can be bricked in with a small opening below each to admit air and remove ashes;

(2) The range can be built of brickwork alone, without drums, but with one or more spaces the shape and size of a drum to hold the sawdust. Each of these spaces should have a 5 cm hole through the brick work into the bottom of the space.

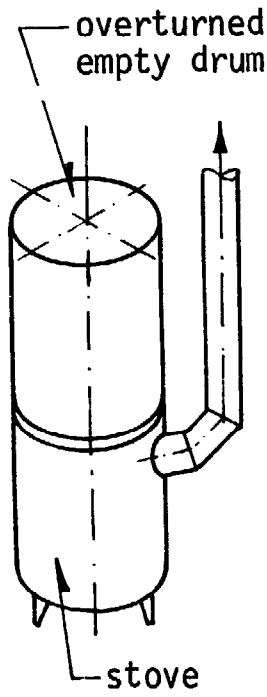
COOKING RANGE



This second model is loaded with the help of two sticks or pipes. One is first pushed through the front opening at least as far as the center of the stove, and the other is held upright resting on the horizontal pipe. Then the unit is packed with sawdust and both pipes or sticks are drawn out. To light this stove, the paper is shoved in horizontally.

The sawdust stove may be modified into a space heater to dry laundry on a rainy day, or warm a living room on a cold night. To adapt a drum stove for this purpose, a second drum, with its top removed, is turned upside-down and fitted snugly on the upper rim of the heater. This radiates warmth into the room. If desired, a hole with a removeable cover could be cut in the top to make an open burner for heating a kettle.

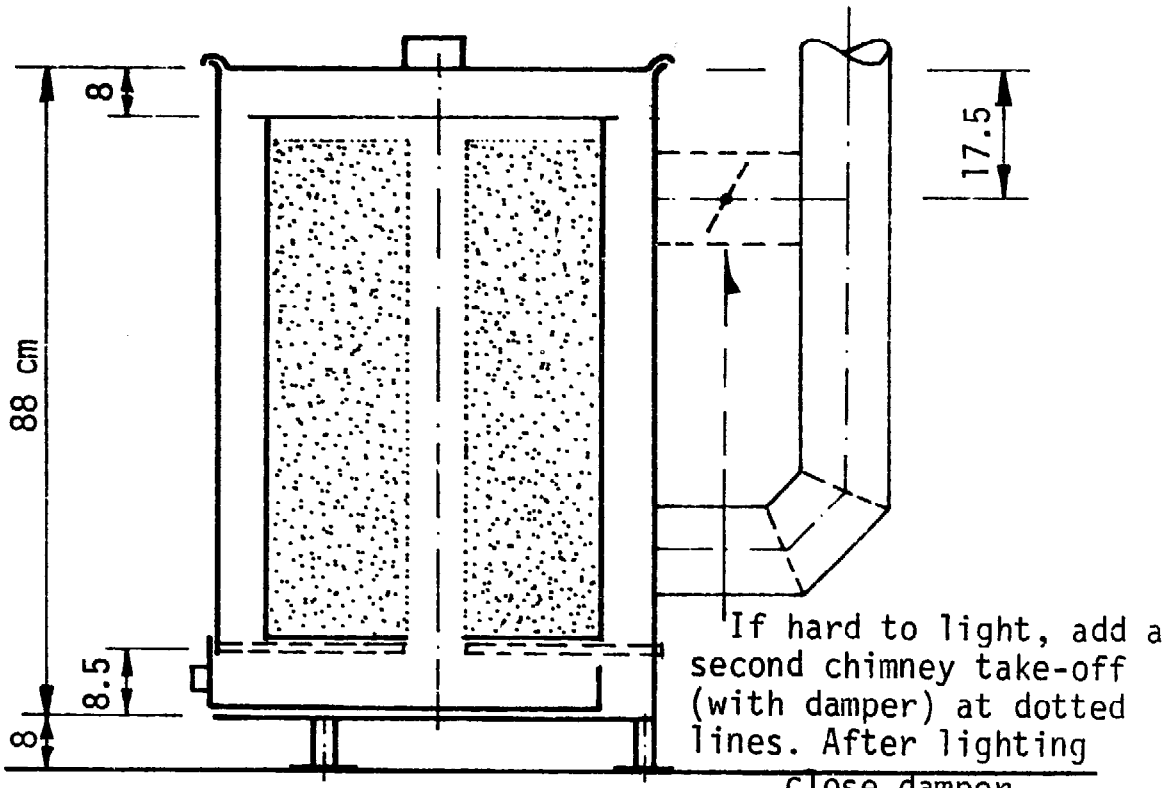
SPACE HEATER

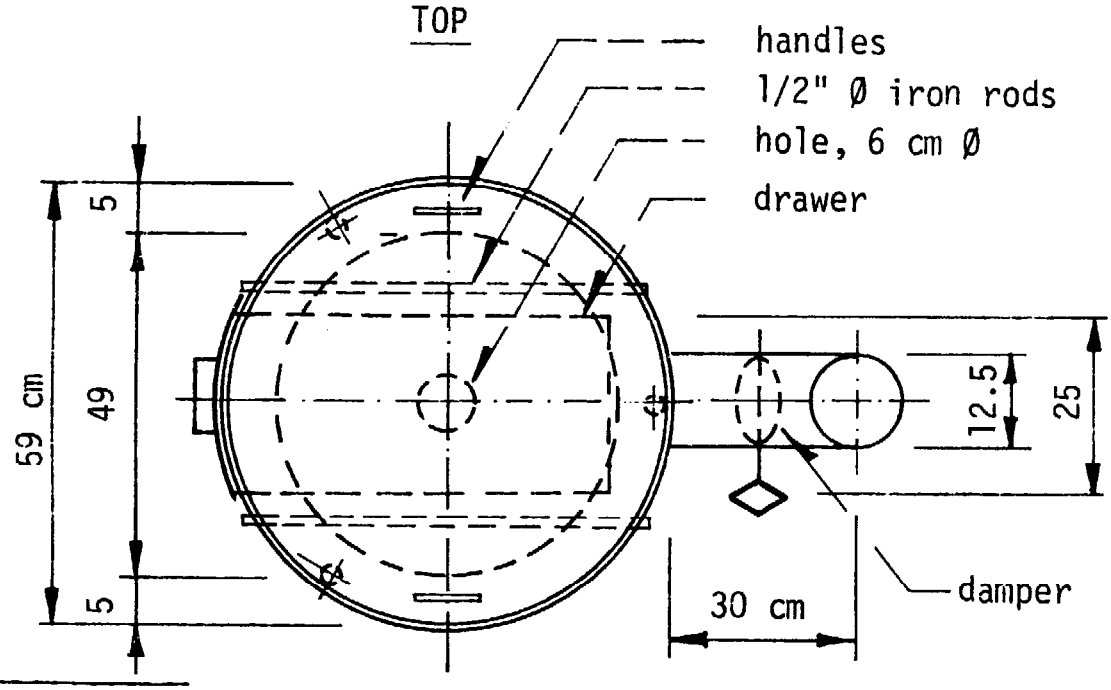


ROOM HEATING WITH AN IMPROVED SAWDUST STOVE

The previous article described a small two-drum sawdust room heater. A much bigger and more efficient heater, also made with two drum, has one inside the other. The outer drum can be a 225-liter one. It should have a securely closing but removable cover with two handles of 1/2" rod. The smaller drum should be some 10 cm less in diameter, and 16 cm shorter in height.

ROOM HEATING WITH SAWDUST





* For the general idea of this stove, and for much of the information given here, we are indepted to the Northeastern Forest Experiment Station, Upper Darby / PA 19082 / USA.

A false bottom, cut to a close fit, is placed inside the larger drum 8.5 cm above the true bottom. It is supported by two 1/2" iron rods running from front to back through holes in the drum and welded or brazed to it. The false bottom should have a 6 cm hole in the very center.

The outer drum is given a chimney take-off hole of 12.5 cm diameter just above the false bottom. Opposite this hole, and between the two bottoms, comes a metal drawer which acts as ash pan and draught control. It has a curved front to fit the drum, and is given a handle. The drum should be given three legs.

The inner drum for holding the sawdust needs no cover. It should have a 6 cm hole in the bottom center.

The center stick used in packing the stove with sawdust (cf. previous article) is better made slightly tapering to facilitate extraction. It should be as long as the inner drum is deep, and should have a handle. Remember to put ashes or sand over the top surface of the sawdust to prevent smoking. To light, put crumpled paper down the hole in the sawdust; cover the stove; put burning paper into the drawer just under the center hole.

The stove cover should have a secure, close fit to prevent the possibility of carbon monoxide fumes escaping into the room instead of going up the chimney. Adequate room ventilation should be provided with this stove as, in fact ,with all stoves. Avoid opening the stove while it is burning.

The stove gives the greatest heat with dry sawdust. If the sawdust is slightly damp (60 percent or less) it will burn, but will smoke. Damp sawdust burns longer, but less hot, because much of the heat generated is spent in drying the fuel instead of being available for heating the room.

A stove of this kind can keep a room 8m x 5m at about 25 ^{o}C for eight to ten hours -provided the house has some insulation- when outside temperature is below freezing.

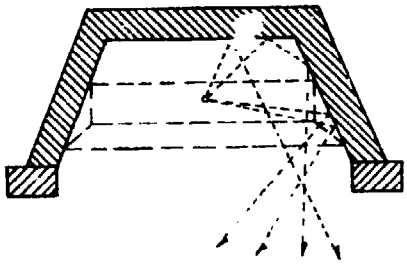
OPEN FIREPLACES (CHIMNEE)

Open fire places are not an efficient way to provide warmth to rooms. In addition they are more dangerous than (closed) stoves; to prevent accidents a framed wire mesh should be in front of the open fire. This prevents sparks to jumping out into the room and children from being burnt.

Open fire place construction needs experienced skilled people who know about proper measurements of such places and the scientific proportions of room, chimney and fire place.

It is not intended to promote open fire places; but if they are to be made they should be constructed to operate satisfactory, thus include all specifications

TOP VIEW

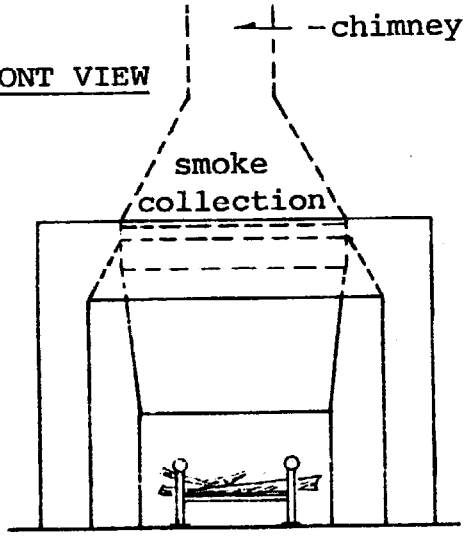


heat transfer

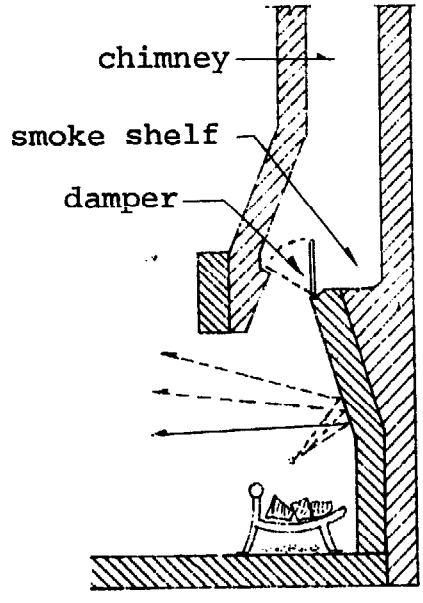
Note: Measurements need to be proportionate to the room size.

Open fire places are not fuel efficient heating devices!

FRONT VIEW



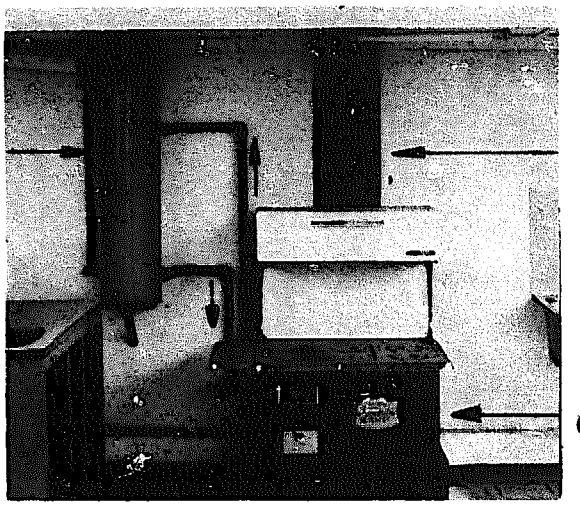
CROSS SECTION



COOKING STOVES COMBINED WITH HOT WATER PRODUCTION

Hot water from a tap can be an added convenience for a home. Where wood or coal is used as a fuel for cooking a quite simple modification to the stove can be made to supply cheap hot water. It increases the safety of the household as hot water does not have to be moved around in pots.

Such installations are very popular in many countries, such as America, New Zealand, Switzerland, etc. The technology is well proven and a range of sizes is available.



A demonstration cooking range installation; combination of cooking, baking and hot water production (Lesotho, S.-Africa)

The system works in the following manner: to the side walls, out of the way of the firewood, of the fire chamber a water jacket is fixed, in which the fire heats water. Out of this box or pipe coil two pipes are lead to a hot water storage tank fixed above the stove. One pipe, the "riser", goes from the top of the water jacket to the top of the storage tank. The other pipe goes from the base of the heat jacket to the base of the storage tank.

When the fire is lit, warm water in the water jacket is displaced by colder, denser water from the storage tank, and circulation of the water between the water jacket and the storage tank starts.

A well-insulated hot water storage tank will easily remain hot overnight, provided the tank is fixed approx. 60 cm higher than the top of the stove. This height difference is necessary to prevent backflow and cooling in the uninsulated water jacket.

To make a system that works properly note the following:

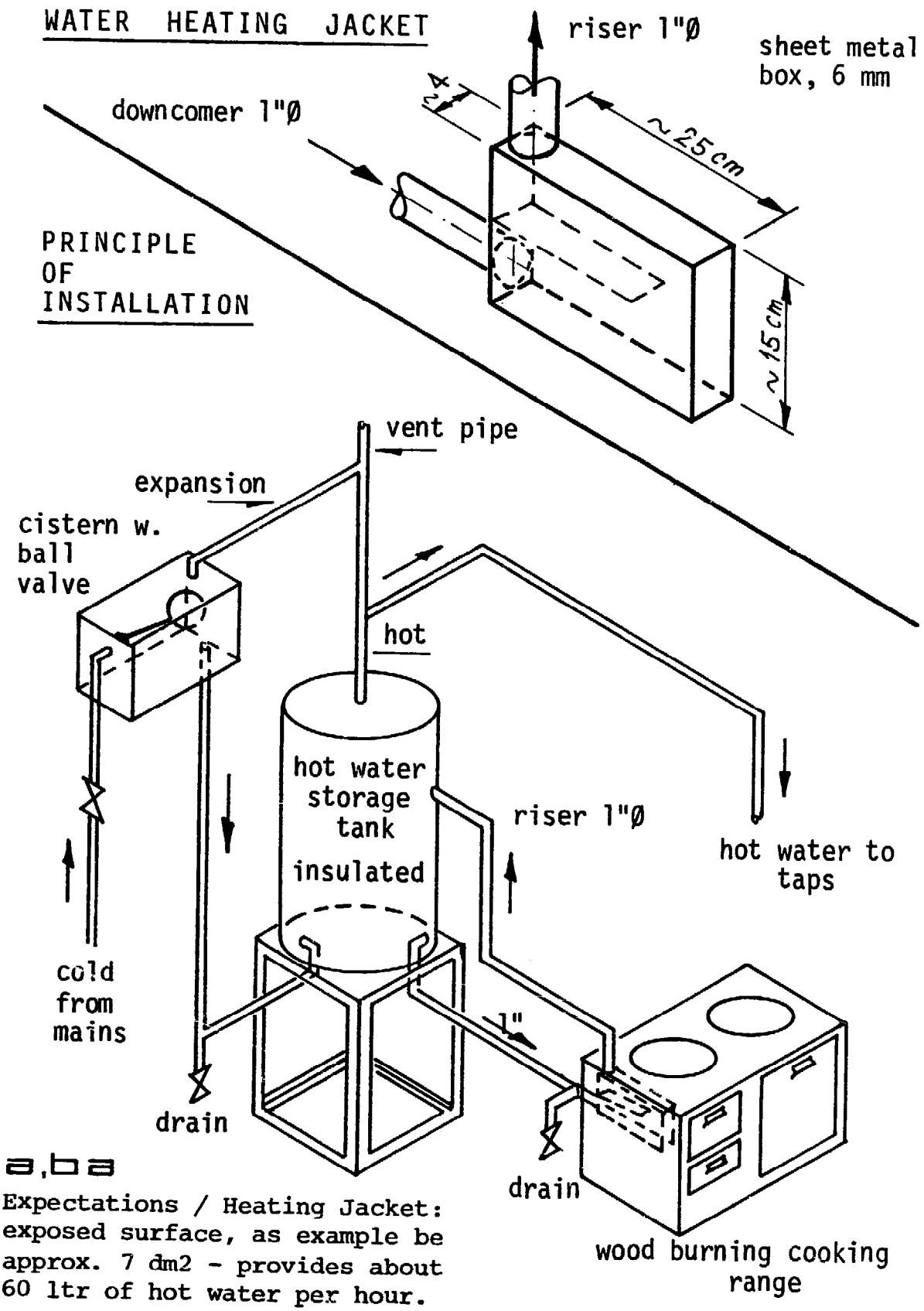
- The system has to be designed and installed so that the heat exchanger will remain filled with water during heating.

- Careful attention has to be given to proper installation; all the circulation pipes (connections between stove and hot water storage tank) must be fixed with a gradient towards the hot water storage tank; a 'breather pipe' must be attached to the top of the storage tank.

  Danger: it is extremely dangerous to have air locks in the pipes: the heated water will transform into steam where air bubbles are and may cause an explosion.

- Heat jackets to be made of welded construction; where pipes are used seamless steam pipes are recommended and should not be of less than 3/4" diameter. Where possible the coil should be made from one piece of pipe. The coil can be made by filling the pipe with sand and bending it over a fire. If fittings are needed, they should be of mild steel and welded; screw joints will leak as the fire will burn out the jute. The water jacket can also be made of strong M.S. sheet, with welded joints.

- Make sure that the circulation pipes are properly fixed: upper pipe of heat exchanger to upper connection of the hot water storage tank (at least 2/3 of the total height of the hot water storage tank. These pipes need to be insulated only where they are longer than approx. 1.5 mtr.
  Note: no valve of course should be fixed in the circulation pipes, for safety reasons!



a,ba

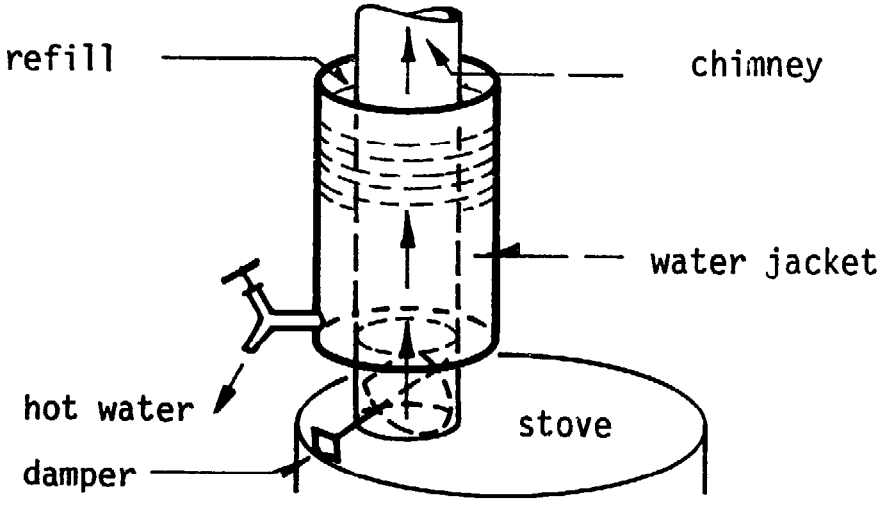
Expectations / Heating Jacket: exposed surface, as example be approx. 7 dm2 - provides about 60 ltr of hot water per hour.

- It is essential to provide the hot water storage tank with a safety device, so that the heated water can expand without troubles. There must be a safety valve or a vent-pipe, etc.

- The pipe that draws off hot water from the system should be fixed to the top of the hot water storage tank, so that the hottest water can be tapped.

- Where danger of freezing exists it is necessary to drain the system. Empty the hot water storage tank, keep the taps open and keep the firing going until the water jacket has dried out. There may also be a drain valve outside the stove for convenient draining of the heat exchanger.

  Note: Before lighting the fire again, the system has to be filled with water, firing without water will quickly damage the water jacket.



A simpler device is used in Africa. The metal chimney pipe is surrounded with a jacket, which is filled with water. A tap is fixed at the bottom to drain the heated water. The system will provide good service for warm water, however, one has also to consider that one can not extract all the heat in the smoke for heating the water (otherwise the gases may condense and soot be deposited in the chimney).

These systems, properly installed, usually give complete user saftisfaction.

BATH OVEN

Not so long ago -when wood was still widely used- this kind of bath oven was fitted in bath rooms. This water heating device has a double purpose:

a) to heat water for a bath quite quickly

b) to provide a little warmth to the room (and that's one reason why the water storage tank is not insulated).

The advantage of this small oven is that it is fuel efficient and that hot water is available in about 15 to 20 minutes.

For the installation of this bath oven it is important to consider several points:

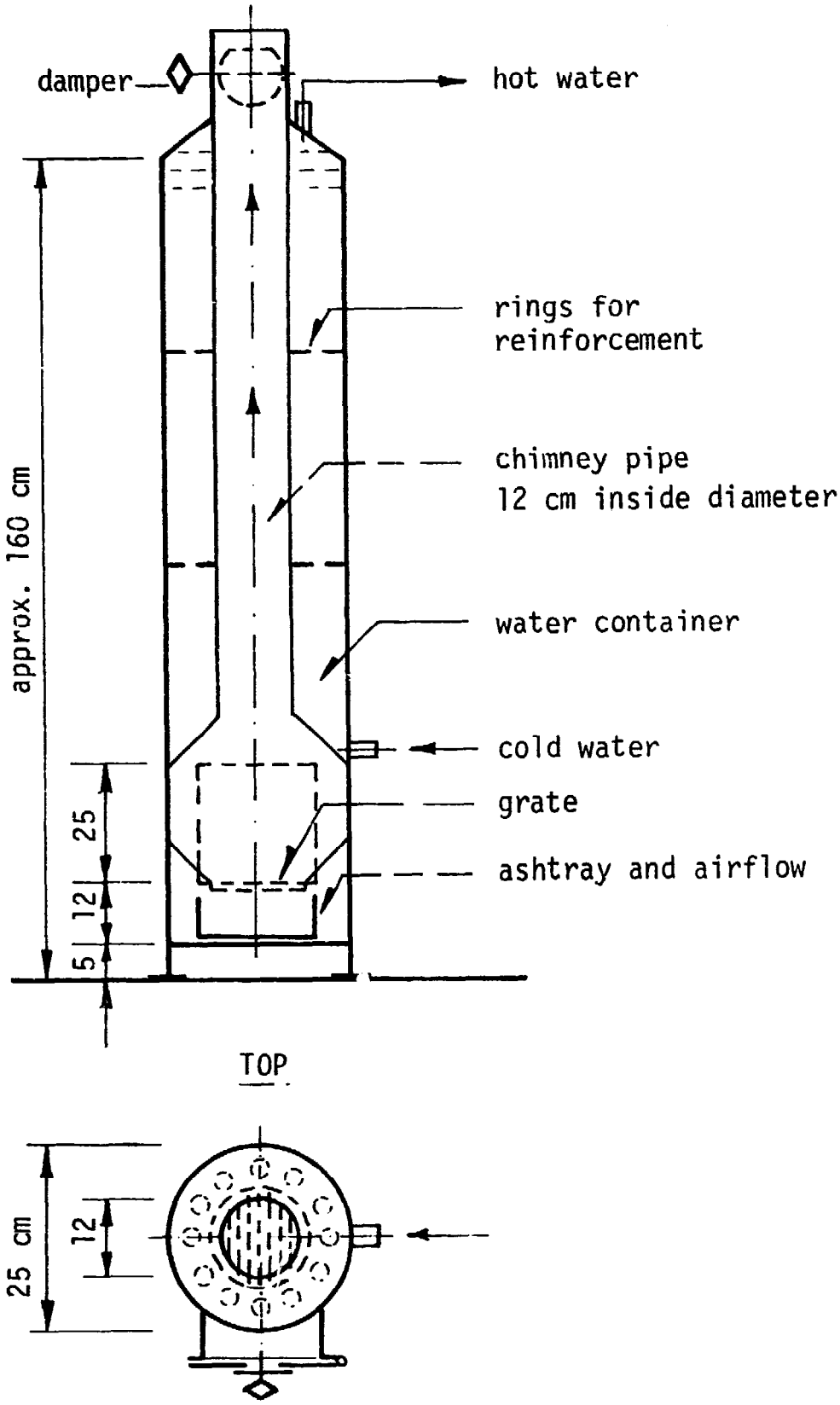
i) safety: make sure that the room gets sufficient fresh air and that the damper on the top does not close completely! (Danger of deathly carbon monoxide formation).

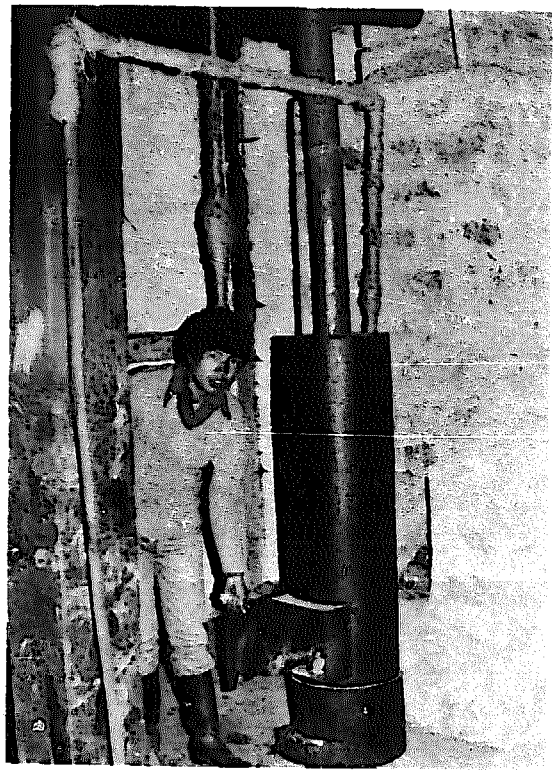
ii) Have the piping properly done, with a vent-pipe (to assure water expansion without spoiling the tank), and to provide air when draining (to avoid syphoning, which would probably squeeze and damage the container).

iii) In areas where the outdoor temperature may drop below freezing point it is essential to have the system drained after its use, to prevent damage from frozen pipes. A drain valve at the lowest point is required for this.

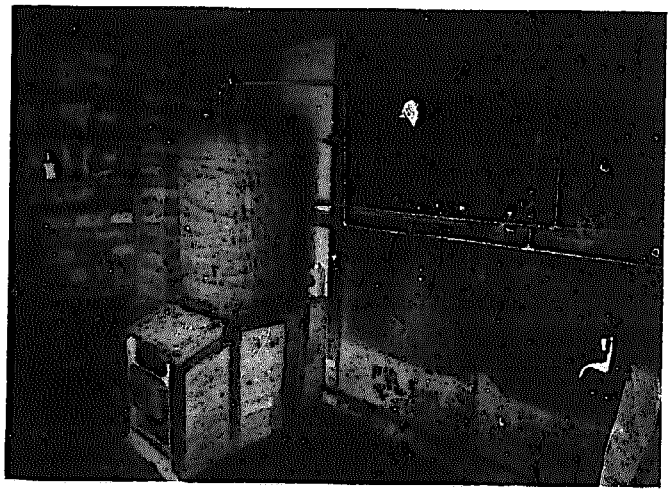
For remote areas, low-pressure systems or open systems have several advantages. It is recommended to ask trained pipe fitters to do the job accordingly. When producing this kind of oven it is good to have a rather strong sheet metal to ensure sufficient strength for pressure and vacuum.

BATH OVEN

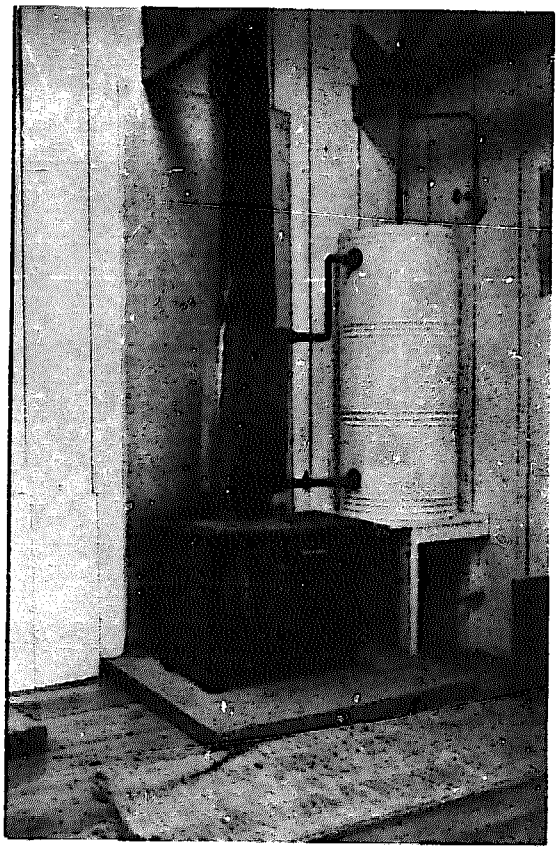

damper
hot water
rings for
reinforcement
chimney pipe
12 cm inside diameter
water container
cold water
grate
ashtray and airflow
approx. 160 cm
25
12
5
TOP
25 cm
12



Bath Oven: is a small but a quite efficient water heater, within 10 to 15 minutes several hot showers are available, demanding little firewood.



A wood-fired water heater. The insulation around the container keeps the water hot for several hours, (provided the damper is closed after firing)!

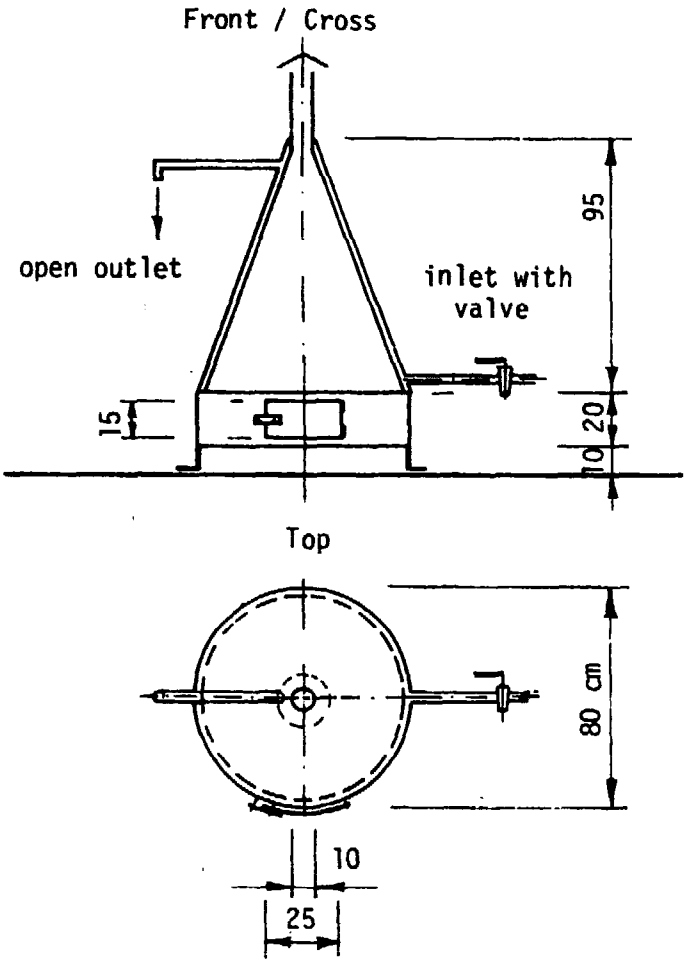


A room-heater combined with hot water production. There is a jacket around the metallich chimney. Note the heat protection on the wooden wall and the solid floor protection (Equipment from New Zealand).

INSTANT HOT WATER

FROM YESTERDAY'S NEWS

In a boarding school in Darjeeling in the Himalayas at an altitude of about 1600 m, the tiny tots aged six to eight needed hot water in the cold months for their morning ablutions. At one time this was provided instantly by a most ingenious device: a conical boiler.



It was a double cone of galvanized-iron sheeting, one inside the other, with a gap of two or three millimeters between them. Water entered at the bottom and came out at the top. The cone was mounted on a fire box in which old newspaper were crumpled up and set ablaze. Within a few seconds the outflowing water was hot. Once the fire is lighted, the water should be allowed to flow, or steam pressure may build up and burst the cone.

A LARGE WOOD-BURNING OVEN

One of these ovens was built for a school with about 150 boarders. It has worked excellently for the past twenty years. Loaded to capacity, it can hold 3 doz. 2-lb loaves (pans 28 cm x 11.5 x 7.5), or nearly 6 doz. 1-lb loaves (pans 19 cm x 9 x 6). After beaking bread, it can bake a lot of bisquits, which being thin, require less heat and bake quicker.

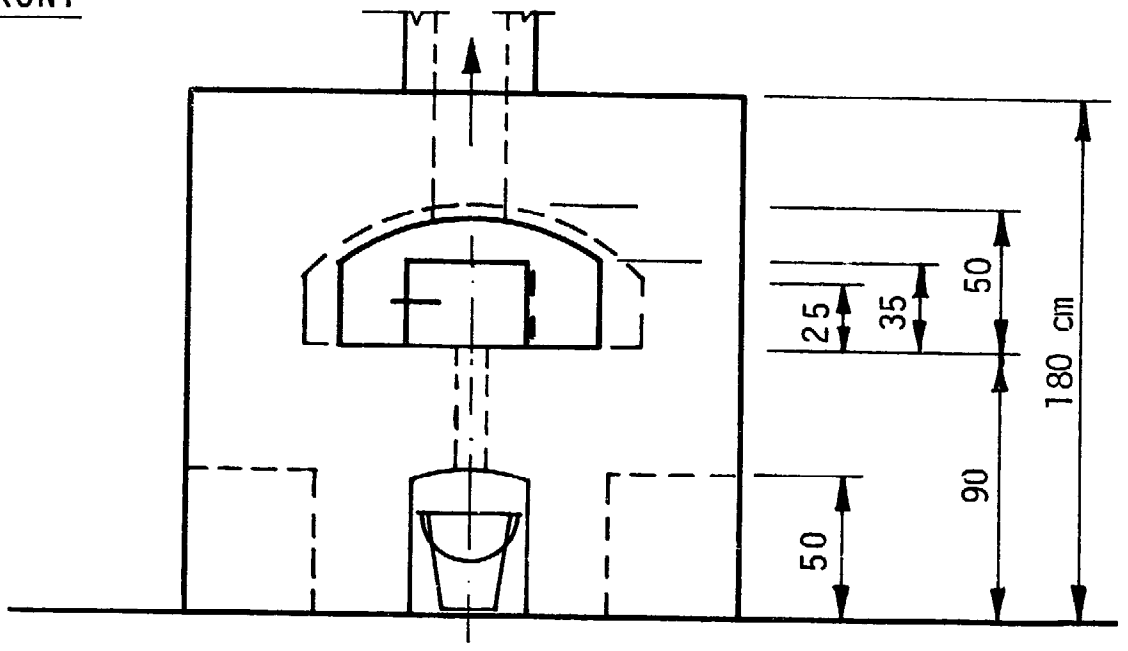
The oven is a cube of brick-and-mortar construction with a side of 180 cm. At 80 cm from the floor comes the oven proper, a square of 120 cm with an arched top. The side walls of the baking space are built up to 25 cm on the right and left, and from there comes the arch. The measurements from the oven floor to the center of the arch is 50 cm. The walls all round are 30 cm thick. The brickwork above the arch center is 40 cm.

The front wall of the oven has an opening in the middle 90 cm wide, narrowing down to the oven door which is 40 cm broad and 30 cm high. This latter is made of iron sheeting hinged to an angle-iron frame to protect the brickwork around the door. If fire-bricks are available, line the baking space with them: otherwise use the hardest brick you can find, at least for the floor, which in the course of time suffers a lot of wear and tear with the pushing in and pulling out of bread pans and the scarping out of embers. The ledge in front of the oven door is covered with a protective sheet of thin metal.

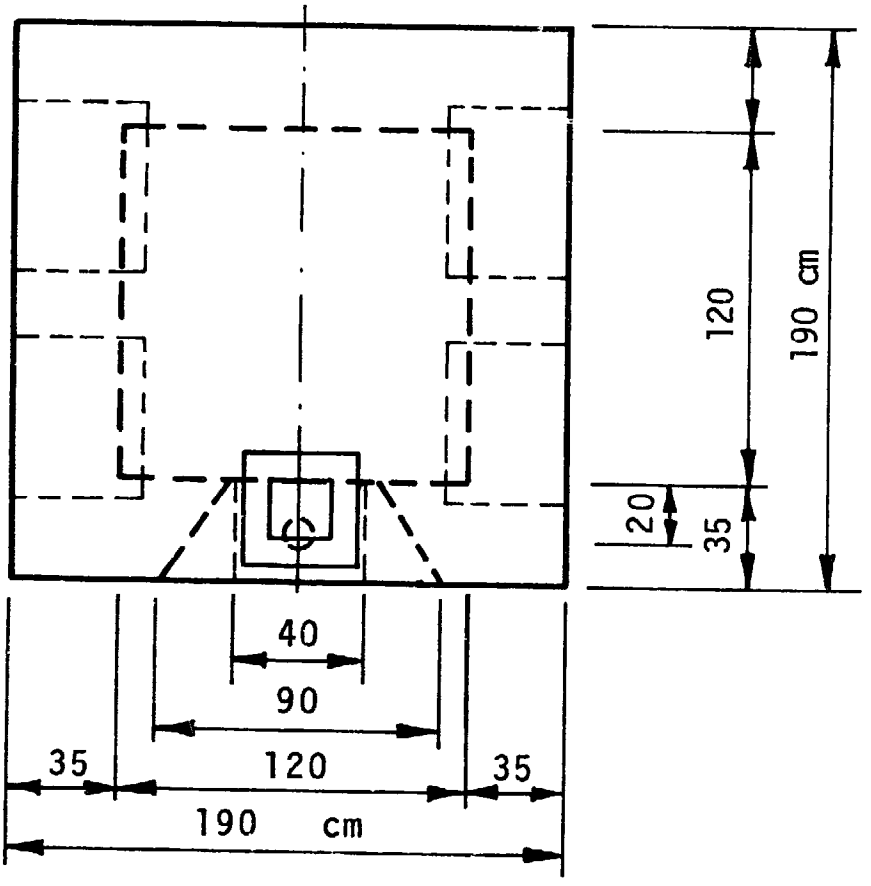
Fire is lighted in the oven. The smoke comes out at the door and rises srtaight up the chimney, which begins immediately in front. Make the chimney hole as large as possible, at least 20 cm, and the smoke will give no trouble whatever. In the twenty years that this oven has been used, the front face has remained clean without the least trace of blackening. When the fire dies down, rake out the embers and put in the bread.

A LARGE WOOD-BURNING OVEN

FRONT



TOP



That is the basic design of the oven. A few helpful improvements are recommended. The thin metal sheet covering the ledge could be replaced by an iron plate, say 2 mm thick, of the same shape, hinged along the front edge so that it can be flipped up to expose a hole in the ledge through which the embers can drop straight into a bucket recessed into the oven wall. This is neater and cleaner than letting the hot embers and ashes fall on the floor.

Another suggestion is to have a couple of arched storage spaces under the baking space. They should not be more than 50 cm high, so as to leave 40 cm of brickwork under the bread.

The school oven mentioned above has no back wall of its own. It abuts against the wall separating the bakery from an adjacent store room, which it keeps warm and dry.

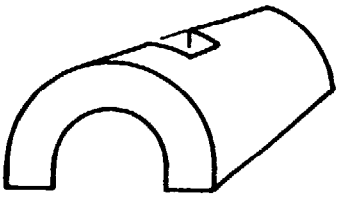
A CAMP OVEN

Late Rev. B.R. Saubolle's father did an awful lot of camping. He baked his bread daily in the simplest oven: an ordinary cooking pot. The pot was set on a very gentle fire. Inside was an overturned saucer or small pot cover to keep the bread pan off the bottom. The pot was closed with a larger cover holding two or three centimeters of glowing ember. And that was all! The baking was always successful. Sometimes he would bake himself a small cake or a few scrumptious scones.

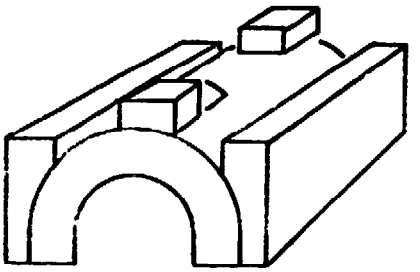
If you have never used a pot oven, it may take a couple of attempts before you can judge rightly just how strong to make the fire. It's so simple that it's well worth the try!

CONSTRUCTION OF A SIMPLE BREAD OVEN

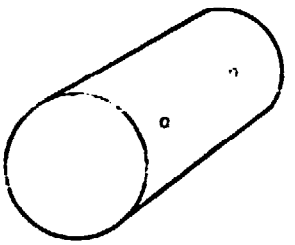
(Uses a 20 ltr small drum)



Construct a small mud brick vault leaving a hole (approx. 15 x 15 cm)



Add on mounting bricks for drum and upper vault.



Drill holes in drum for support rods (ID - 12 mm). These rods help to stabilize the drum and hold the tray for the upper row of bread pans.

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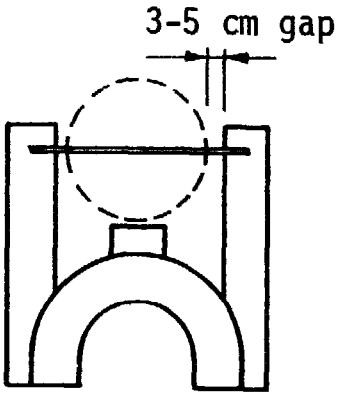
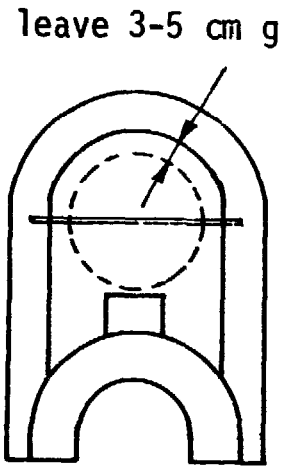
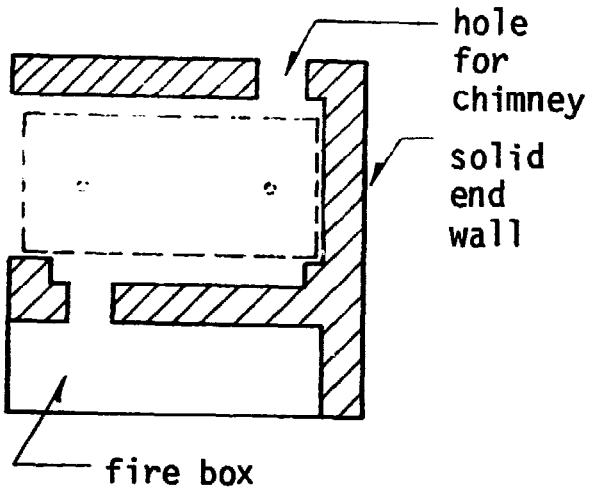
* Information received from: Richard Carothers, Institute for the Study and Application of Integrated Development / 43 Queen's Park Cres. East, 3rd Floor, Toronto / Ontario M5S 2C3 / Canada



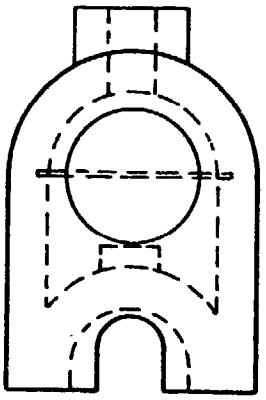
Mount drum and continue to build upper walls.



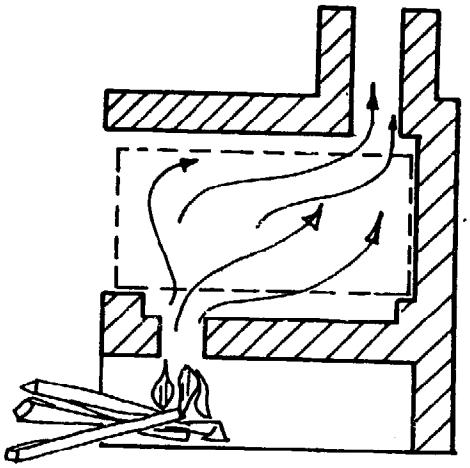
Complete upper vault leaving a 3 - 5 cm gap between the bricks and the drum.



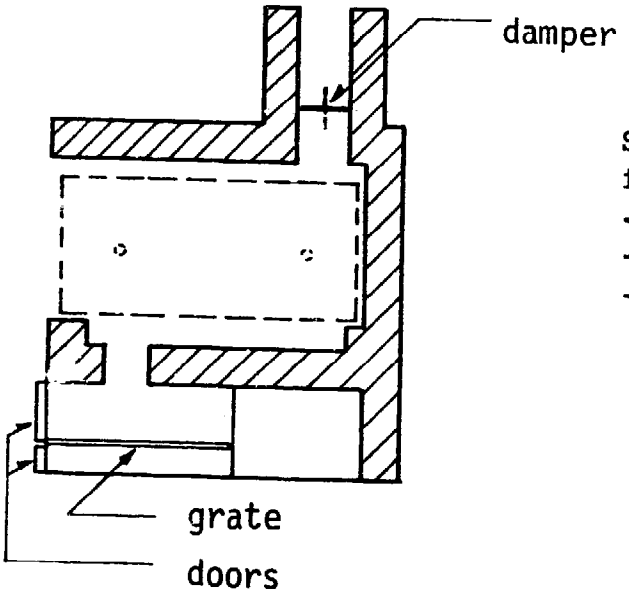
Section through the oven at this point



Use mud plaster to close in the front of the oven up to the drum. Use drum lid as a door. Build chimney extension.



Operation of oven



Suggested improvements for fuel efficiency, addings of:
- a front door
- a grate, for airflow and ash
- a damper, to control smoke exit and heat escape

We found that this oven could cook ten loaves of bread at a time and took less wood than the large massive types that use residual heat for baking. We found that women also could earn a reasonable daily income from the production and sale of 20 loaves of bread/day.

A SMALL BRICK OVEN

(Capacity: 8 pcs one-lb loaves)

- Mark off on the ground a square of one meter.
- Lay bricks within this space to a height of four to five layers.
- In the center mark off a square of 50 cm. This space will be the oven floor. Make it as hard and compact and smooth as possible.
- Build up the sides and back to a height of 20 cm. Then make an arch with its apex 35 cm above the floor.
- In the front wall leave a door space 25 cm wide and 20 cm high. Fix a sheet-iron door in the brick work.
- It is recommended to plaster the outside of the oven with a mixture of clay and cowdung (or chaff, or rice husk). This chars in course of time, leaving tiny air pockets in the plaster having an insulating effect which keeps the heat in.
- If the oven is out in the open and not under shelter, make the top slope down gently from the center so that rain water may flow easily.

That's all! Let the oven dry thoroughly before lighting a fire in it.

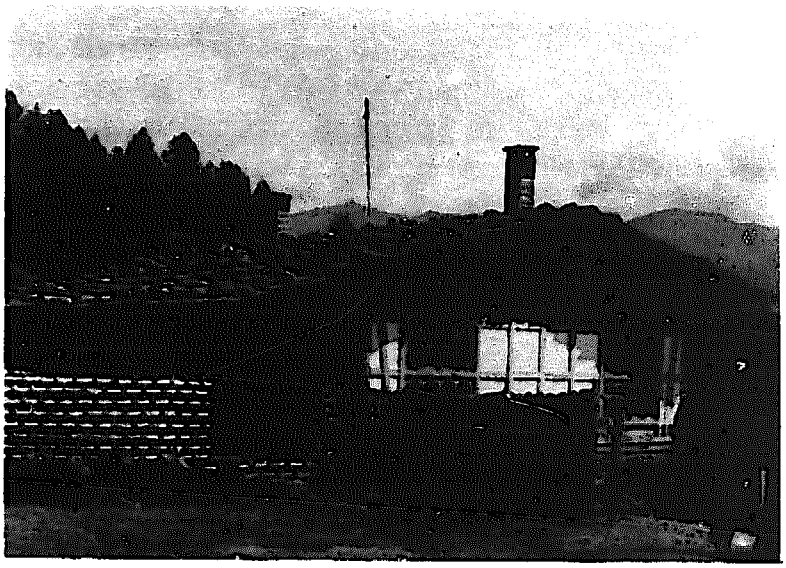
To use, fill the oven with firewood and light it. Leave the door and the smoke hole open. When the wood is consumed, close the smoke hole securely, pull out the embers, put in the bread placing the pans a little away from the sides, and close the door. In about 40 minutes the bread will be baked. The loaves are ready when the emit a hollow sound if tapped on the bottom.

Immediately after extracting the bread, the oven should still be hot enough to bake a batch of biscuits.

CHIMNEYS

Chimneys are very convenient structures, provided they function properly. Correct chimney construction is a science in itself, with numerous variations possible. Fortunately there are also some rules of thumb that give satisfactory results.

The points mentioned here are for improve cooking stoves and room heating stoves. The rules for open fire places are not specified. In any case, those interested in efficient heating with wood will probably not be interested in open fireplaces.



1. Fuel Efficiency: Every stove connected to a chimney should have a draught regulator (=damper). This can be a metal flap in the connecting pipe between stove and chimney. Dry wood burns more efficiently, and hard wood produces more heat (and less soot).

2. Temperature: The chimney needs to be warm for a good air draught and to reduce sooting. In cooler climate it is better to have the chimney inside the house. A good chimney is made of special chimney blocks (with hollow spaces for insulation), or it can be insulated with fire resistant material (mineral wool).

3. Materials: Suitable materials are those which retain heat well (and non-corrosive), such as special chimney blocks (with hollow spaces for insulation), bricks, stones, caly pipes, etc.
Sheet metal (without insulation) may be used to connect the stove to the main chimney; and radiate the heat inside the house. Sheet metal pipes should not be exposed to cold temperature outside, as fast cooling reduces the draught, and hastens soot formation (and possibly corrosion) inside the chimney.

4. Joints: Chimney pipes have to be sealed well for proper functioning, as well as protection against the the risk of fire. Where bricks or stones are being used a mixture of clay and sand may be applied; pure cement is not suitable as it tends to crack when the temperature changes frequently.

5. Inside Surfaces: The inside surface of the chimney should be smooth and without any obstructions, so soot will not be deposited readily and cleaning is easier.

6. Foundations / Construction: Where the chimney is built of stone or brick one has to keep in mind that this structure is the "heaviest" part of the hole house! It rests on a compartively small platform which carries the entire weight of the chimney which may pass through several floors. It is essential that chimneys be vertically. The size of the foundation depends on length and dimension of the chimney. Foundations for chimneys must be on solid ground, well below frostline. Construction of chimneys should be done in non-freezing climate! Note also that no wood should be in contact with the chimney, and that they should be given the chance to expand, although fixed in vertical line!

7. Height of the Chimney: Whereever possible the chimney should be higher than the top of the roof, and in any case not be less than three meters in height, and go at least 60 cm above the roofing. (If shorter, the draught may be reduced and combustion quality decreased).

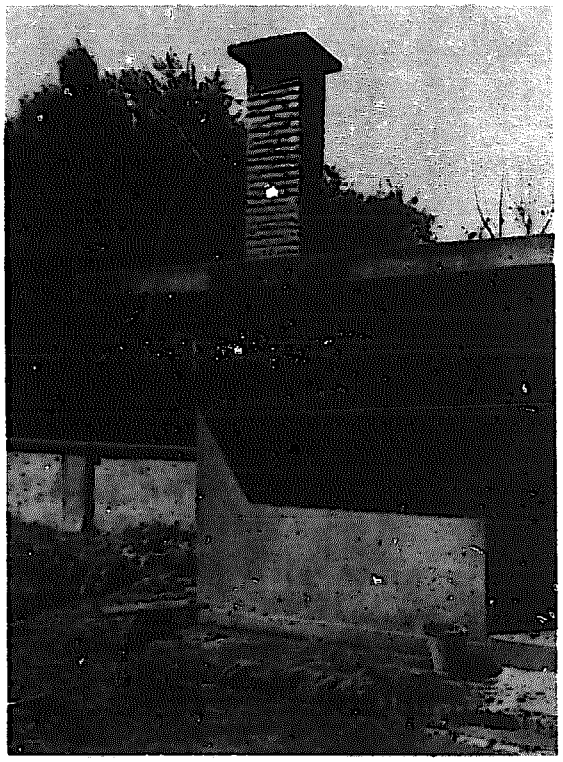
8. Top: The upper end of the chimney has to be covered with a rainwater cap. It is of course essential to have a cap design that minimises the effect of wind which may cause back draught; a tee-piece is often used. It is easier to protect the roof from penetration by rainwater, when the chimney passes through the roofing at the ridge; here is less water than on the lower part of the roof.

9. Cleaning: Chimneys need regular cleaning. This can be done by using a brush attached to a stick, and by moving it through the chimney pipe from above and from below. It is wise to have an easily accessible opening at the bottom (and below roofing) for the cleaning out of ashes and soot particles.

10. Sizes: Where bricks or stones are being used an inside square of 20 x 20 cm is very suitable for household applications. Where clay pipes or cement pipes are readily available they may be inserted in stone or brick structures which provide the required insulation. Where sheet metal pipes are being used a diameter of 100 to 200 mm is suitable, depending on the size of the stove to be fitted.

11. Number of Connections: It is best to have a separate chimney for each stove, for reasons of proper functioning and safety. It is also possible to have two or more stoves connected to the same chimney, provided the chimney size is increased accordingly and the branches are at different levels.

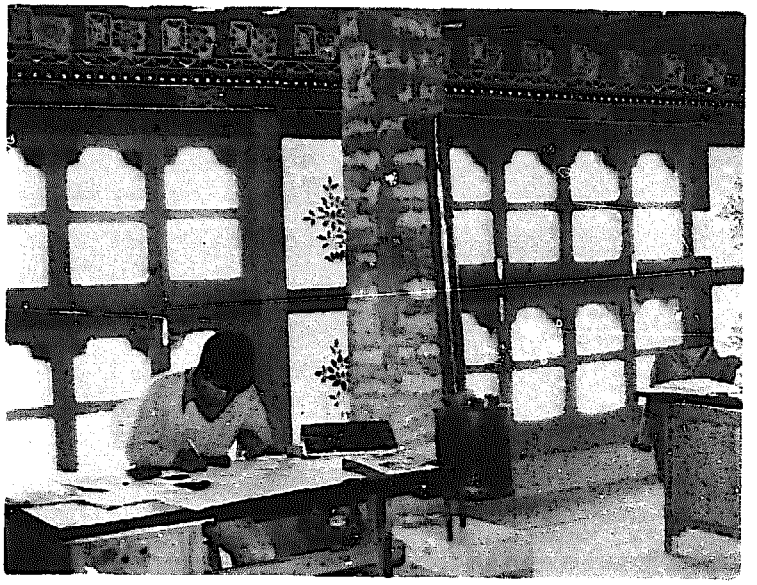
12. Before lighting a fire in a stove: A good draught depends on a certain minimum of fire in a stove respectively of a certain temperature inside the chimney. It may be worthwhile to light a newspaper at the smoke exit inside the stove near the chimney, especially when the chimney is cold.



Good chimneys are made of masonry: bricks, stones or prefabricated chimney blocks with hollow spaces for insulation. Chimneys on flat roofs should be approx. 1.5 mtr above the roofing.

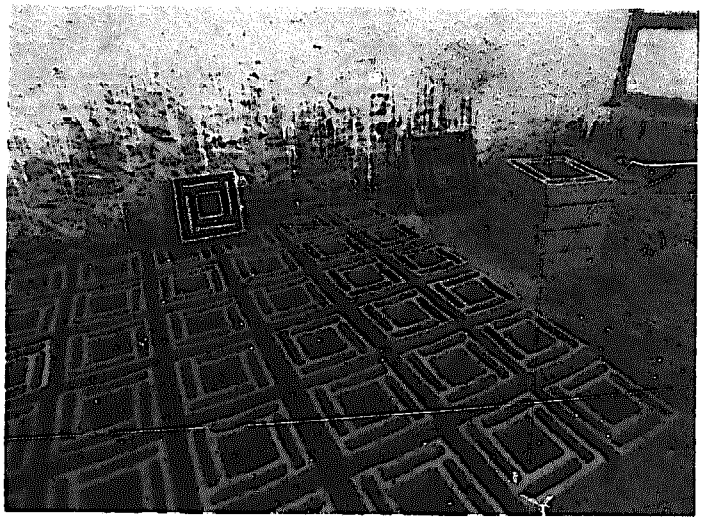
13. Danger: Chimneys are also dangerous! To prevent chimney fires regular cleaning is a must (say every three to four months, approximately). Foundations and joints must be airtight and strong. Fireplaces must not be completely sealed off from the chimney draught: the damper should have an open section and keep draught functioning. An almost dead fire can produce enough poisonous gas to kill a whole family in a quite closed room!

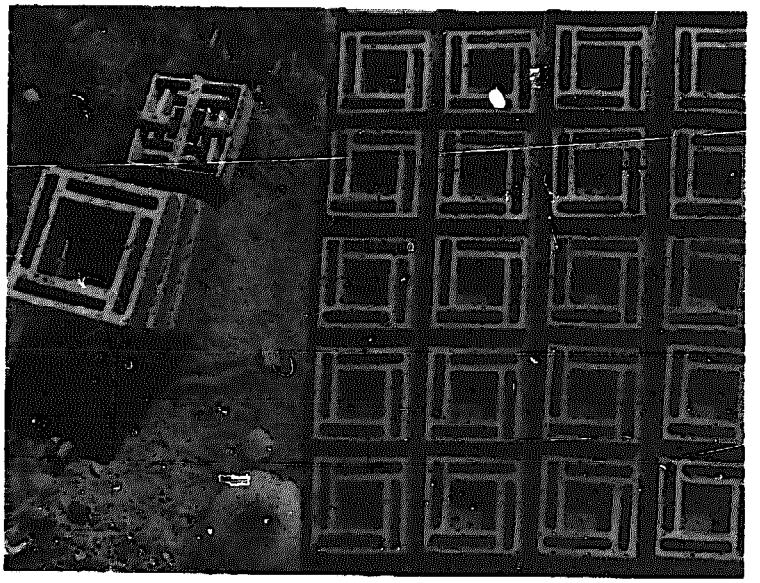
Well designed and properly constructed chimneys can greatly reduce the discomfort and health risk caused by smoke. Smoke is a problem encountered especially in the homes of poorer people: chimney construction deserves more attention and support!



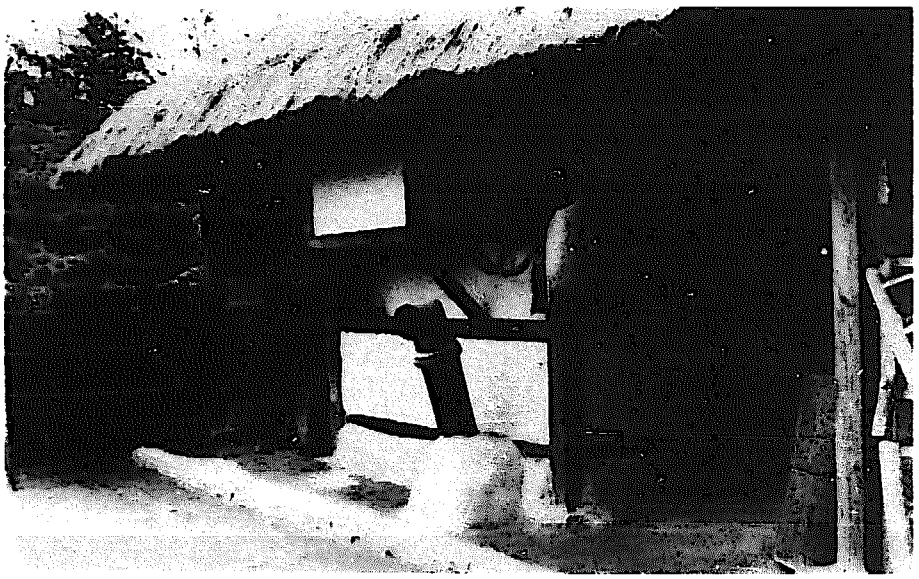
A new chimney, made of prefabricated chimney blocks, with a small room heater fitted to it.

Newly made chimney blocks at the Forestry Training Center in Bumthang. The mould is made of wood.



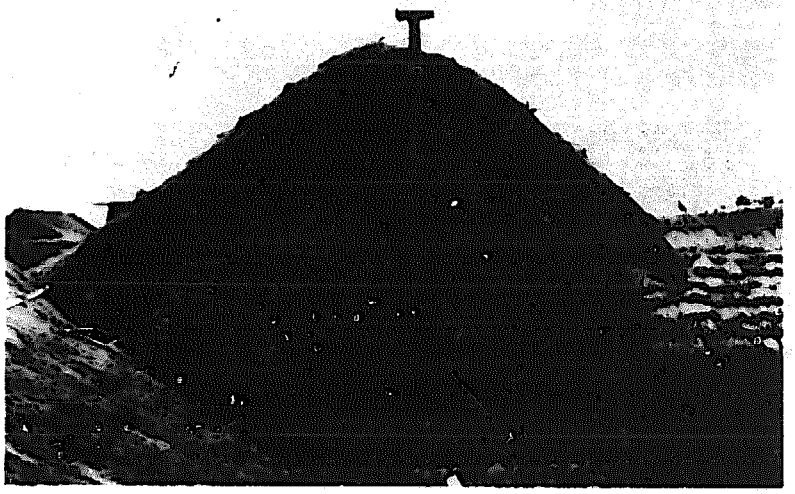


It takes three people one day to produce approx. 50 such blocks. One bag of cement is required for 12 blocks.



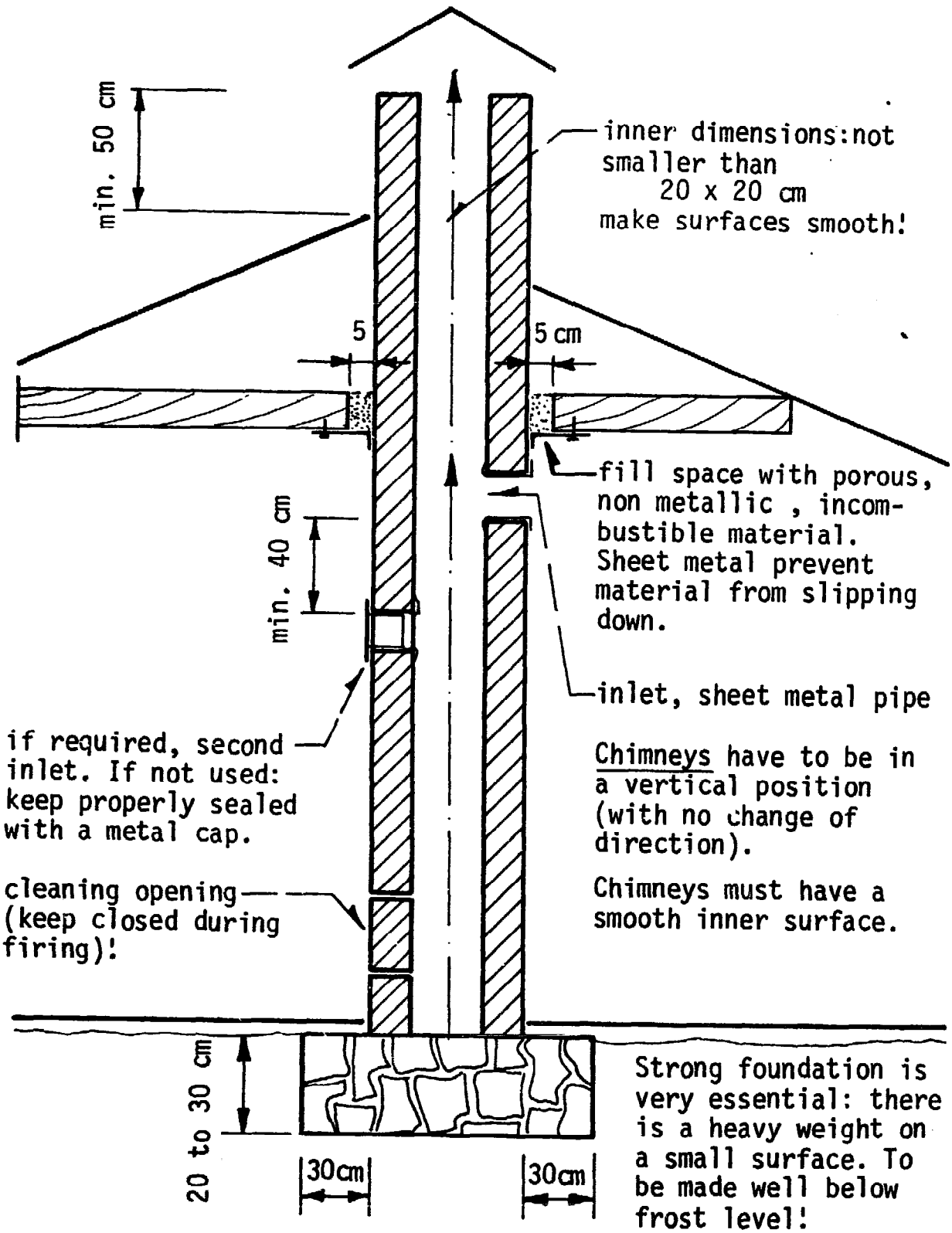
Chimney-pipe made of fired-clay. This solution is from Korea, Suweon.

Chimney pipe made of fired clay. Where the temperature remains quite warm chimneys may be fitted outside the house.



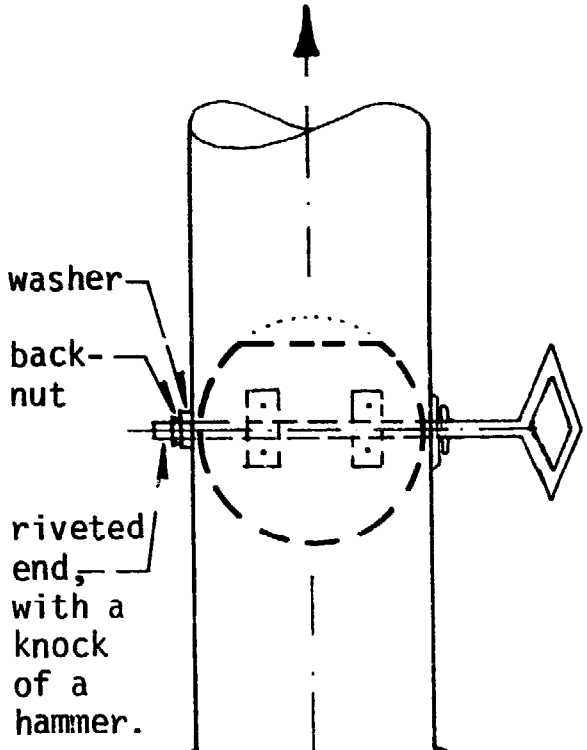
Low-cost chimney installation. Workable solution which will need replacement after some years.

MASONRY CHIMNEY



DRAUGHT CONTROL

CROSS VIEW



Each wood-fired device (Bukharis, cooking range, hot water stove, etc.,) needs to have a draught control. In most cases a

damper (flap valve)

will do the job.

Note that the closing should never be 100 percent, so that poisonous gas can still escape through the chimney - and not enter the rooms)!

Dampers (flap valves) have to be fitted properly: with a "key-handle", having the same direction as the damper -to indicate to the users its position. Such dampers need to be near the stoves!

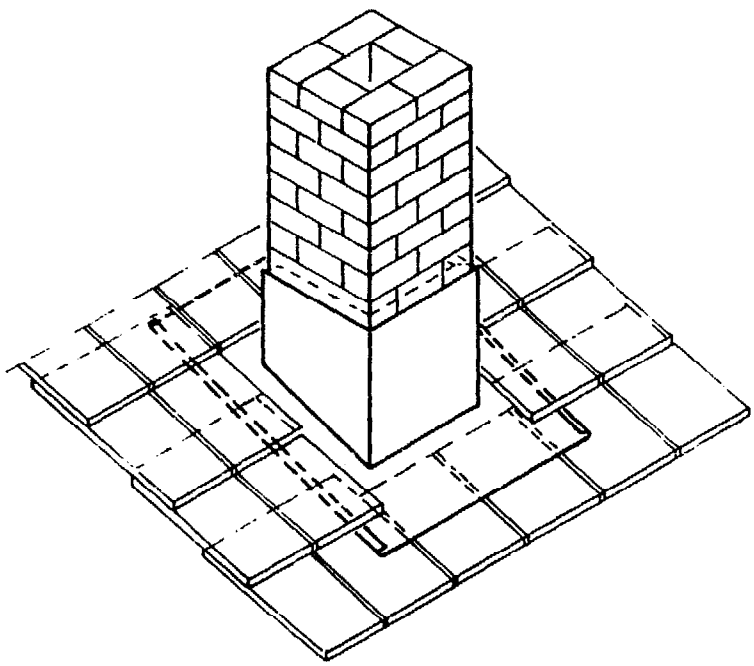
STOVE / BUKHARI, etc.

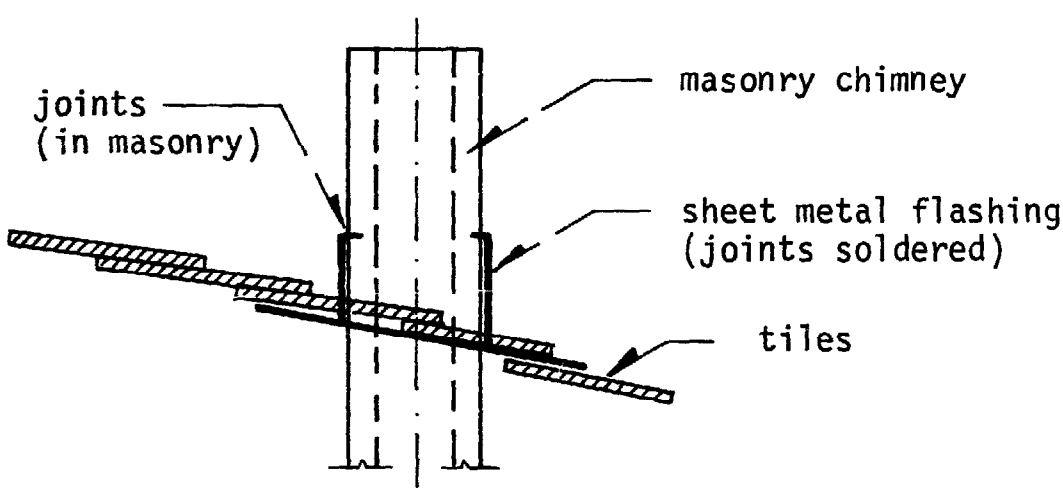
IMPORTANT:

Dampers need to be made of strong material. preferably of cast-iron; or of thick sheet metal

ROOF / CHIMNEY RAIN PROTECTION

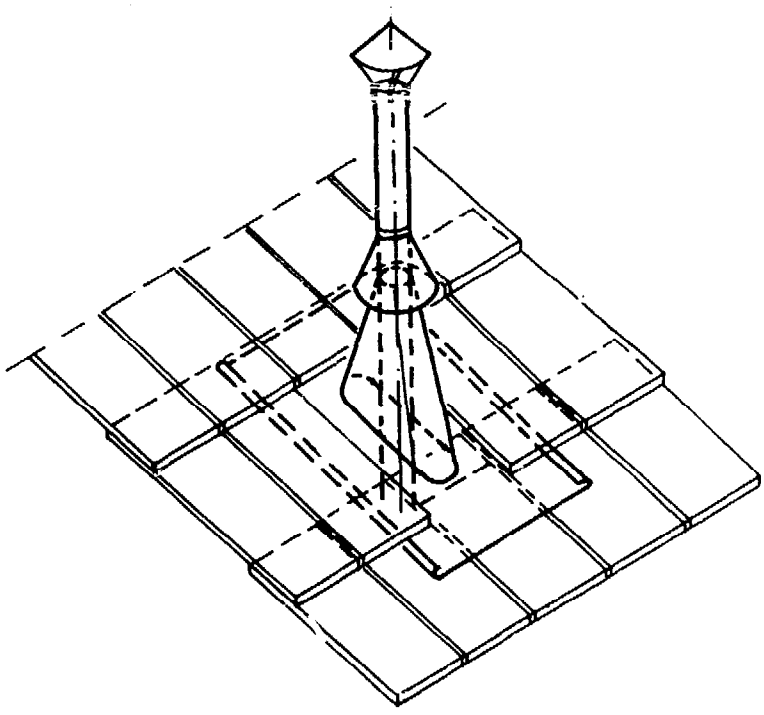
MASONRY CHIMNEY

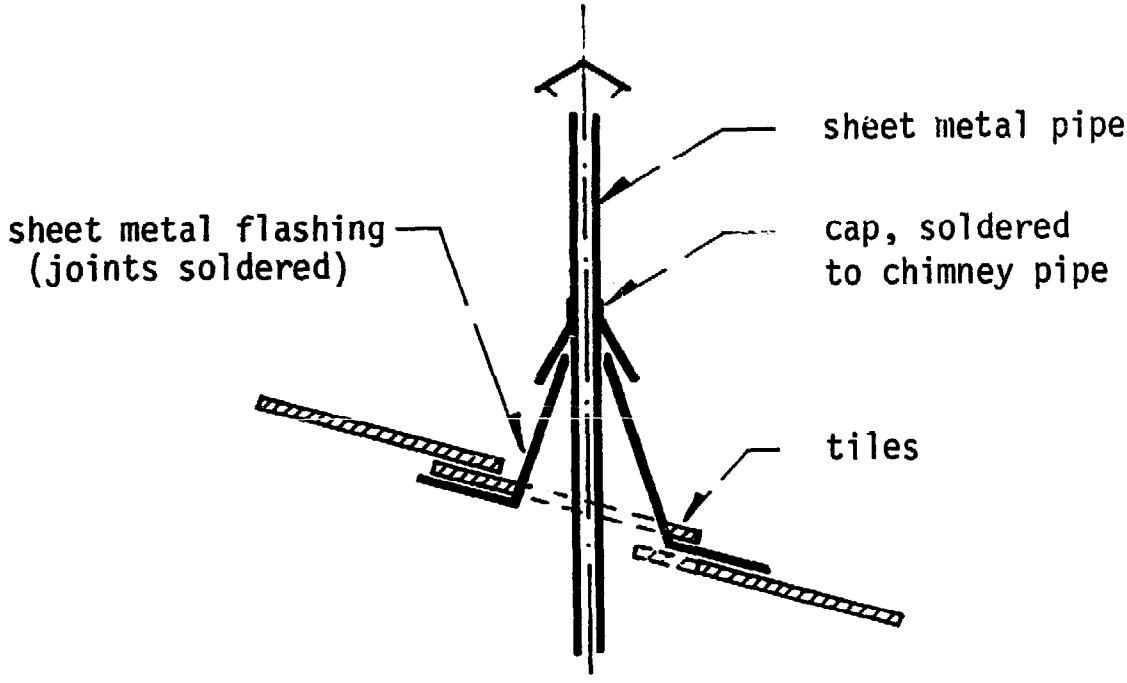




ROOF / CHIMNEY RAIN PROTECTION

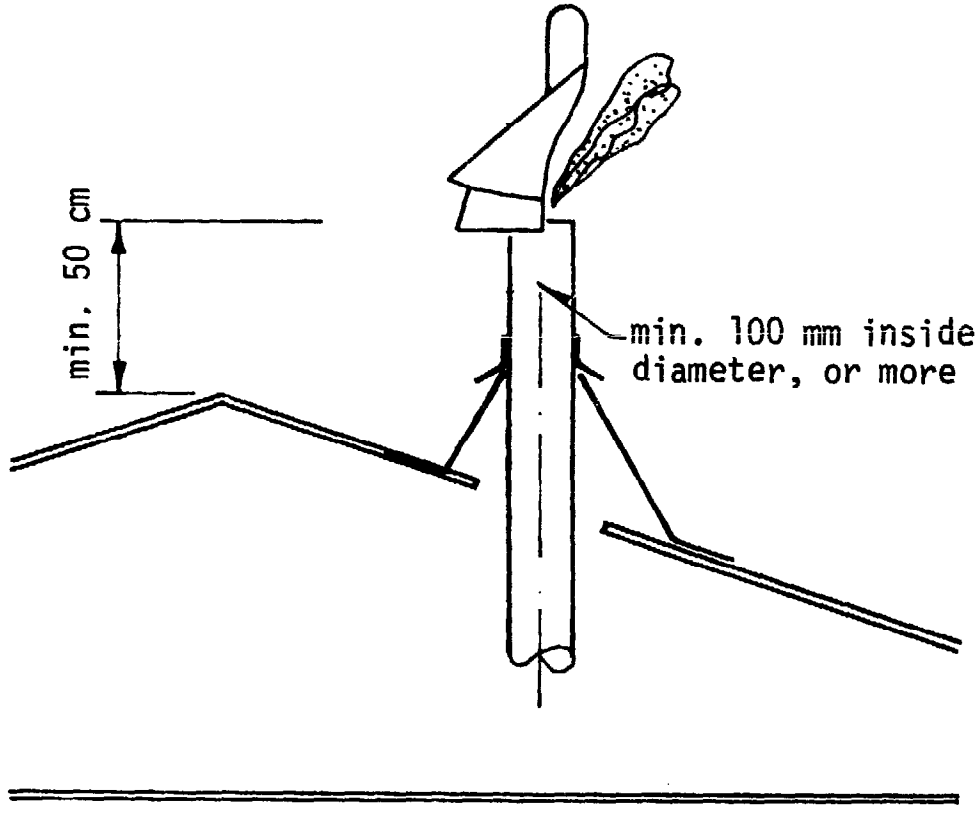
SHEET METAL PIPE

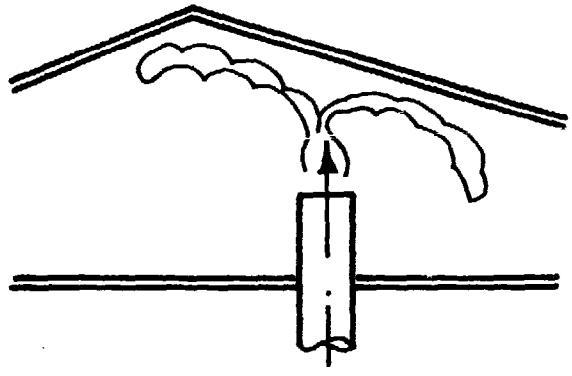




CHIMNEY PIPES ABOVE ROOF TOP

Correct Installation



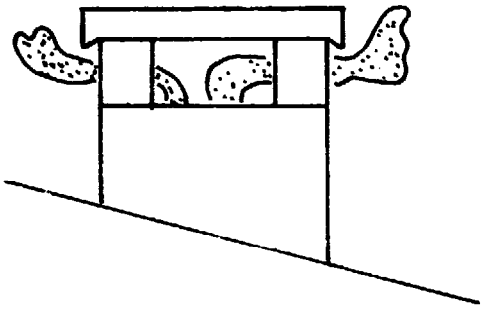


W R O N G

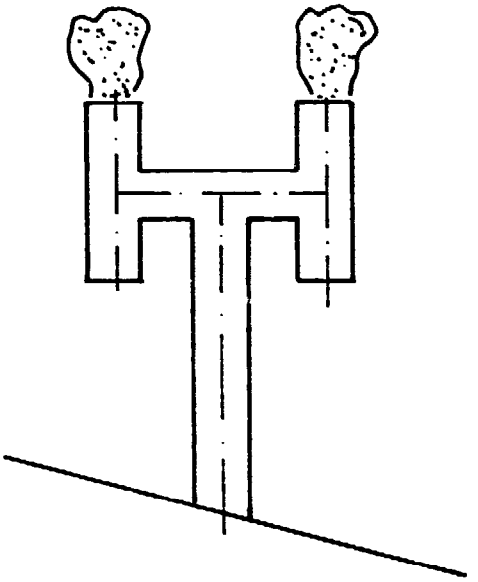
It is wrong and dangerous to put the smoke exit under the roof!

TOP OF CHIMNEYS

NORMAL TOP COVER

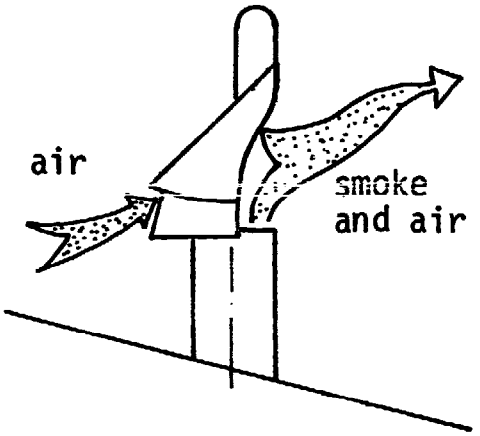


The top of a chimney requires a hat for protection from rain. However, the design may need to to be in such a way that the draught is increased, even with wind from the side (without providing back-flow to the stoves.



H - PIPE

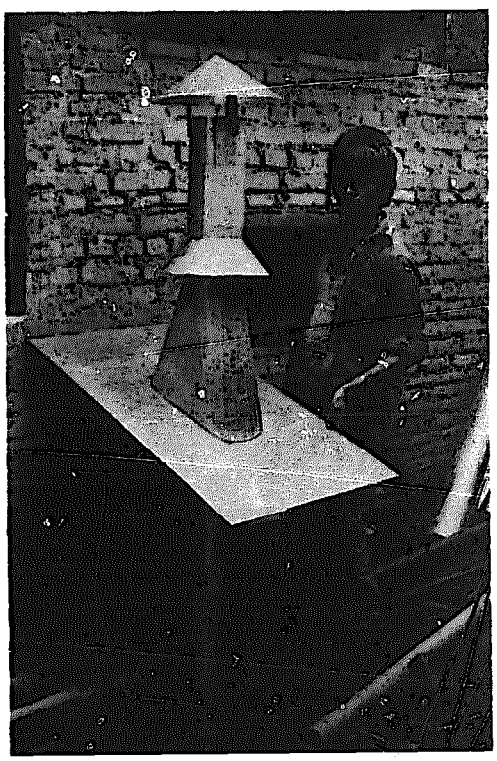
The diameters of the pipes should be the same as that of the main chimney pipe, not smaller than 100 mm inside



TURNING CHIMNEY HAT

This hat turns with the wind. It is designed to increase the draught, without back-flow to stoves.

It is good to have several chimneys for many stoves. It is also easier to have the roof-chimney joints protected from rain, if the chimneys are near the ridge.



A roof flashing, made of sheet metal, ready for installation. (Kathmandu Metal Industry).

A chimney needs a proper flashing, to protect the house from leakages! This flashing is made of sheet metal by the Mechanical Training Center, Balaju, Kathmandu.

SHEET METAL PIPES

Cooking stoves and room heaters normally are connected to main chimneys with sheet metal pipes. Quite often single room heaters (Bukharis) are fitted simply by having a single pipe passing through walls or ceilings.

There is a tendency to overlook the importance of proper dimensions of pipes and safety during installation, (stabilizing of pipe).

Diameter: The diameter of sheet metal pipes varies with the stove to be fitted:

- small room heater, 1-pot stove	100 to 120 mm Ø I.D. (Inside Diameter)
- 2 pots stove	120 to 150 mm Ø I.D.
- 3 pots stove	150 to 200 mm Ø I.D.

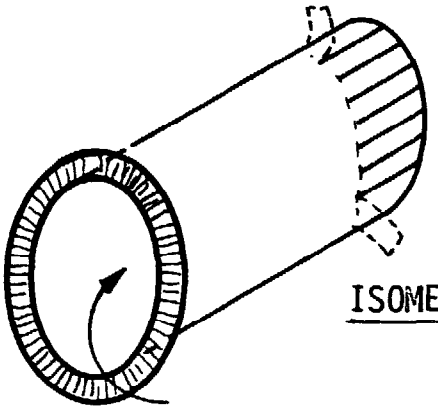
Length: Such pipes provide some additional warmth to the rooms, but should not be very long (say maximum three to four meters) and fitted firmly with clamps and hangers (but pipes should never touch directly walls, ceilings, etc.).

Dampers: Near the stove a damper is required for draught control. This is essential to reduce firewood consumption. Note that a damper should never close completely, so that poisenous gas can still escape through the chimney - and not enter the rooms!

Safety: Pipes can get very hot and are a constant risk. Where they pass through walls and ceilings proper installation and safety precautions are required (see drawings). Replace corroded pipes in time, before anything is set ablaze!

Clean the pipes regularly to remove soots, for efficient operation and also to prevent chimney fires!

CONNECTION TO MAIN CHIMNEY

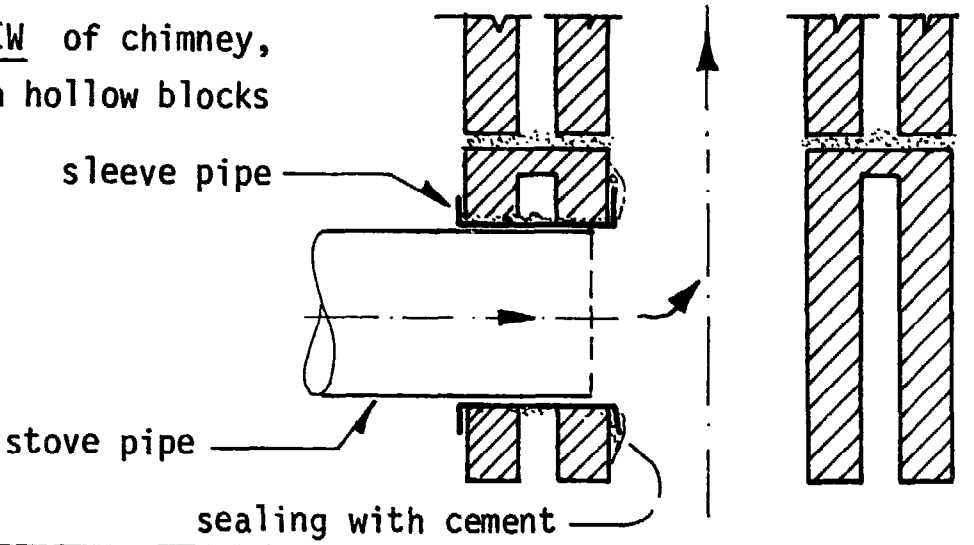


The main chimney will have connections from stoves, through sheet metal pipes.

A sleeve pipe is fitted into the masonry chimney and sealed with cement (inside and on the joints).

ISOMETRIC VIEW of sleeve pipe, made of sheet metal.

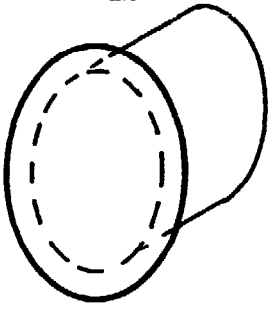
CROSS VIEW of chimney, made with hollow blocks

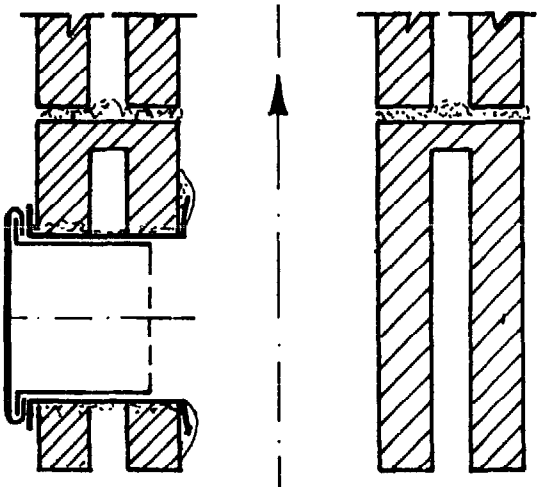


CROSS VIEW of chimney, made with hollow blocks

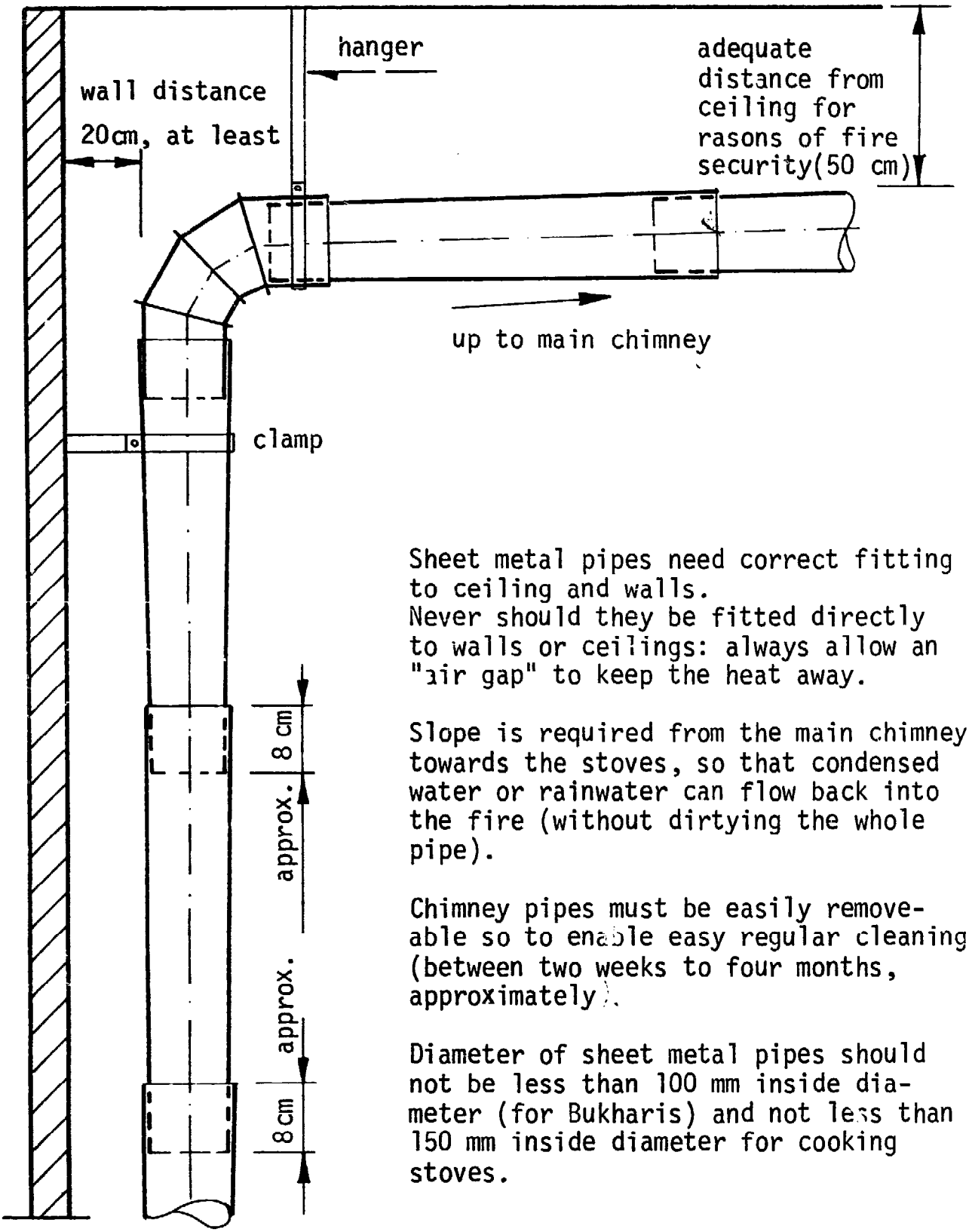
****

ISOMETRIC VIEW of cap





SHEET METAL PIPE INSTALLATION



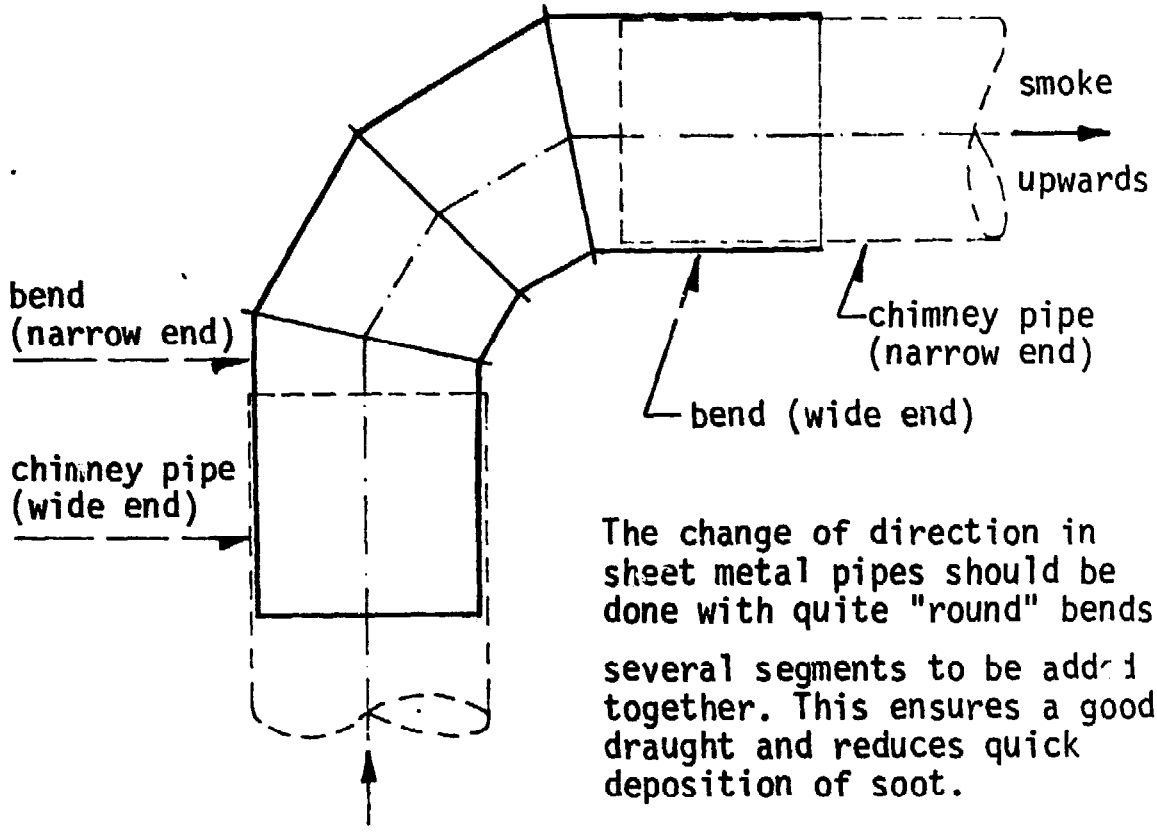
Sheet metal pipes need correct fitting to ceiling and walls.
Never should they be fitted directly to walls or ceilings: always allow an "air gap" to keep the heat away.

Slope is required from the main chimney towards the stoves, so that condensed water or rainwater can flow back into the fire (without dirtying the whole pipe).

Chimney pipes must be easily removeable so to enable easy regular cleaning (between two weeks to four months, approximately).

Diameter of sheet metal pipes should not be less than 100 mm inside diameter (for Bukharis) and not less than 150 mm inside diameter for cooking stoves.

CHANGES OF DIRECTION WITH SHEET METAL PIPES



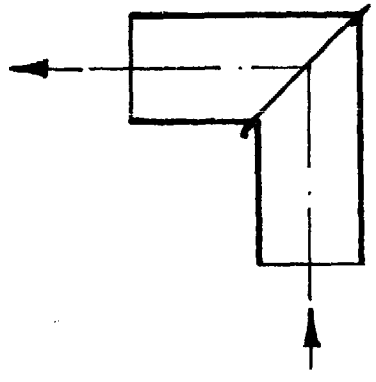
The change of direction in sheet metal pipes should be done with quite "round" bends:

several segments to be added together. This ensures a good draught and reduces quick deposition of soot.

W R O N G

It is wrong to have "elbows" fitted in smoke pipes.

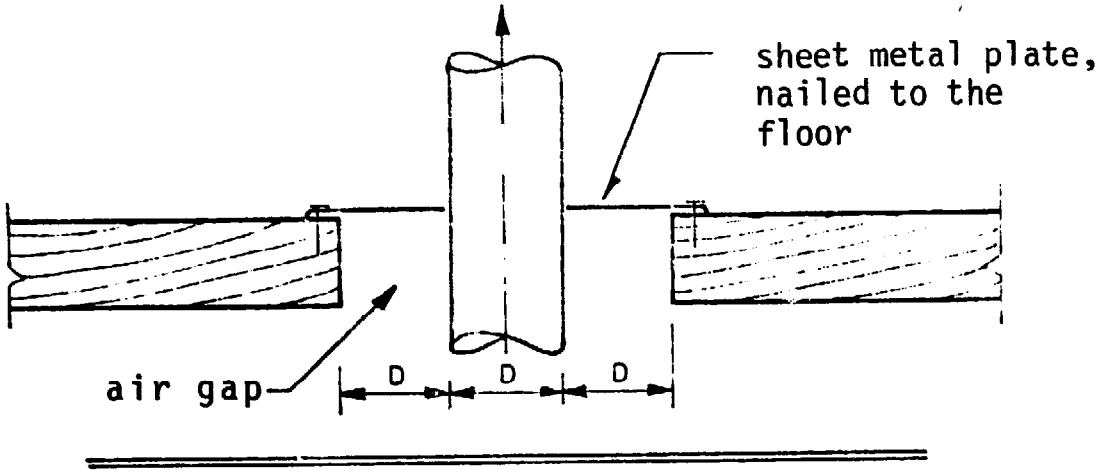
They reduce the draught considerably and clogs up the pipe in no time.



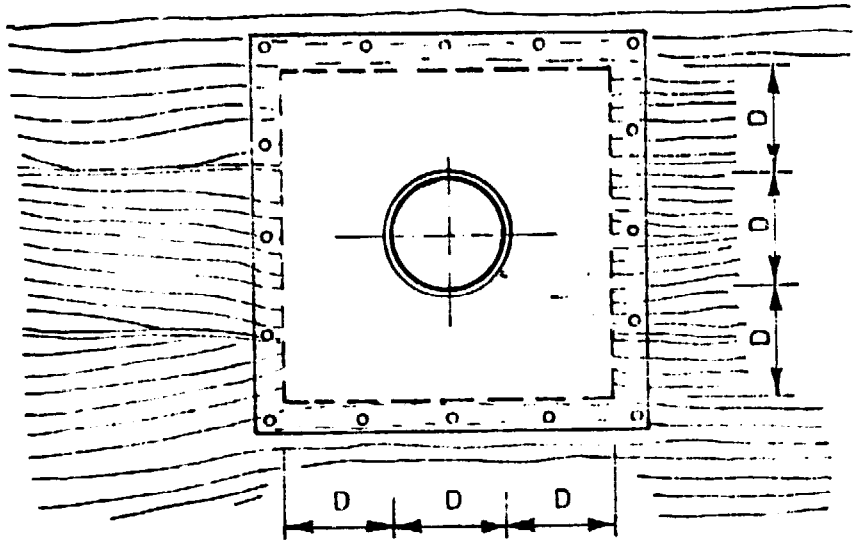
PASSING THROUGH CEILINGS

A sheet metal pipe should never be in direct contact with the ceiling materials. Of course the air gaps need to be closed, with a piece of sheet metal, so that the heat does not escape through the ceilings!

CROSS VIEW



TOP VIEW



To prevent heat transfer from the pipe to the ceiling materials a space, all around the metal pipe, of the diameter of the pipe (or even with more distance) is required.

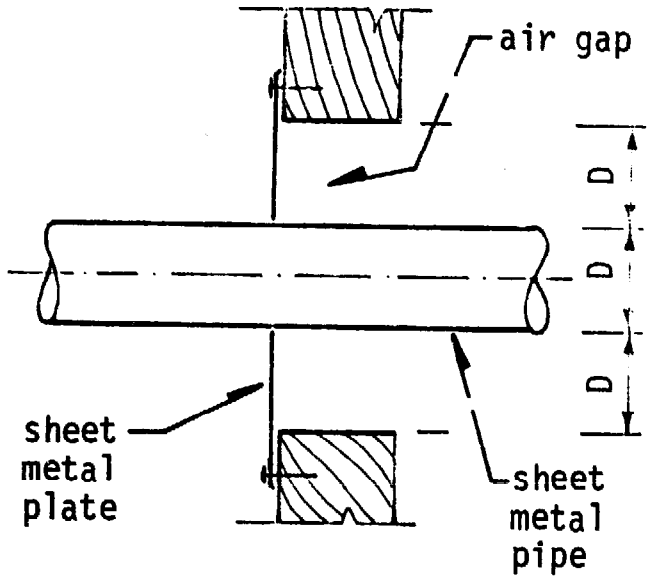
PASSING THROUGH WALLS

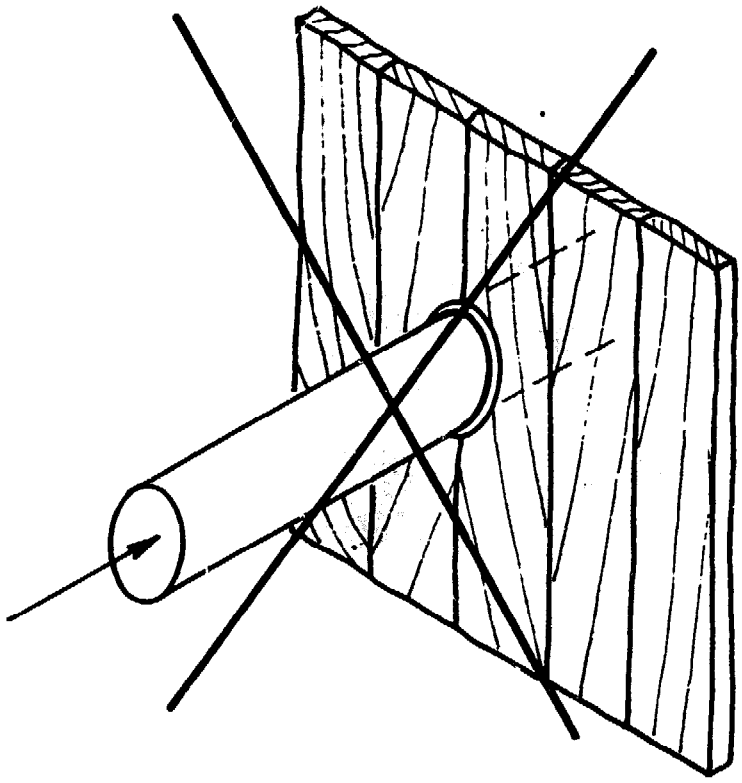
Sheet metal pipes should never be in contact with the wall materials.

Where wood or other dangerous materials are used a "safety gap" is very essential, to prevent fire hazards.

A sheet metal plate keeps the pipe in position - on the other side an open space interrupts the heat transmission.

CROSS VIEW

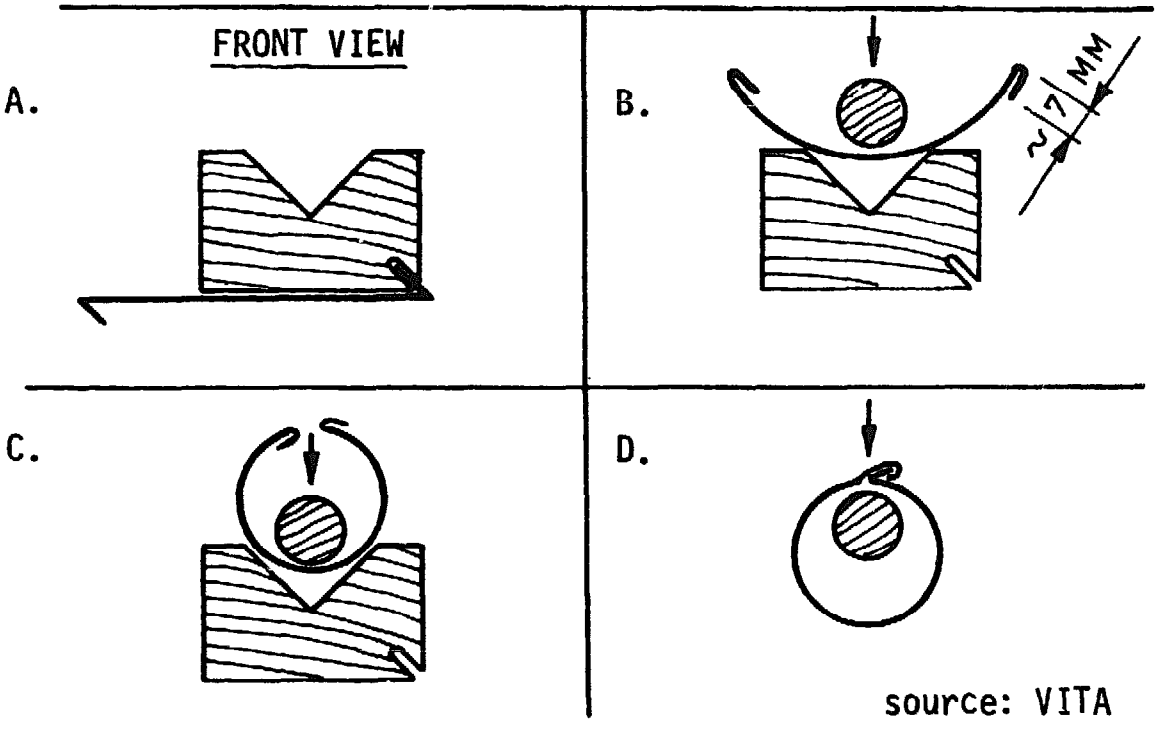




W R O N G

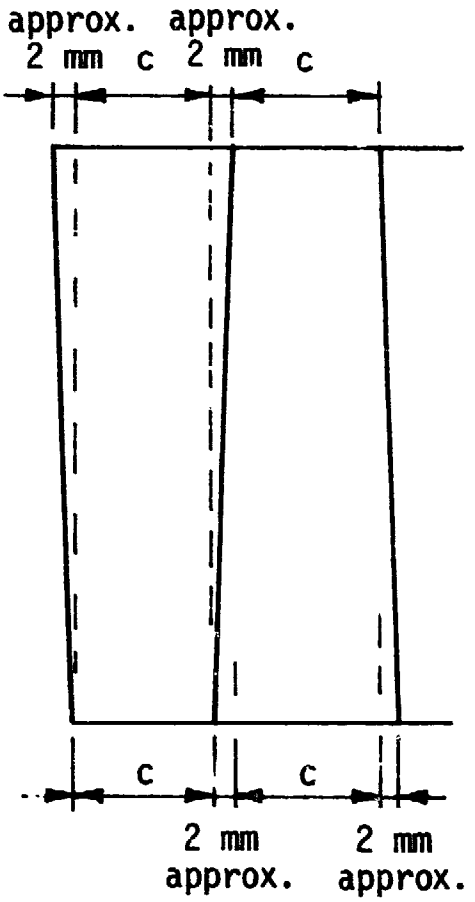
Don't pass pipes through walls without having a sheet metal plate!

Simple sheet metal pipe manufacturing tool (made of wood)



source: VITA

Demonstration of sheet metal pipe manufacturing, using a simple tool made of wood.



c = circumference (incl. seams)

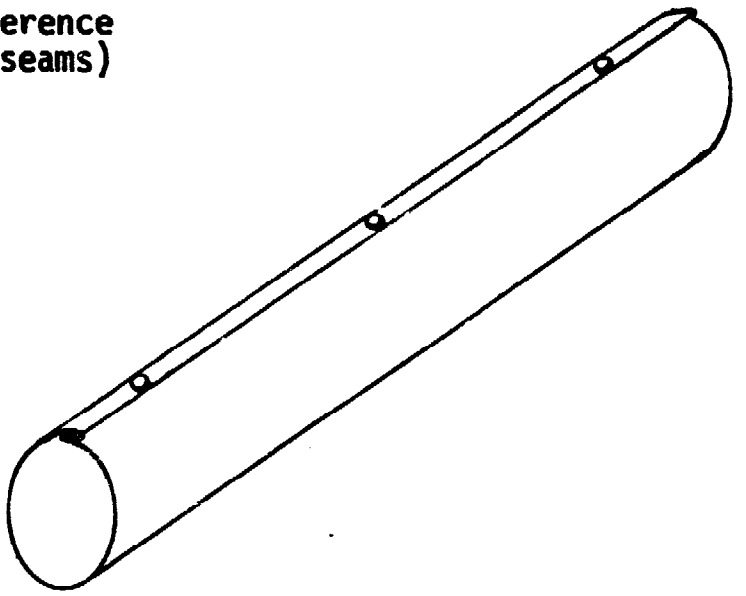
MANUFACTURING OF SHEET METAL

PIPES

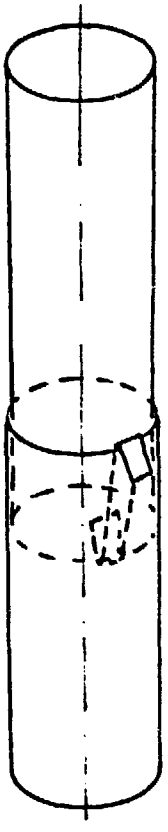
Sheet metal pipes should have a narrow end and on the other side a wide end. This can easily be achieved by having the pipes cut in a "conical shape".

Of course provision needs to be made for the seams.

Properly made pipes should have a slip of approx. 8 cm into the other pipe.



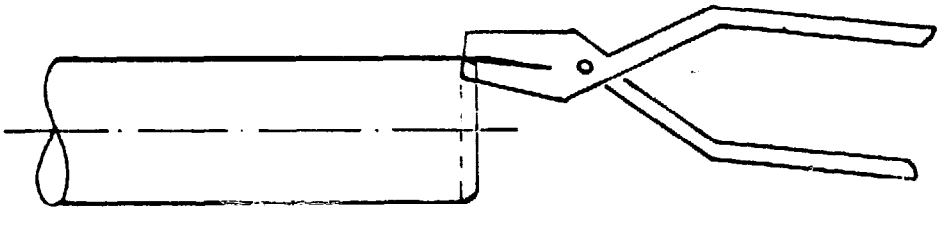
Sheet metal pipes may be riveted or folded. If folding is applied some rivets are required to prevent the seams' opening.



FIXTURE OF VERTICAL SHEET METAL PIPES

In cases where the sheet metal pipe needs a fixture to prevent it slipping into the lower pipe a small "S"-shaped metal strip will do the job.

Narrow end of pipe



To enable easy fitting the narrow end of the pipe should be prepared this way (and where necessary also the wide end - to keep the air gaps small).

STOVE AND CHIMNEY SAFETY

Location:

1. Stoves should not block doors
2. Keep sufficient distance from combustible materials, walls, ceilings, etc.
3. Wood floors need to be protected.
   Room Heaters (Bukharis): should stand on a large sheet metal plate and have a ventilated air space between floor and bottom of the stove.
   Cooking Stoves: should be fitted on a fire-proof material on sufficient height (bricks, stones,etc.) with a small platform in front to prevent ash falling on wooden floors.
4. Bukharis are very light in weight, therefore they should be attached to the floor to prevent them falling over.
5. Stove pipes have to be short and mainly vertical. Avoid long horinzontal pipes and many bends (don't use elbows.)
6. Secure pipes with clamps to ceilings, etc.
7. Masonry chimneys need strong foundations and a fixture in each floor (stability during earthquakes).
8. Chimneys need to extend far enough (50 cm) above the roof to draw properly (and should never end below the roof in the top floor!)

Use:

1. Have plans for emergency escape.
2. Keep a safe distance away from combustibles: fire wood, clothes, boxes, etc.
3. Don't leave fires unattended.
4. Child safety: Keep a frame (railing) around the Bukharis (room heaters) to protect children from dangerous burns. Do not let children play with stoves and matches!

   Don't let handles of pots extend over the edges of stoves -this prevents children pulling down the cooking utensils which probably have hot contents.
5. Remember always that grease is flamable liquid and should never get too hot. If spilled around the stove - clean it up.
6. Make sure that no pot or kettle boils dry, otherwise food could catch fire or pots could melt and turn over.
7. Keep a handful of salt near the cooking range. With this a chimney fire could probably be extinguished as soon as it starts.
8. Help your community organization to be available in cases of fire.
9. A fire insurance can help you in case of losses!

Maintenance:

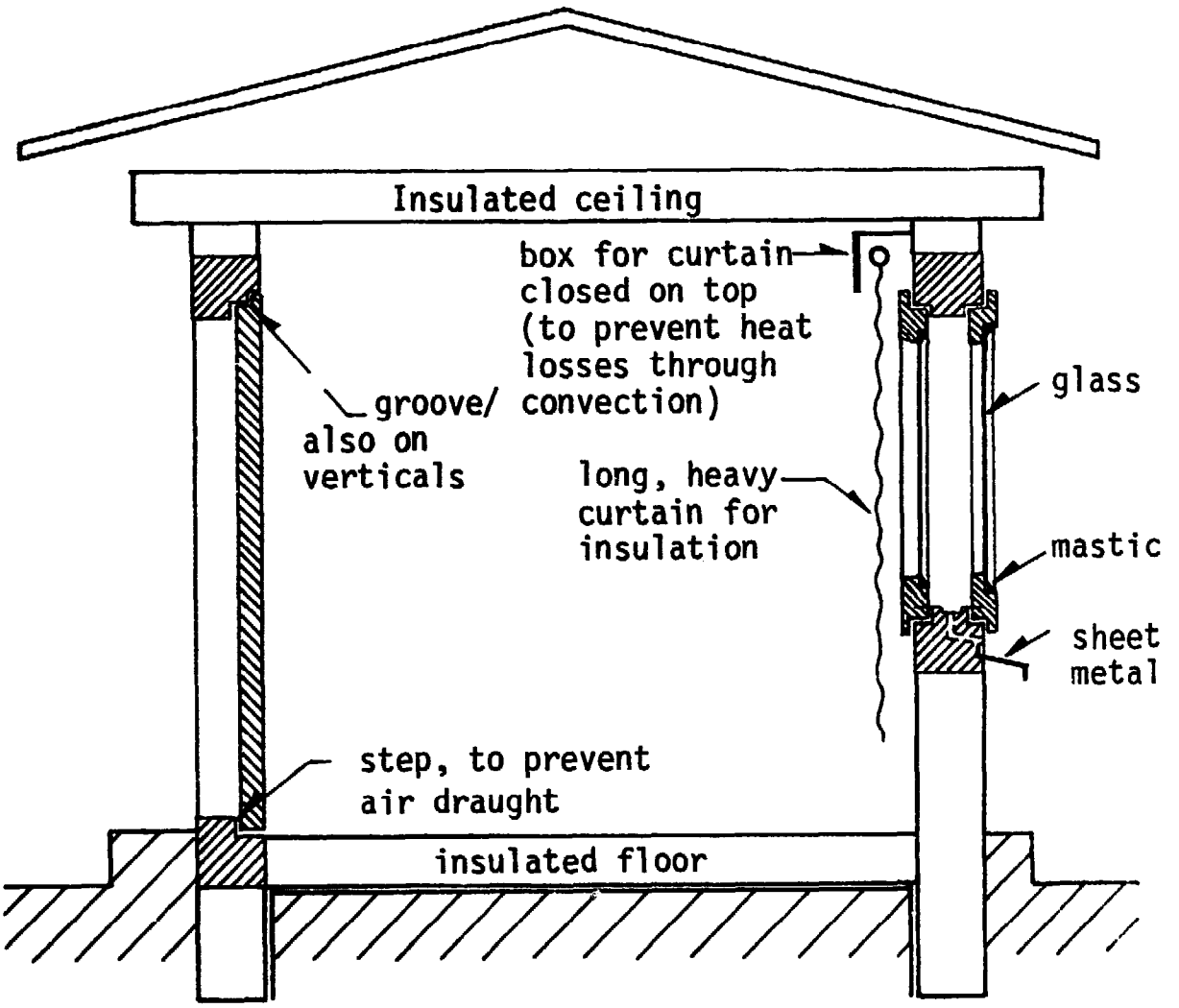
1. Stoves and chimneys need periodical checking for signs of deterioration. Defective parts need repair or replacement.
2. Keep chimneys, pipes and stoves free from ashes and soot.
3. Ashes removed from the stove should be placed safely outside the house.

A WORD ON ROOM HEATING

Heating goes along with insulation! A lot of warmth can be gained through insulation:

- suitable materials on top ceiling.
- windows with glass or transparent materials; double glazing in windy and/or cold regions.
- doors and windows to fit properly groved frames (to reduce heat escape through gaps).
- keep windows closed with shutters; heavy curtains (in proper boxes on top) during night time.
- continue the traditional way of making door steps; this considerably retards rapid heat loss.
- it is essential to keep doors and windows closed!

IMPROVED DOOR AND WINDOW DESIGN
(REDUCTION OF HEAT LOSSES)



TOP

ALTERNATIVE RENEWABLE ENERGY RESOURCES

Forests are renewable resources, however, due to many reasons they are disappearing much too fast (for example because of population increase, paper/timber industry, management, etc.). Probably the rural population is suffering most, and different measures are required. One of these is improved forest management, another is the improvement of wood fired devices.

In addition, there are also other useful alternatives:

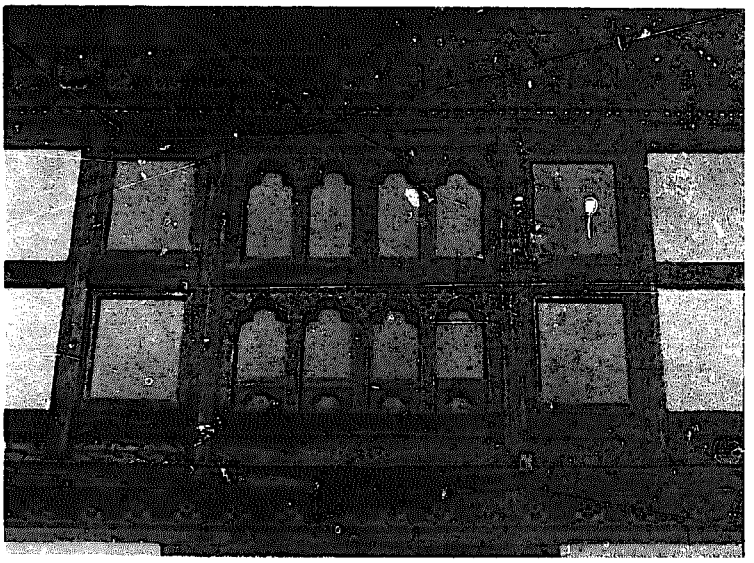
- Fuel gas from Cowdung
- Solar utilization / insulation
- Mini water power utilization
- Other natural resources

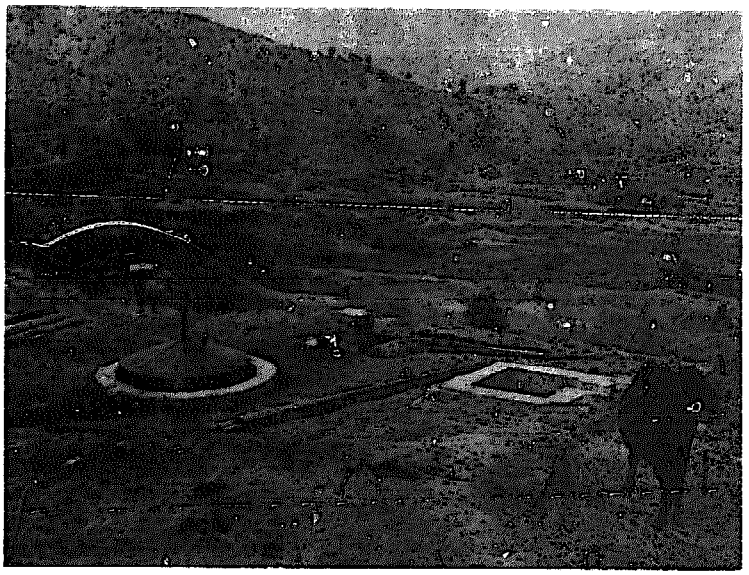
Of course each of them has it's own potential and limitations, but several alternatives may prove an advantage, if made available and to function properly.

Many problems can be solved when farmers undertake the task of growing their own trees to satisfy their requirements for wood (cooking; timber and fodder) -just as they grow their own food - which may also be more effective than large-scaled projects!

Combined energy utilization: a chimney for the wood-fired devices and solar collectors (below the windows, first floor) for hot water provision.

Passive solar heating: besides the small windows the clever house owner fitted glass panels. With this he gains more light and warmth.





Fuel Gas from Cowdung: a newly constructed biogas plant above Lobeysa in Bhutan. Such plants can provide fuel for cooking and lighting and also fertilizer. This system needs a fairly warm climate to be operational.

MANUFACTURERS & SUPPLIERS

Mr. Akkal Man Nakarmi KATHMANDU METAL INDUSTRY 12 / 514 Quadon / Nagal Chhetrapati / Kathmandu Nepal	Improved cooking stoves, using cast-iron parts, hot water production with improved stoves for bathing- water jackets Metal parts for large-sized cooking pots Sheet metal pipes, bends roof flashings, etc.
NATIONAL STRUCTURE AND ENGINEERING COMPANY Patan Industrial Estate Lalitpur / Kathmandu Nepal	Improved cooking stoves, using cast-iron parts
FORESTRY TRAINING CENTER Lame Gompa Bumthang / Bhutan	Improved cooking stoves, using cast-iron parts, hot water production with improved stoves for bathing production of special chimney blocks, with hollow spaces
BUMTHANG WORKSHOPS Jakar / Bumthang Bhutan	Improved stoves, made of sheet metal and with cast-iron parts, bath oven, sheet metal pipes and bends, Bukharis
TECHNICAL TRAINING SCHOOL, KHARBANDI Phuntsholing / Bhutan	Improved cooking ranges and room heaters, made of sheet metal
PUBLIC WORKS DEPARTMENT Thimphu / Bhutan	Cooking stoves, made of rammed earth and chimneys made of sheet metal pipes

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Due to such effort and support by so many people, many new developments can now be put to use in improving people's welfare.

FIRE PROTECTION
FOR YOUR FAMILY AND YOUR PROPERTY

- Make sure that your stoves are installed properly
- Don't leave fires unattended
- Keep combustibles: firewood, clothes, boxes, etc., a safe distance away
- Do not let children play with matches and stoves
- Clean chimneys, pipes and stoves regularly (to prevent chimney fires)
- Remember always that grease is flamable liquid and should never get too hot. If spilled around the stove - clean it up.
- Make sure that no pot or kettle boils dry, otherwise food could catch fire or pots could melt and turn over.
- Have fire-fighting equipment ready
- Have plans for emergency escape
- Help your community or organization to be available in cases of fire
- Remember in time that fire insurance will help you in case of losses!