

# **Introduction to the Production of Compressed Stabilized Earth Block (CSEB) using AnyWay Soil Block**



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## INTRODUCTION

**AnyWay** Solid Environmental Solutions Ltd. is a global leader in providing soil stabilization products to the infrastructure and development sectors. Our products are based on a unique technology patented worldwide.

One of the many alternatives available for building low cost housing, Compressed Stabilized Earth Block (CSEB) construction is one of the most favorable. **AnyWay** unique products maximize the use of local soils (even poor quality soils) as the primary building material for the homes.

In addition, **AnyWay** has developed a Rural Community Development Plan (RCDP) which incorporates low cost housing and road building construction projects utilizing our products with the transfer of the technology and training of local populations in the skills associated with these applications.

Earth building using **AnyWay's** new line of products has much to offer those who place value upon environmental sustainability. It enables us to incorporate the land we live on into our buildings; it saves energy both in the process of creating the building materials and in importing them to the building site; it creates more efficient thermal and acoustic isolation; and adapts itself to the local environment in which we live.

### **Aim for This Manual**

This manual aims to give the basics of block production.

Please note that it is only an introduction to block production.

**The development of this manual is based on work done with "Auroville Earth Institute" and its user and production manual.**

## The environmental advantages of building with Stabilized Compressed Earth Blocks using AnyWay products

Earth building using AnyWay's new line of products has much to offer those who place value upon environmental sustainability. It enables us to incorporate the land we live on into our buildings, saves energy both in the process of creating the building materials and in importing them to the building site, creates more efficient thermal and acoustic isolation, and adapts itself to the local environment in which we live.

In the last years has arisen a global movement that emphasizes the need to use advanced technologies in the building process which protect and preserve the world we live in. AnyWay's innovative technology enables the use and recycling of local readily available materials while creating strong and easy to use earth blocks.

### **Cost and Energy Efficient in production**

The cost of an Earth Block wall system is about 40% cheaper than conventional systems. Earth Blocks are made on-site, saving in transportation costs and fuel consumption while requiring little energy in the block making process.

### **Cost and Energy efficient through the lifespan of the building**

Earth Block building creates incredible energy savings for the owner throughout the life of the building. The thermal mass quality of Earth Blocks alone can offer the owner savings of up to 14% on cooling and heating costs. When the owner's home energy requirements are reduced this much, the community saves as well.

### **Non-Toxic**

Block making itself is a non-toxic process, and accordingly the buildings themselves are comparatively clean. Often, man-made ingredients of modern construction (like concrete) contribute to an environment that is filled with toxic chemicals and gases. It's a win-win for both occupant and the community when new buildings are constructed with earth-friendly materials.

### **Structural walls**

A wall system using Earth Blocks can be as much as 40% cheaper than the conventional alternative.

### **Environmentally Friendly**

**When you consider the attributes listed above, the underlying theme is that building with Earth Blocks is environmentally friendly. From the construction of the block itself to the finished home, this is a way of building which benefits everyone.**

### **Durable**

When you consider that the oldest structures standing throughout the world today are made of earth, to say that Earth Blocks are durable seems an understatement.

### **Fire and Pest Resistant**

Earth Blocks are fire, bullet, sound and bug resistant to the point of being considered "proofed". Using Earth Blocks increases your comfort and your enjoyment of your home.

### **Virtually Soundproof**

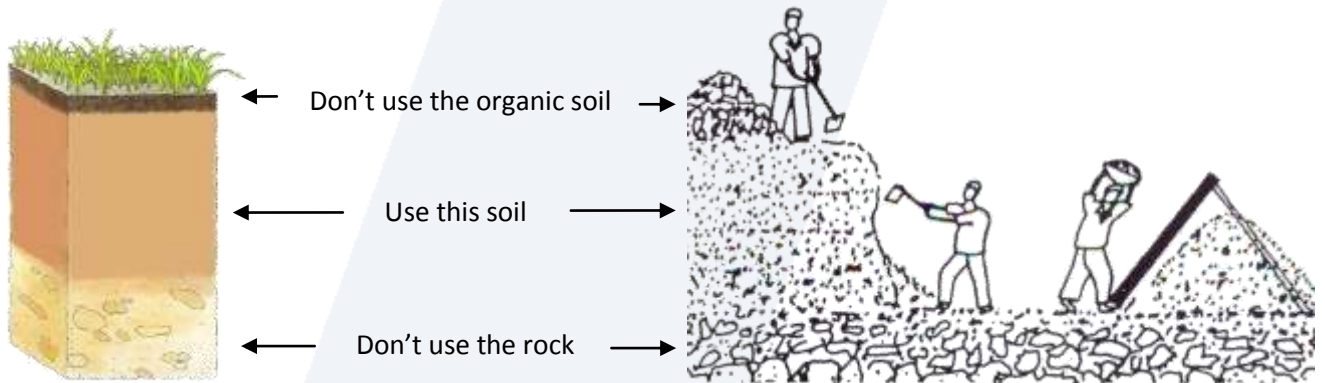
Earth Blocks are so dense a building material that, if they wish, occupants can be effectively "shut off" from the outside world. Earth block buildings create their own world on the inside which most people find is an added attraction.

### **Aesthetically Pleasing**

The use of Earth Blocks as the primary building material provides an opportunity to explore an endless number of creative architectural designs. The natural colors of the earth can be used to enhance the warmth of the living environment. Exteriors are typically given a weather-resistant skin which can be colored or left natural, while interiors can be plastered with a variety of decorative mixtures or left exposed. Arches and rounded corners are options that allow for additional flexibility in design. Earth Block buildings have a look and feel which envelops their occupants and blends beautifully with the natural world.

## COMPOSITION OF SOIL

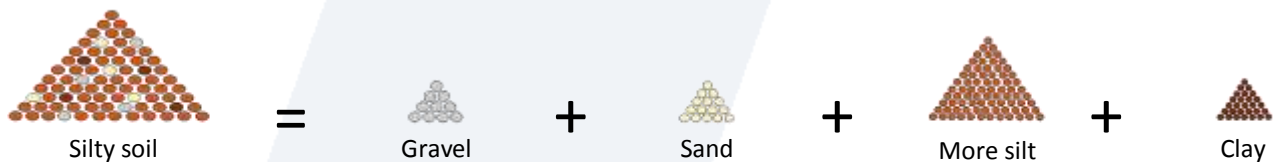
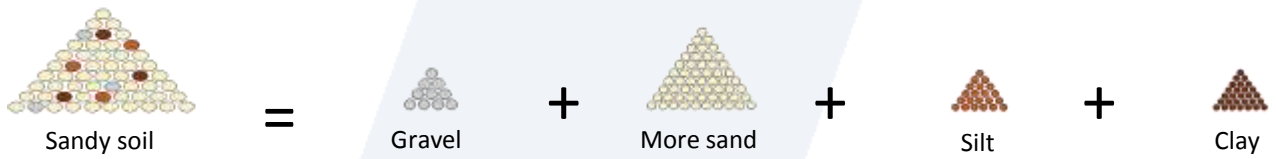
Soil is the result of the transformation of the underlying parent rock: it is transformed into smaller components and aggregates by the weather, the water, biological processes and by animal and plant life.



**FOUR TYPICAL SOILS**

According to the proportion of the different components (gravel, sand, silt, clay) the soil will have different properties and behavior, according to these categories. It will be named:

Either: gravelly (if more gravel), sandy (if more sand), silty (if more silt) or clayey (if more clay)



## FIELD TESTS



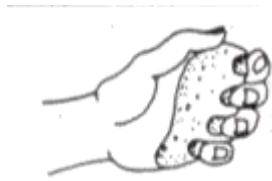
### Visual Examination

The dry soil is examined with the naked eye to estimate the relative proportions of the sandy and fine fractions. Large stones, gravel and coarse sand are removed in order to facilitate the evaluation.



### Smell test

The soil should be smelt immediately after removal. If it smells musty it contains organic matter. This smell will become stronger if the soil is heated.



### Touch Test

After removing the largest grains, crumble the soil by rubbing it between the fingers and the palm of the hand. The soil is sandy if a rough sensation is felt and has no cohesion when moist. The soil is silty if it gives a lightly rough sensation and is moderately cohesive when moistened. The soil is clayey, if when dry it contains lumps or concretions, which resist crushing and if it becomes plastic when it moistened.



### Lustre Test

A slightly moist plastic ball of earth is cut in two with a knife. If the freshly revealed surface is dull, the soil will be predominantly silty. A shiny surface on the other hand indicates the presence of a plastic clayey soil.



### Adhesion Test

A slightly moist plastic ball of earth is prepared and a knife is stuck into it. When the knife is withdrawn, some soil may stick on the blade: a gravelly or sandy soil will not stick, a silty soil will stick a bit and a clayey soil will stick a lot.



### Washing Test

Wash the hands with the slightly moistened soil. The soil is sandy if the hands easily rinse clean. The soil is silty if it appears to be very sticky and the hands can be rinsed clean with difficulty. The soil is clayey if it gives a thin film and the hands can be rinsed clean quite easily.

## JAR OR SEDIMENTATION TEST

Jar test is a simpler procedure than a lab- test. This gives the earth block producer good feeling of the soil composition through a layering effect. After being shaken in a capped jar filled with water, and allowed to settle, the course materials sink to the bottom of the jar: small gravels at the beginning, then sand, silt and the finest at the top, clay.

Procedure:

1. Pick a straight sided jar with a flat bottom, such as a tall olive jar, or larger mayonnaise jar.
2. Fill about 2/3 of the jar with the soil to be tested.
3. Fill the jar with water, making sure that the soil is completely saturated and the water level is near the jar top.
4. Add about one teaspoon of ordinary table salt, which will aid in settling the fine clays.
5. Cap the jar and vigorously shake it until all of the material is in suspension.
6. Place the jar on a flat shelf and wait approximately 6 hours. (After 4-8 hours, all material should have settled out, with almost clear water between the top of the soil and the water level above).
7. Consider the entire soil depth from bottom to top as 100% and mark equal increments of 10% on the side of the jar. This will give you a rough idea of the percentages of the above ingredients in your soil.

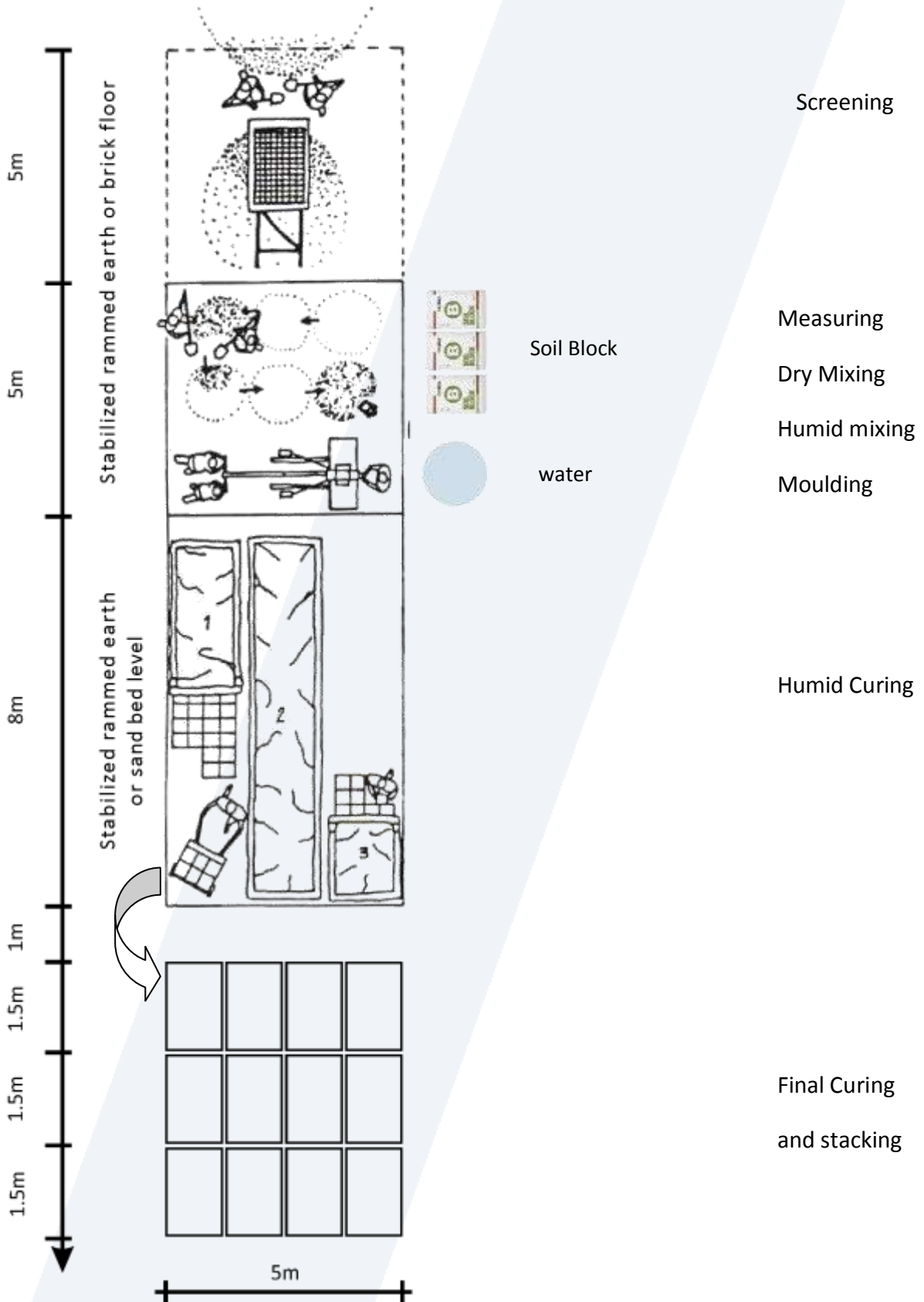
**JAR OR SEDIMENTATION TEST – OPTION 2**

This test measures the proportions of clay, silt, and sand/gravel.

The jar test consists of the following steps:

1. Filling a quart size canning jar up to 1/3 of its volume with dry soil;
2. Adding clean water up the second-third of the jar's height;
3. Adding a pinch of salt to the water;
4. Mixing the soil, water and salt with a paddle or other device;
5. With the lid on the jar, shaking the jar vigorously until the soil particles are in suspension;
6. Letting the jar sit for one hour;
7. Again, with the lid on the jar, shaking it vigorously, and allowing it to sit for one minute;
8. After one minute, marking the height of the fine gravel and sand, which will readily settle to the bottom of the jar, as T1;
9. After 30 minutes, add second mark to the point where the fine gravel, sand and silt have settled out of the water, as T2 will;
10. another 24 hours, adding a mark at the highest level of the fine gravel, sand, silt, and clay, just where the water and soil contents have separated visually, as T3; and,
11. Calculating the percentages of the ingredients of the soil by following the equations where  
T1 = depth of sand, T3-T2 = depth of clay, T2-T1 = depth of silt, and where each depth is divided by T3 and then multiplied by 100.

## LINEAR ORGANIZATION OF A BLOCKYARD



## LINEAR ORGANIZATION OF A BLOCKYARD



2 workers for screening



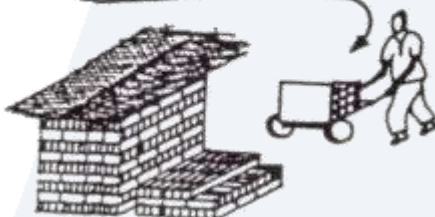
3 workers for measuring  
and dry and humid mixing



3 workers for moulding

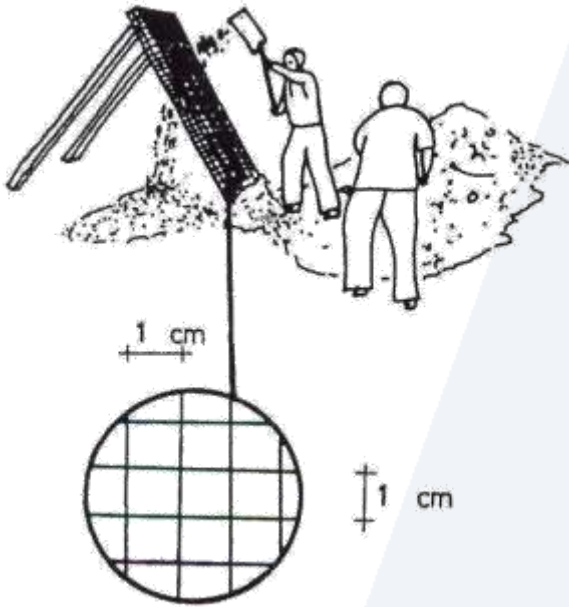


1 worker for humid curing



1 or 2 workers for final  
curing and stacking

## SCREENING



Throw the soil at the top part of the screen (Dim. = ± 1 x 2 m)

Size of the Wire Mesh

(should not be more than 1.5 cm)

### POSITION OF THE SCREEN



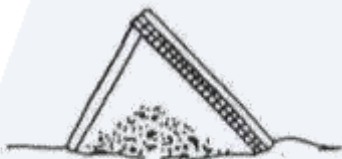
**X Not Good**

Too flat: big gravel goes through the screen.



**X Not Good**

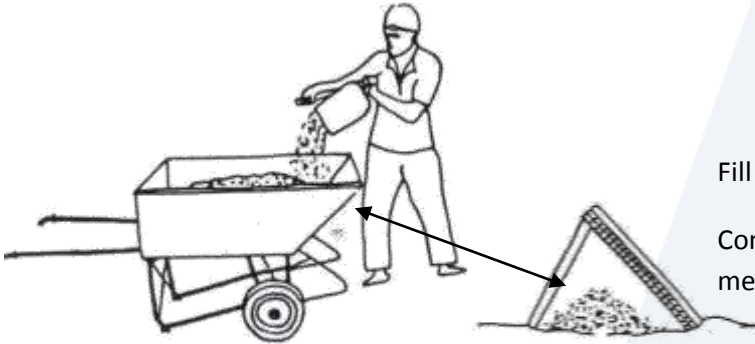
Too vertical: very thin soil goes through the screen, and there is a lot of waste.



**✓ Good**

Correct angle: Well screened soil and little waste

## MEASURING

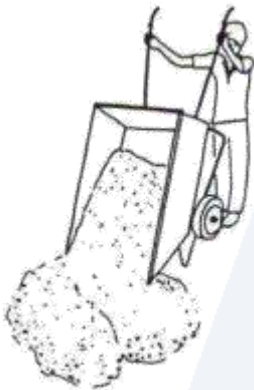


Fill the wheelbarrow.

Consider to place the wheelbarrow under the wire mesh.



Level the top with the ripper. Check that it is filled according to the requirements.



### Deliver to the mixing area

For example: for each mixing we will use 1/3 bag of Soil Block (1 bag= 25 kg, 1/3 bag= 8.33 kg) which provide 6% out of 132 kg earth.

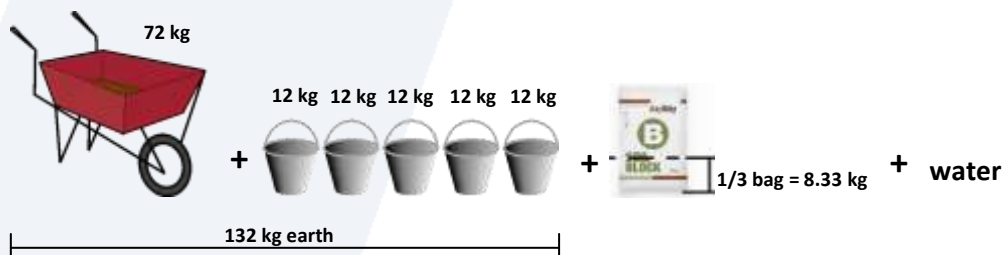
It is recommended to split the bag evenly to three buckets.

In order to prepare 132 kg earth we will need:

- A. 10 liter bucket= 12 kg (1 liter= 1.2 kg)
- B. 1 wheelbarrow smithy is 60 liter= 72 kg (60x1.2 kg)

That means that for each mixing we will need:

1 (72 kg) wheelbarrow + 5 (12 kg) buckets= 132 kg (earth) + 8.33 kg Soil Block + water



## DRY MIXING

### COMPONENTS



### PROCESS



Pour the Soil Block (1/3 bag=8.33 kg) on the pile of Soil (132 kg earth).



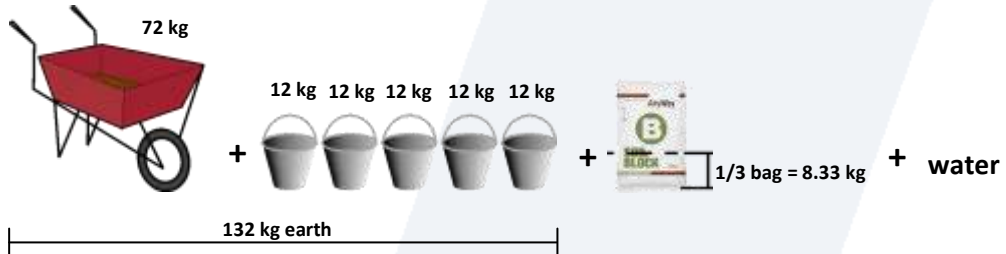
Mix all the components.



Move the pile 2 or 3 times to obtain a uniform color and homogenous mix.

## HUMID MIXING

### COMPONENTS



### PROCESS



Sprinkle water on the dry pile.



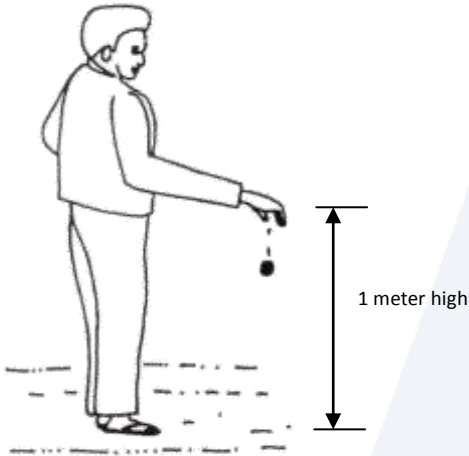
Mix the humid pile again. Shift the pile 2 or 3 times, so as to get a homogenous mix.



Sprinkle water and mix again to have a uniform color and texture.

**Note: be sure to break all lumps that are created.**

## CHECKING THE MOISTURE CONTENT



Drop a squeezed ball from 1 meter high and observe the result.

### THE RESULT



**✗ Not Good**

The ball bursts apart in very small pieces or powder: Too dry.



**✗ Not Good**

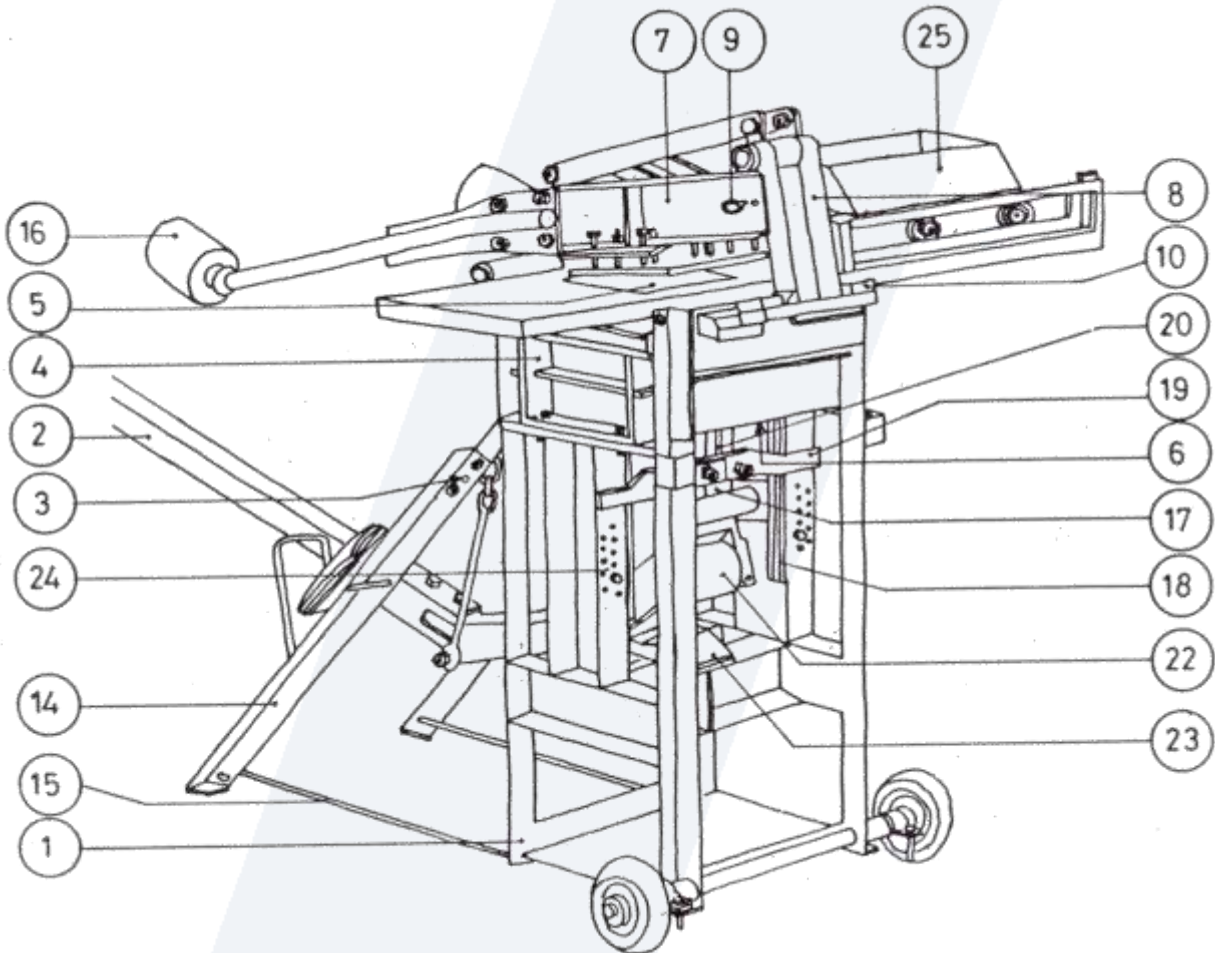
The ball does not break or just cracks: Too wet.



**✓ Good**

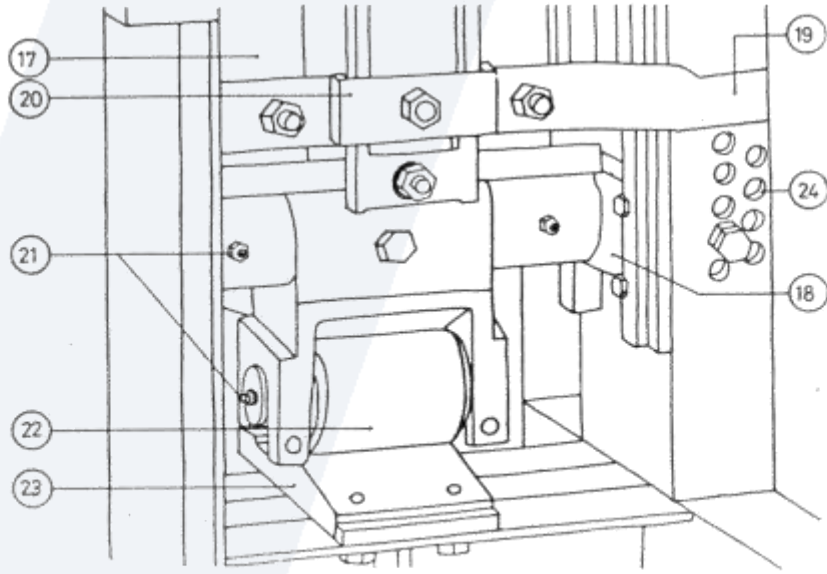
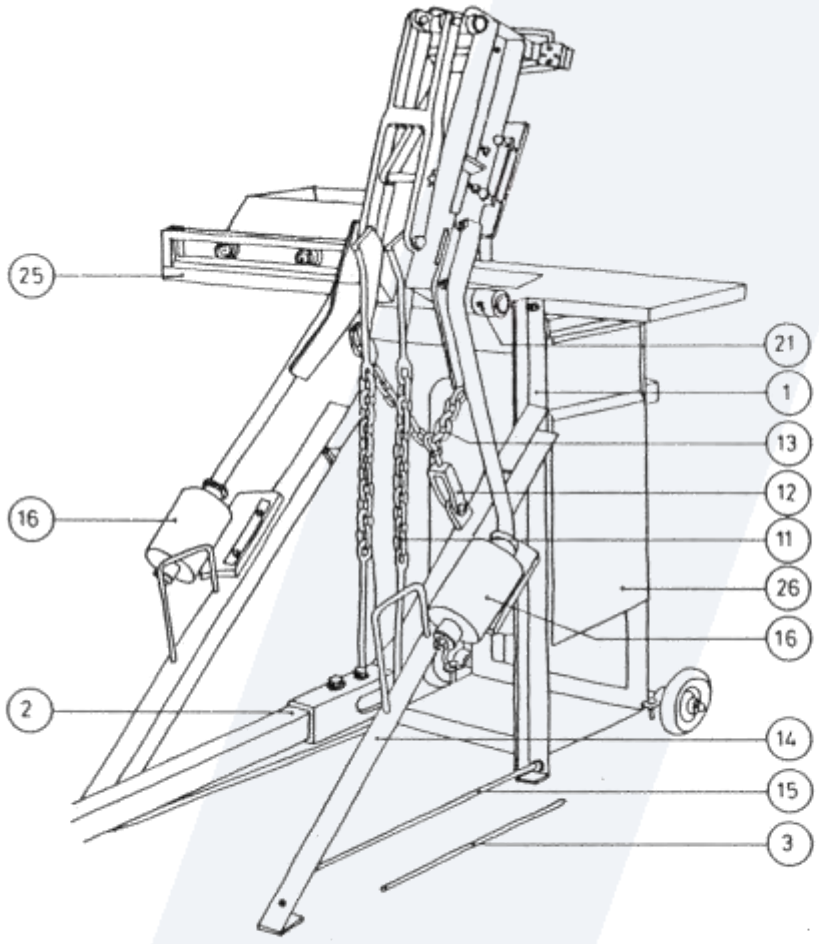
The ball bursts into 4 or 5 pieces: Good moisture content.

## DESCRIPTION OF THE PRESS



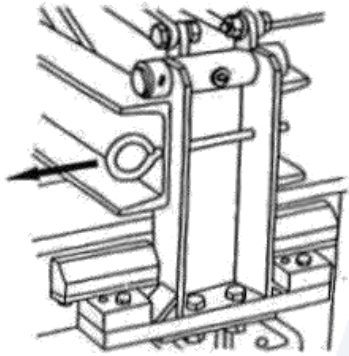
- |                         |                                       |
|-------------------------|---------------------------------------|
| 1. Frame                | 14. Braces                            |
| 2. Removable levers     | 15. Brace stiffener                   |
| 3. Lever safety         | 16. Counter weights                   |
| 4. Mould                | 17. Piston                            |
| 5. Top plate            | 18. Piston guide wearing parts        |
| 6. Bottom plate         | 19. Piston stopper                    |
| 7. Lid                  | 20. Piston connector                  |
| 8. Lock                 | 21. Grease nipples                    |
| 9. Lock safety          | 22. Roller                            |
| 10. Lock wearing parts  | 23. Roller path                       |
| 11. Lock chain          | 24. Holes for compression ratio       |
| 12. Ejection turnbuckle | 25. Top protection and sliding hopper |
| 13. Ejection chain      | 26. Side protection                   |

## DESCRIPTION OF THE PRESS

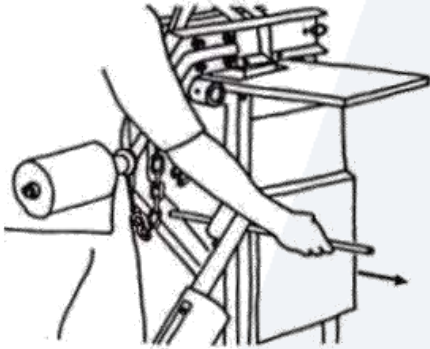


Piston Mechanism

## SAFETY

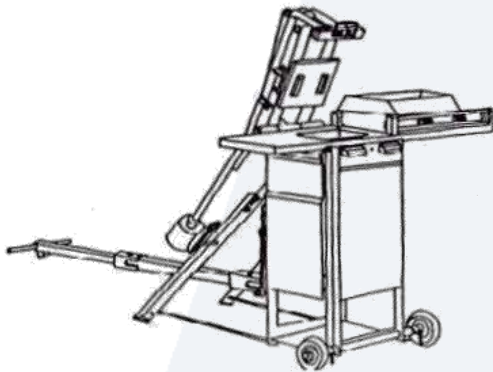


Remove first the lock safety.

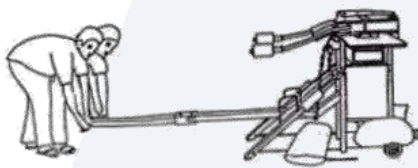


Then remove the lever safety.

**Beware:** If someone handles the lever before removing the lock safety device you will break it.

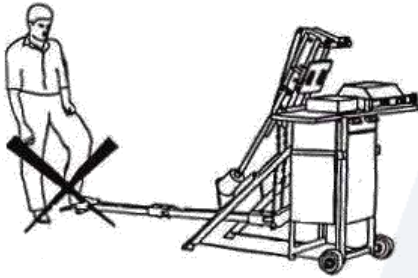


Always keep the side and top protections in place while moulding.

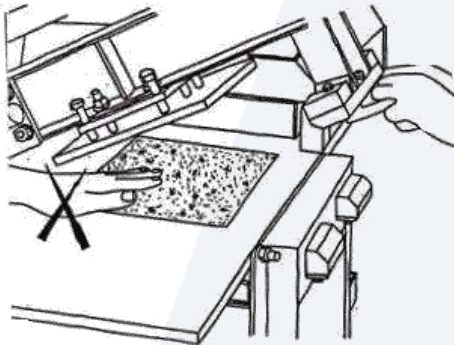


Bags of sand or encered to a concrete slab.

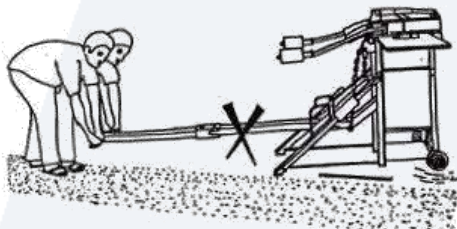
## MISS HANDLING THE PRESS



Never jump on the lever.



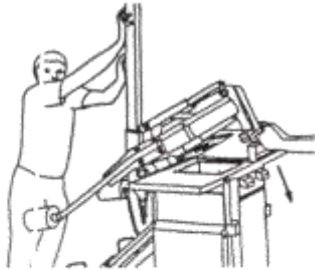
Never allow someone else than the operator to fill the soil or to touch the top protection. One can easily receive a hand cut because of lack of care.



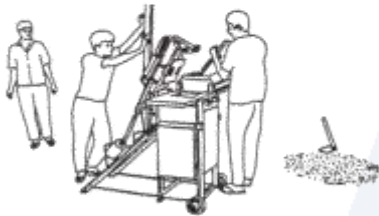
Never fill the mould too much: rather adjust properly the compression ratio.

With the weight of 3 bags of sand, the machine must not lift.

**HANDLING THE PRESS**



Remove the safety lock device first and then the safety lever device. Open the lid manually.



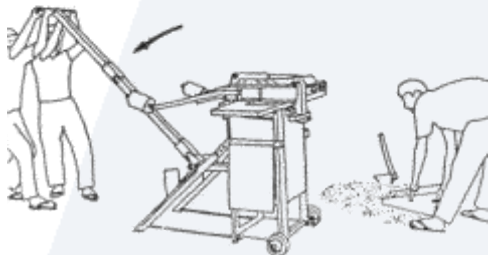
Keep the lever in the filling position and fill the hopper with the scoop.



The operator slides the filled hopper above the mould and pushes it back to its initial position. Check that the mould was well filled and the soil well leveled by this operation.



Close the lid manually with a good impulse.



Pull the lever down with 2 men for compression, while the operator is filling the scoop.

**HANDLING THE PRESS**

Pull the lever further down for the automatic opening of the lock and lid.



Pull the lever fully down, without delay, for ejecting the block, while the operator is filling again the hopper with the scoop.



The operator slides the filled hopper towards the mould. The hopper will push the block on the side of the table, but not the operator himself.

Keep the filled hopper above the mould.



Push back the lever towards the filling position: the bottom plate goes down and the soil inside the hopper will fall into the mould.

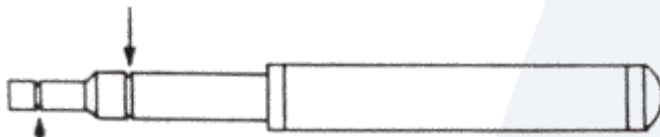


Push back the hopper to its initial position and check that the soil was well leveled by the hopper, while the helper is stacking the block.

## QUALITY CONTROL

### QUALITY OF COMPRESSION

First groove for checking the max. pressure to apply.

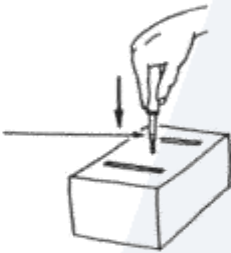


Pocket penetrometer (5 kg/ cm<sup>2</sup> pressure).

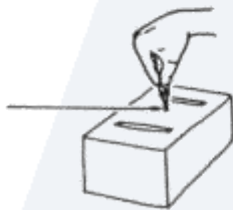
Second groove for checking the max. depth into the soil.



Check regularly the quality of the compression.  
Do it at least once every new batch of mix:  
**test the first block of every new mix!**



Keep the block on its plate and push the penetrometer slowly and vertically to the center of the freshly made block, till the first groove.



When the max. pressure is applied, the penetrometer must not penetrate more than the second groove into the block.

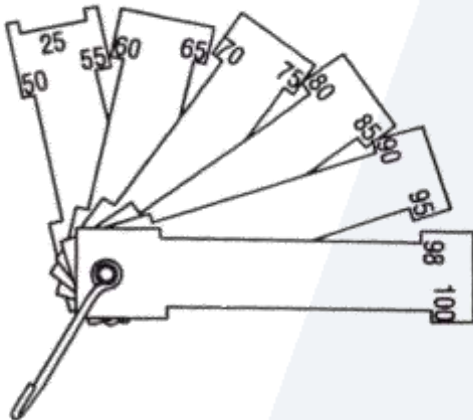
#### Note

If the penetrometer penetrates more than the second groove, the block must be rejected immediately! This means that either the mix is too wet, or the amount of soil is not enough in the mould. This test is valid only for freshly made blocks (up to 10 min. after manufacturing). Later than 10 min. this test will be useless: the Soil Block is already hardening.

## QUALITY CONTROL

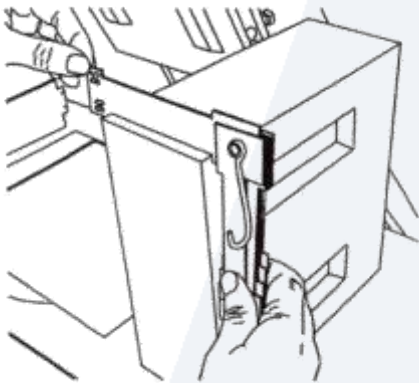
### BLOCK HEIGHT

Set of gauges to check the thickness: 2.5 cm and from 5 to 10 cm.



Block height gauge

Check regularly the block height. Do it at least once every new batch of mix: **test the first block of every new mix!**



Tilt the block on its edge and check the 4 corners with the block height gauge.

The block height gauge must touch gently the block: it must neither be loose nor scrape the block. A slight friction is acceptable.

If the mix quality is perfect and yet is still happens, correct the adjustment of the top plate (see p.27)

#### Note

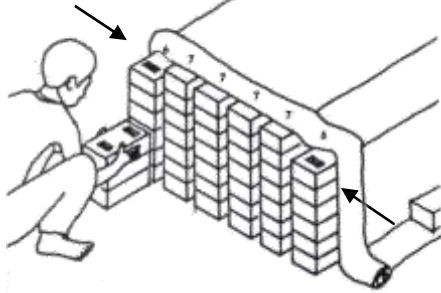
When the top plate is well adjusted, but if the block height gauge does not give a good result, that means that the quality of the mix is not correct: a too dry mix will give thicker blocks, when a too wet mix will give thinner blocks.

Irregularities in the corners can come from a mix, which is not homogeneous, and/or, the mould not evenly filled. When the mix quality is alright and the height is not correct then check the adjustment of the top plate (see p.27).

**When the block height gauge test is not satisfactory, always check first the quality of the mix, and never touch for any reason the top plate adjustment!**

## HUMID CURING

Row of 6+7+7+7+7+6 (blocks height) = 40 blocks



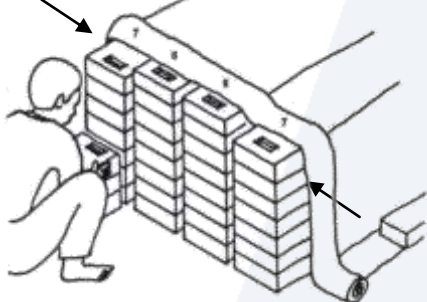
Blocks 290 = 25 rows of 40 blocks.

Handle the blocks with care.

Hold the block in the middle of its narrow and long side.

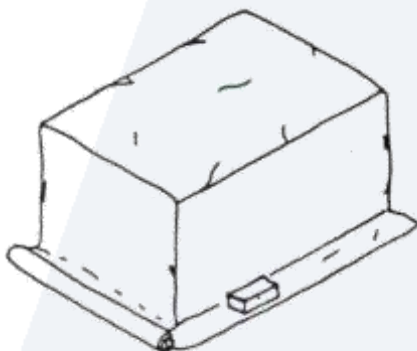
This holding will minimize the pressure on the block and will keep the block from breaking.

Row of 7+8+8+7 (blocks height) = 30 blocks



Blocks 240 = 34 rows of 30 blocks.

Stack the blocks and unroll straight away the thick plastic sheet, as soon as a row is over.

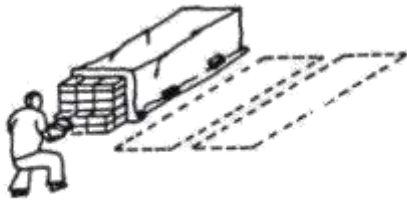


The pile will stay 3 days and 2 nights under a plastic sheet because the blocks are very fragile and because they must not lose any moisture.

Check that the plastic are covering very well the pile, and that they are loaded properly with blocks.

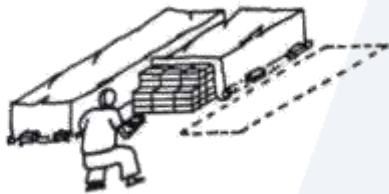
**The pile must be airtight!**

## HUMID CURING AND FINAL STACKING



### First day

Stack on the first pile area.



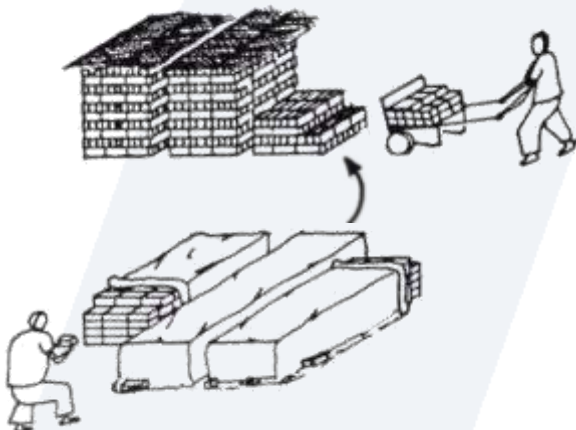
### Second day

Stack on the second pile area.



### Third day

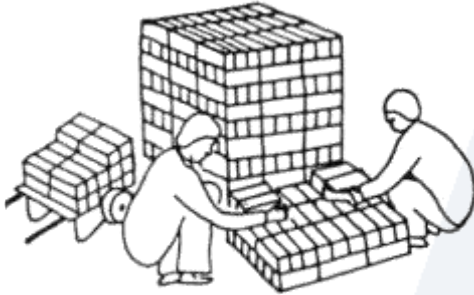
Stack on the third pile area, while moving the first pile to the final stacking area.



### Fourth day and following days

Stack on the production on the place of the pile, which has just been removed to the final stacking area.

## FINAL STACKING



Every early morning move the 3 days old blocks from the humid curing to the final stacking area for another 28 days.

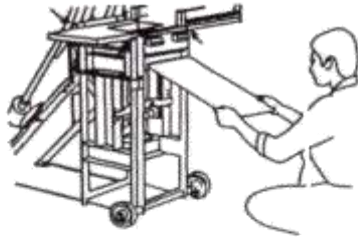
It is possible to stack the blocks up to 15 blocks in a row.

In case of rainy weather the stacking area should be under a shed.



Write the date of production on a block corner.

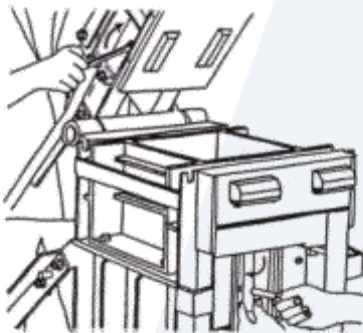
## MAKING ¾ BLOCKS



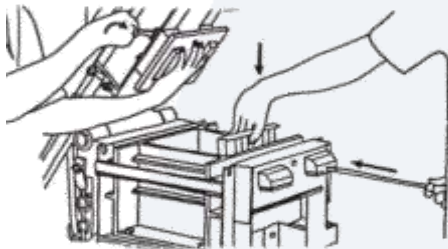
Remove the side protections and loosen the 4 bolts of the top protection.



Remove the top protection and the sliding hopper.



Remove the top and bottom plates.

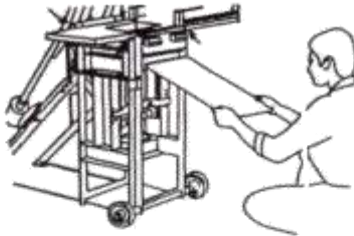


Tighten the new top and bottom plates, slide in the side pieces and tighten them with the screw driver.



Put back the top protection with the sliding hopper and tighten the 4 bolts.

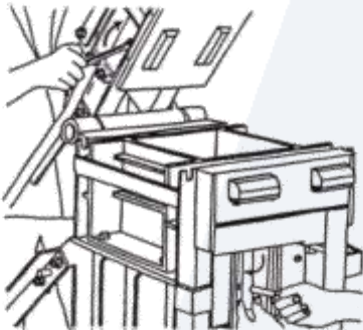
## MAKING ½ BLOCKS



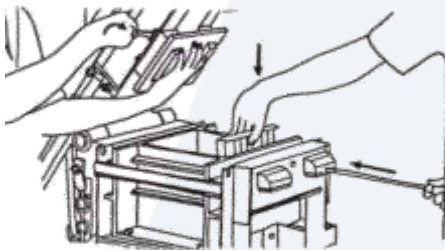
Remove the side protections and loosen the 4 bolts of the top protection.



Remove the top protection and the sliding hopper.



Remove the top and bottom plates.

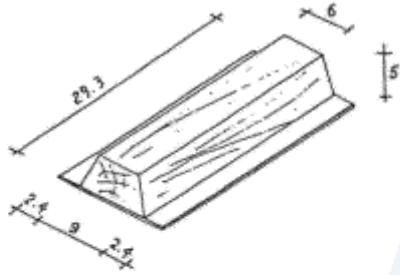


Tighten the new top and bottom plates, slide in the central piece and tighten them with the screw driver.

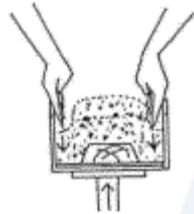


Put back the top protection with the sliding hopper and tighten the 4 bolts.

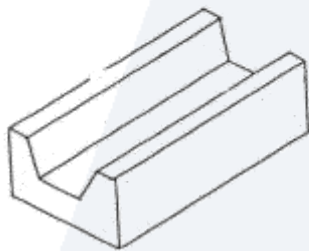
## SPECIAL BLOCK MOULDING



Metal shape for tie beam

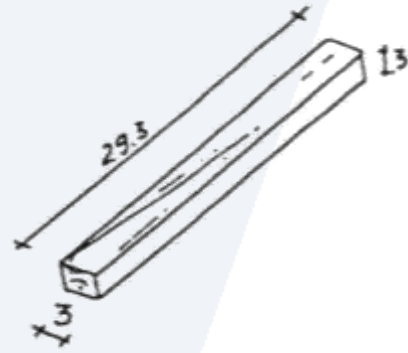
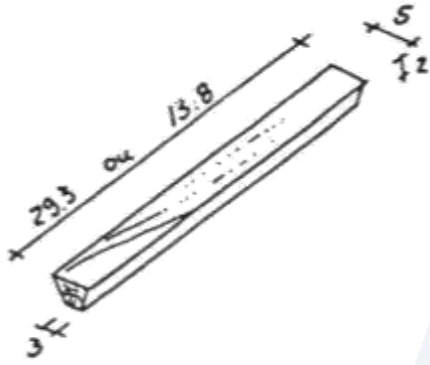


Compress the soil at the edges with the hands.

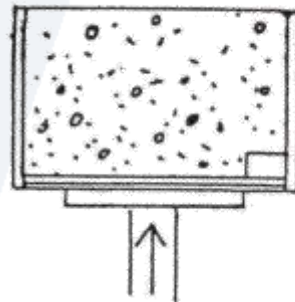
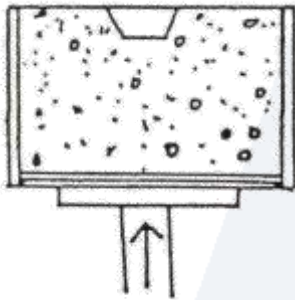


Handle the tie beam block with the metal shape till the curing area.

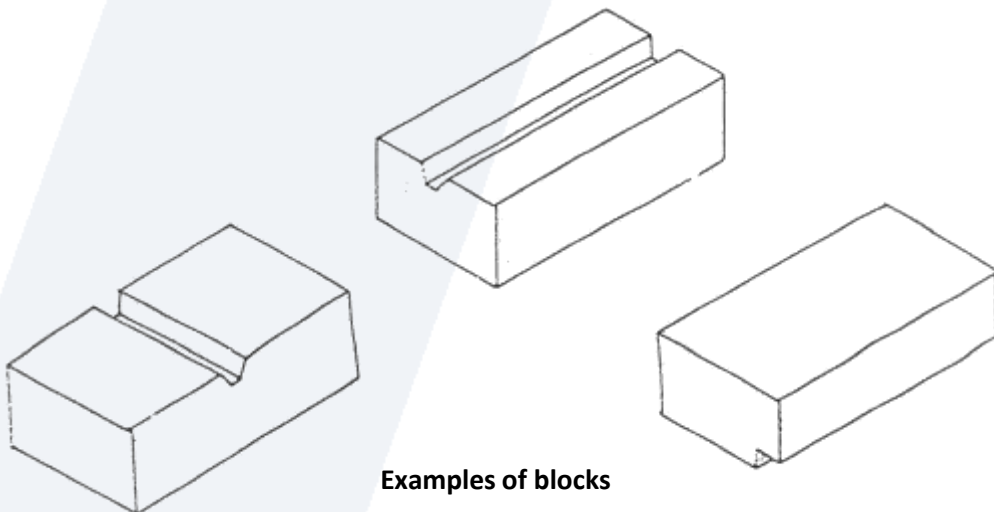
## SPECIAL BLOCK MOULDING



Metal shapes for "electrical blocks".

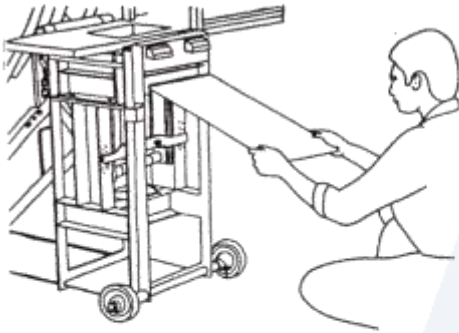


How to put the metal shape into the mould.

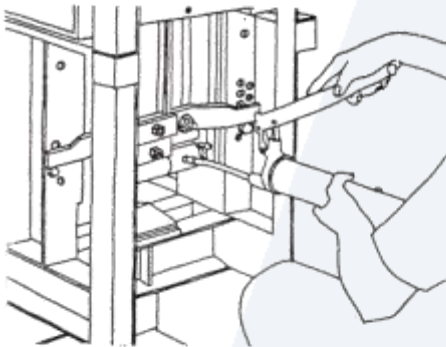


Examples of blocks

## DAILY MAINTENANCE



Remove the side protections.



### Every morning:

Check that the machine was well cleaned the previous evening.

Check that all the bolts are tightens strongly: especially those from the lever and the opening and lid/lock mechanism.

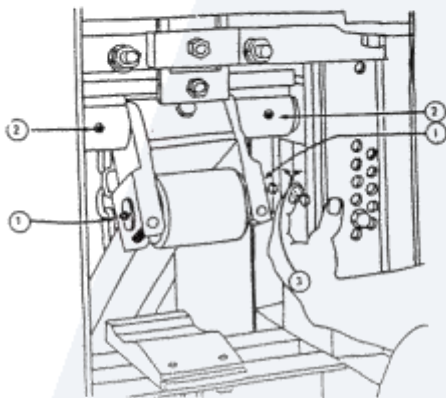
**Beware:** A disregard to this will let the bolt loose and later the machine will get damaged!

Fill the 7 grease nipples with the grease gun till some grease appears on the side of the shafts. Clean the excess of grease.

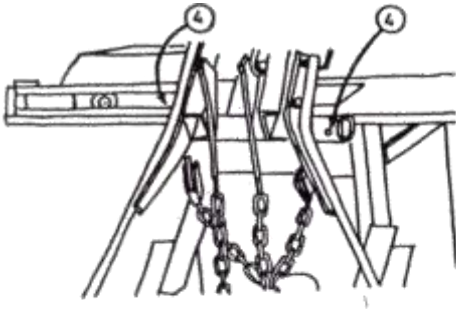
Grease the roller ①

Grease the piston shaft ②

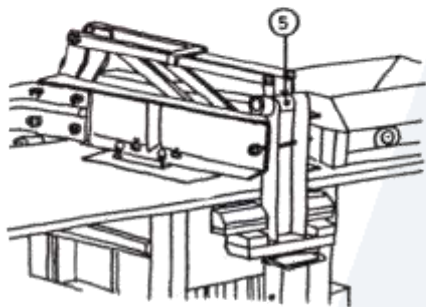
Grease the sliding guides of the piston with the fingers ③



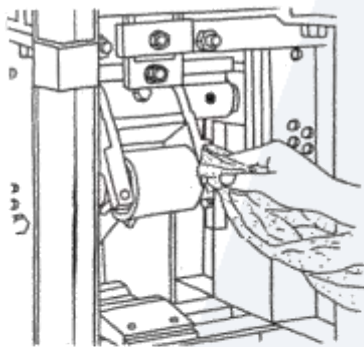
## DAILY MAINTENANCE



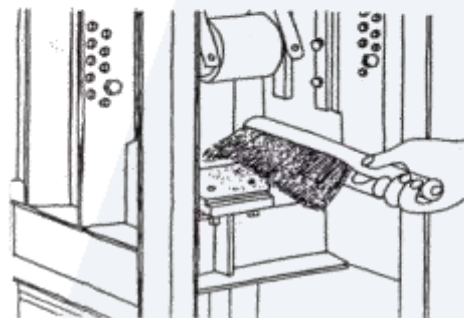
Grease the lid axis ④



Grease the lock axis ⑤



Clean the excess of grease with waste cloth.



**Every evening:**

Clean the dust and brush the machine especially the piston mechanism.

The machine should be very clean and should look like new!

Check that no bolts are loose and, if any, tighten them strongly.