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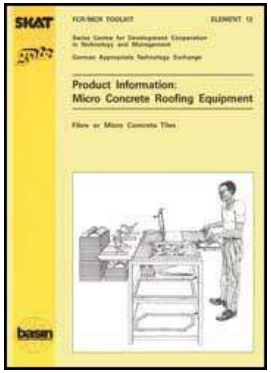

- **Product Information: Micro Concrete Roofing Equipment - Fibre or Micro Concrete Tiles (BASIN - GTZ GATE - SKAT, 1997, 38 p.)**
  - ***(introduction...)***
  - **Introduction**
  - **Fibre Concrete / Micro Concrete Roofing Equipment**
  - **CECAT TEVI - Unit de production de tuiles en micro-bton**
  - **TEJACRETO Plana**
  - **TEJACRETO Escalera**
  - **TEJACRETO Romana**
  - **TEJACRETO Colonial**
  - **TEJACRETO Pantile**
  - **Product Information: MCR/FCR Equipment**
    - **Parry/ITW Electric and Hand Powered Vibration Screeding Machines**
    - **Development Alternatives TARAcrete MCR Tile Production Kit**
    - **ECO Systems Concrete Rooftile Machine**
    - **DCS Foot-Powered Vibrating Table**
    - **APPRO-TECHNO Tegulamatic Roof Tile Plant**
  - **Equipment and Tools for Basic Module for Fibre Concrete**

- **Tiles Production TEJACRETO - Peru HABITECH - BUILDING - SYSTEM**
  - **Roofing ROOF STRUCTURE MCR Tiles Installation**
  - **Roofing WORKSTATION Micro Concrete Roofing Tiles**
  - **Ralisations en Tuiles Fibro-Mortier - Realizations in Fibre-Mortar Tiles**
  - **Processus de Fabrication - Production Process**

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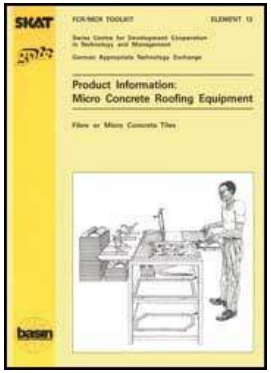

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Equipment and Tools for Basic Module for Fibre Concrete Tiles Production TEJACRETO - Peru
HABITECH - BUILDING - SYSTEM

FCR / MCR TOOLKIT
ELEMENT 12

Swiss Centre for Development Cooperation in Technology and Management

German Appropriate Technology Exchange

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August 1997, 500 ex

FCR/MCR Toolkit Overview

National Center Kit

	Promotion Kit	**Producer Kit**	
1 National Center Guide	10 FCR/MCR Basics	20 Workshop and Equipment	30 Business Skills Guide
2 Feasibility Study Guide	11 Case Reports	21 Production Management	31 Marketing & Selling Guide
3 Teaching FCR/MCR Technology	**12 Product information**	22 Production Guide	
4 Standards Guidelines	13 Promotion Material Kit	23 Quality Control Guidelines	
	14 FCR Video	24 Roof Structure Guide	
		25 Roof Cover Guide	
		26 Technical Bulletins	
		27 Equipment Producer Guide	
		29 Roof Truss Guide	

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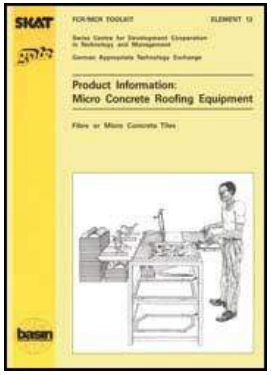


Product Information: Micro Concrete Roofing Equipment - Fibre or Micro Concrete Tiles (BASIN - GTZ GATE - SKAT, 1997, 38 p.)

Product Information: MCR/FCR Equipment

Parry/ITW Electric and Hand Powered Vibration Screeding Machines

Manufacturer:
JPM Parry & Associates Ltd
Overend Road, Cradley Heath,
West Midlands B64 7DD
United Kingdom
Tel. [..44] 1384-569171 or 564991

Fax. [..44] 1384-637753

Description

The Intermediate Technology Workshops (ITW) is the research and consultancy function of JPM Parry and Associates and were the first to develop and manufacture vibration screeding machines for the production of fibre concrete roof tiles. They are thus the most experienced manufactures of these machines, of which several types are available catering for various production scales and energy inputs, and producing several different types of roofing element.

The following types of electric powered machines are available:

- **MV Table Top Unit**

  This consists of the essential Multivibe vibrator, screeding plate, screeding frames and mould holding arms only.

- **MV Workstation**

  Consisting of the Table Top Unit but fitted in a steel Workstation giving the correct working height and a storage shelves for interface sheets etc.

- **MV Workstation & Hopper**

  As above but with the addition of a raised container to hold mortar within easy reach of the operator.

The above machines are all capable of the same output, but in the case of the more basic model the operator must provide his own table (workstation) on which to place the Table Top Unit and also a mortar container (hopper) from local sources. Production capacity depends upon the number of moulds used with the machine and also the number of workers employed. In practice a single machine will usually be able to fill a maximum of 600 moulds in an 8 hour working day. Typical production plants are as follows:

- **Parry MV Tile machine, 2 workers, 200 moulds plus accessories**

  - output 200 tiles per day.

- **Parry MV Tile machine, 3 workers, 400 moulds plus accessories**

  - output 400 tiles per day.

- **Parry MV Tile machine, 5 workers, 600 moulds plus accessories**

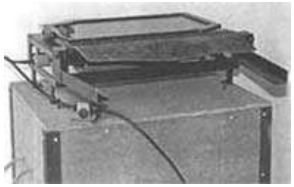
  - output 600 tiles per day.

In order to achieve the above outputs it will usually be necessary to use a concrete mixing machine, also available from Parry Associates, Alternatively mixing can be done by hand, but this may require an additional worker.

On request, Parry can also supply a Fast Moulding system whereby one machine can produce 800 to 900 tiles per day.

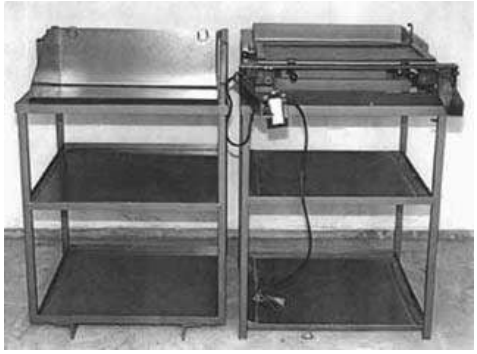
All the parry electric plants use the Multivibe detachable vibrator (described in a

separate leaflet in the GATE Product Information Folder on Concrete Block Producing Equipment), which runs on 12 volt DC power from a car battery or transformer-rectifier connected to a mains power source. The advantage of the Multivibe is that it can be used with alternative moulds and accessories to manufacture a number of other concrete building components.



The smallest Parry tile machine is the Table Top Unit, a standard screeding machine which can be transported by one person. When in use the machine is usually bolted to a workbench or into a workstation. As with all tile machines, output depends upon the number of workers and the organisation of the factory. The typical range is from two workers filling 200 moulds per day up to 5 workers filling 600 moulds per day.

The Parry Workstation machine uses the standard screeding machine fitted into a frame set at the most convenient height for working. The workstation has tool tray and shelves for holding interface sheets etc. The hand powered machines are always supplied in workstation format. Rubber mounted mould brackets and screed transfer flaps are fitted to all Parry machines, making it easier to slide the wet tile onto the mould.



The Workstation plus Hopper machine includes a second raised framework with a container to hold a quantity of mortar within easy reach of the machine, plus extra shelves.

Hand Powered Parry Tile Machine - This is supplied in a workstation to which parts of the mechanism are attached. The main advantage of hand-powered screeding machines is that they are completely independent of all power sources, but completely replicate the functions of the electric machines. Although slightly more working space is required, the output of the hand powered machines is the same as that of the electric, and in plants producing significant quantities of tiles the labour requirements is not increased. Cranking the handle once per second (60 rpm) generates a vibration at 3000rpm. By using hand powered rather than pedals, the second worker is free to move about the workplace handling moulds, interfaces, mortar etc.

The Workstation and Workstation plus Hopper versions of the above machines are also available in Hand Powered form, suitable for remote areas where power supplies are unreliable or do not exist at all. The vibrator is set in motion by a second worker who cranks the handle on the side of the machine, producing

vibrations of identical amplitude and frequency to the electric machines. It has been found that the work of powering the machine can usually be carried out by an operator who is also carrying out tasks such as taking away the filled moulds and handling interface sheets etc., it is therefore not usually necessary for additional workers to be employed, compared to where an electric plant is being used.

A duel power Electric and Hand Powered machine is available on request.

The standard roof tiles produced on these machines are Pantiles and Roman II tiles, 50cm long, 25cm wide and 6, 8 or 10mm thick. To cover one square metre of roof 12.5 tiles are needed. As an alternative, Parry Associates also offer equipment and moulds to produce larger tiles. The latest development is a Super Roman tile which has a coverage of 8 tiles per square metre. Super Roman plants are available in the same specifications as the Pantile and Roman II machines. Maximum outputs are slightly lower, eg. 2 workers with 1 Super Roman machine could fill around 150 moulds per day.

Parry Associates also offer a much larger machine and moulds to produce Semi Sheets, 60cm long and side, requiring only 4 per square metre of roof coverage. In practice a single Semi Sheet machine will be capable of filling a maximum of 250 moulds in an 8 hour working day. Typical production plants are as follows:

- **Parry Semi Sheet machine, 2 workers, 80 moulds plus accessories**

  - output 80 Semi Sheets per day.

- **Parry Semi Sheets machine, 3-4 workers, 200 moulds plus accessories**

  - output 200 Semi Sheets per day.

- **Parry Semi Sheet machine, 4-5 workers, 250 moulds plus accessories**

  - output 250 Semi Sheets per day.

Operation and handling of the Semi Sheet equipment are principally the same as for the standard roofing tiles.

The moulds are injection moulded polypropylene or vacuum formed polyethylene and are self-stacking, ie the interlock when placed on top of each over, saving space and providing air tight humid chambers for the wet tiles to set during the first 24 hours after moulding. Wooden frames need to be attached to the moulds and these are usually supplied in standard plants by Parry Associates, but may be sourced locally. Additionally, interface sheets are provided with full plants but again these may be sourced locally.

Full accessory packs can be supplied with machines and moulds which include comprehensive instruction manual, batching boxes, mortar measuring scoop, fibre balance, demoulding and quality control gauge, sample sieve, sample tile, sample dry mortar mix, 2 trowels and spare parts kit. Alternatively Parry Associates supply a minimum accessory package to suit users requirements.

Additional items such as mains electricity transformers, concrete mixers, tile testing and quality control equipment, special tile kits (Valleys, Hips, Top Row,

Edge, etc.), plus various other items such as handling equipment, mobile curing bins etc. are also available.

Semi-sheet screeding table: spreading mortar.

Placing wet Semi-sheet on the setting mould.

Semi-sheet moulds stacked to set overnight.

Operating the Parry Screeding Machines

An interface sheet is placed on the screeding plate and clamped down with the screeding frame. An appropriate level scoop or scoops of mortar is measured and spread out on the screeding surface with a trowel. With the Multivibe vibrator switched on, the mortar is smoothed out such that the surface is level with the screeding frame. Finally the nib-forming box is filled under vibration and, if desired, a wire loop is inserted.

The mould is then placed on the mould holding brackets, the frame released carefully, making sure not to damage the nib, and the interface sheet with the flat screeded mortar pulled onto the mould. Care needs to be taken to ensure that the edges of the tile are exactly in line with the guide markings on the mould. The mould is then placed aside on the curing stack.

Technical Details - MV Tile	1000 tiles/week	2000 tiles/week	3000 tiles/week

Plants				
Size of machine (l x w x h)		38 x 65 x 19 cm	38 x 65 x 19 cm	38 x 65 x 19 cm
Weight of machine		32 kgs	32 kgs	32 kgs
Size of crate for shipping		1 box total 0.80 m^3	1 box total 1.44 m^3	2 boxes total 2.24 m^3
Weight of packed plant		210 kgs	360 kgs	525 kgs
Standard tile size (Roman II or Pantile)		50 x 25 x 0.6/0.8/1 cm	50 x 25 x 0.6/0.8/1 cm	50 x 25 x 0.6/0.8/1 cm
Number of moulds: roof tiles		200	400	600
energy input/transmission		electric/mechanical	electric/mechanical	electric/mechanical
Output: No of tiles per cycle/per day		1/200	1/400	1/600
Labour force required		2 men	3 men	5 men
Price Ex-Works Valid Dec 1996	with Multivibe detachable vibrator	2093 £ Sterling	3533 £ Sterling	4973 £ Sterling

Technical Details - HP Plant	**1000 tiles/week**	**2000 tiles/week**	**3000 tiles/week**
Size of machine (l x w x h)	65 x 67 x 92 cm	65 x 67 x 92 cm	65 x 67 x 92 cm
Weight of	61 kgs	61 kgs	61 kgs

machine/workstation				
Size of crate for shipping		1 box total 1.00 m^3	1 box total 1.74 m^3	2 boxes total 2.54 m^3
Weight of packed plant		240 kgs	400 kgs	570 kgs
Standard tile size (Roman II or Pantile)		50 x 25 x 0.6/0.8/1 cm	50 x 25 x 0.6/0.8/1 cm	50 x 25 x 0.6/0.8/1 cm
Number of moulds: roof tiles		200	400	600
Energy input/transmission		manual/mechanical	manual/mechanical	manual/mechanical
Output: No of tiles per cycle/per day		1/200	1/400	1/600
Labour force required		2 men	3 men	5 men
Price Ex-Works Valid Dec 1996	with hand powered vibrator	2369 £ Sterling	3809 £ Sterling	5249 £ Sterling

Technical Details - Semi Sheet Plants	**400 sheets/week**	**1000 sheets/week**	**1250 sheets/week**
Size of machine (l x w x h)	96 x 93 x 94 cm	96 x 93 x 94 cm	96 x 93 x 94 cm
Weight of machine	100 kgs	100 kgs	100 kgs
Size of crate for shipping	1 box total 1.74 m^3	2 boxes total 3.18 m^3	2 boxes total 3.48 m^3
Weight of packed plant	320 kgs	570 kgs	670 kgs

Weight of packed plant		320 kgs	570 kgs	670 kgs
Standard tile size (Semi Sheet)		60 x 60 x 0.8 cm	60 x 60 x 0.8 cm	60 x 60 x 0.8 cm
Rubber moulds: roof tiles		80	200	250
Energy input/transmission		electric/mechanical	electric/mechanical	electric/mechanical
Output: No of tiles per cycle/per day		Jan-80	1/200	1/250
Labour force required		2 men	3 to 4 men	4 to 5 men
Price Ex-Works Valid Dec 1996	with Multivibe detachable vibrator	2809 £ Sterling	5299 £ Sterling	6337 £ Sterling

The next day the mould and green tile are placed upside down on the demoulding gauge so that the mould can be lifted off and the plastic interface sheet peeled off. Any rough edges of the tile are trimmed off and the tile is then placed in a curing chamber. (More experienced producers often demould without the use of the gauge and use this only to quality control the shape of sample tiles from each batch made.) Two methods of curing can be used. The most basic being to simply place the products in a water filled tank for up to two weeks. More rapid curing (3 to 4 days in hot climates) is possible by using a humid chamber. Fixed high humidity curing chambers can be constructed on site (instructions provided by Parry), or the Parry system of mobile high humidity curing bins can be used.

Koma Rock, Nairobi/Kenya: The largest single housing scheme with fibre concrete roof tiles made with Parry/ITW equipment.

On request, special training courses are offered at the Intermediate Technology Workshops Cradley Heath, UK and by their local representatives in other countries. The courses not only cover the technology of lightweight concrete roofing elements and building construction, but can also include other production technologies with Parry Equipment. These include various other concrete building components plus clay bricks and roof tiles and compressed earth blocks.

Course duration can vary to suit the time available to the trainee, but are usually between 3 and 10 days. Costs are around £300 to £600, but purchasers of equipment will usually be trained free of charge at the UK workshops.

ADDRESS LIST OF OVERSEAS AGENTS, REPRESENTATIVES, DISTRIBUTORS

Angola

Cemtec LDA

Rua Conego
Manuel das Neves
No. 106, CX postal 1402
Luanda

Tel/Fax: +244 2 349035

Bangladesh

Castle Construction Co. Ltd.
PO Box 2680
House No. 50, Road 2A
Dhanmondi Road R/A
Dhaka 1209

Tel: +880 2 507497 / 502404
Fax: +880 2 863044

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Gush & Emy Ltd.
5 Mapp Street
PO Box 1237
Belize City

Tel: +501 2 45953
Fax: +501 2 31042

Cameroon

Revetement Jacal
PO Box 7331
Douala
Bassa

Tel: +2237 409413
Fax: +2237 428423

Ghana

Parakuo Estates Ltd.
Plot 7, block 5
Dadeban Street, Ring Road
PO Box 3727
Accra

Tel: +233 21 223245 / 226757
Fax: +233 21 2292
e-mail: mattouk@africaonline.com.gh

Kenya (East African Representatives)

ITW (KENYA) Ltd.
4th Ngong Avenue
PO Box 45156

Nairobi

Tel: +254 2 720962/3
Fax: +254 2 727657
e-mail: nevans@form-net.com

Kenya (Agents and Distributors)

Kate Freight & Travel Ltd.
Ufanisi House
PO Box 28330
Nairobi

Tel: +254 2 543716
Fax: +254 2 544446
e-mail: kate@form-net.com

Madagaskar

Famokarand Tao Trano
BP 3508
Antananarivo 101

Tel: +261 2 295 10
Fax: +261 2 242 48

Nigeria

Niger Equipment Ltd.
Jagal House
Jagal Road
Oregun, PO Box 3959
Ikeja, Lagos

Tel: +234 1 900010-19
Fax: +234 1 964409

Senegal

Fibre-Mac
Domaine Industriel
BP 5872, Dakar

Tel: +221 257384

Sudan

Maria Enterprises Ltd.
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Street 47
Khartoum 2

Tel: +249 11 45392

Surinam

Hesdy Landburg
Sureineve Kanehai Weg 53
PO Box 5147
Paramaribo

Tel: +597 65643
Fax: +597 10555

Sri Lanka

HDL
Construction & Property Trades (PVT) Ltd.
No. 78, Cannal Road
Hendala, Wattala

Tel: +94 930650
Fax: +94 930817

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CVBT
Km 147 Udonthani-Nongkhai Road
Group 5, Ban Thin
Tambon Ban That
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Udonthani 41150

Tel: +66 1 2130801
Fax: +66 42 241712

Uganda

Magric (U) Ltd.
Kitgum House
PO Box 3218
Kampala

Tel: +256 41 232100
Fax: +256 41 244606

Zambia

Lutanda Ltd.
PO Box 20516
Moseshi Road
Kitwe

Tel: +260 2 218166

or

Compresstair Ltd.
PO Box 33139
Washama Road

Lusaka

Tel: +260 1 216110

Development Alternatives TARAcrete MCR Tile Production Kit

Manufacturer
T.A.R.A. - Technology and Action
for Rural Advencement
B-32, TARA Crescent
Qutab Institutional Area
New Delhi-110 016
India
Tel. [..91] 11-696 7938 or 685 1158
Fax. [..91] 11-686 6031
e-mail: tara@sdalt.ernet.in

Figure

Description

Technical Details		**TARAcrete production kit**
Size of machine (l x w x h)	without seat.....	..... 100 x 54 x 50 cm (40 x 21 x 20 in)
	with seat	..... 115 x 54 x 87 cm (45 x 21 x 34 in)
Weight of machine	without seat	..... 35 kg
	with seat	..... 45 kg
Size of crate for	.....	..... 113 x 63 x 76 cm (44 x 25

shipment ..		x 30 in)
Weight of packed machine.	.....	..... 160 kg
Standard tile size / weight ..	.....	48.8 x 24 x 1.0 cm (19.2 x 9.4 x 0.4 in) / 2.85 kg
Energy input	.....	..... electrical (80 watts)
No. of tiles per cycle/output rate		..... 1 / 25 tiles per hour
Labour force required (incl. Mixing and stacking)		..... 4 men
Price (ex works)	TARAcrete Vibrating table (incl. accessories) ..	16800 Rs (≈ 480 US$)
valid Dec. 1996	Polystyrene mould (on wooden frame)	280 Rs (≈ 8 US$)

Rs = Indian Rupees

The TARA Vibrator is the result of design and production research at the Regional Centre for FCR/MCR Technology at Development Alternatives, New Delhi. The roofing tiles are being produced since 1988 and the TARA Vibrator since 1989.

The TARA Vibrator consists of an aluminium table top, which is vibrated by a rotating eccentric mass at a frequency of 2800 rpm, and an interchangeable hinged frame for the production of different shapes and thicknesses of tiles. The machine is powered by an electric motor (1/4 hp), driven from a mains supply of 230 volts.

A clear disadvantage of some of the vibrating machines available is their inability to control the vibration. The TARA Vibrator provides a unique mechanism suspended on leather belts, which allows for the vibration to be controlled by adjustable tie rods, depending on the type of cement mix, availability of materials and water-cement ratio. The machine operation is optimized to give a vibration time of about 45 seconds for high strength and minimum porosity of tiles.

Another special feature of the machine is a swivel seating arrangement for the operator to sit on, reducing the physical strain during tile making and permitting free rotation when the fresh tile is transferred to the mould stack at the side of the machine.

The machine requires very little maintenance, which is normally restricted to the changing of bearings after prolonged operation.

The TARA Vibrator is preferably used to produce micro-concrete tiles, because fibre reinforcement has proved to be a major constraint towards achieving high production and consistent quality of tiles. The micro-concrete mix consists of 1 part cement, 2 parts of graded sand and 1 pan of stone grit passing through 4 mm mesh. This mix requires a water-cement ratio between 0.45 and 0.5. With this mix and a labour force of 4 persons, a production rate of up to 200 tiles a day is easily achieved.

Together with the vibrating table, Development Alternatives supplies 200 self-stacking, high-impact polystyrene moulds (mounted on wooden frames) and the necessary accessory tools, such as trowels, scoops and quality control implements.

Training

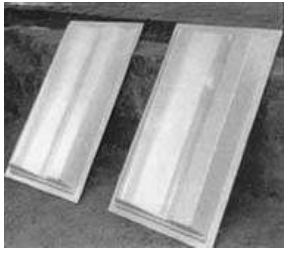
Development Alternatives conducts training courses in MCR tile production for supervisors and masons. The courses, which are held in New Delhi or at one of the many collaborating institutions in India, not only deal with practical aspects, but also with economical aspects, management and marketing.

Operating the TARA Vibrator

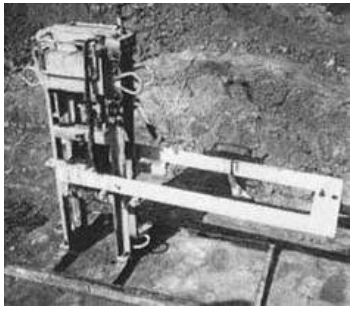
Theoretically, MCR tiles can be made on the TARA Vibrator by a single person, but for an uninterrupted and constantly high production rate of about 200 tiles per day, a team of 4 persons is required.

The production process is principally the same as for all other screeding machines: clamping down a plastic sheet with the screeding frame, placing a measured amount of mortar on the screeding surface, spreading it out under vibration and smoothing the surface, filling the nib construction box, lifting the screeding frame, removing the plastic sheet with the screeded mortar and placing it on a the mould for setting. The main difference is that the operator can remain seated during the whole operation, even when placing the fresh tile on the mould, making the work less tiresome. The 3 helpers are mainly occupied with supplying the operator with fresh mortar and moulds, as well as other odd jobs.

The TARA Vibrator with a stack of moulds



Locally made polystyrene tile moulds



The TARA BALRAM soil block press (*), which is described in the GATE Product Information "Soil Block Presses". The BALRAM is a manually operated block press, which turns out two blocks per cycle and can achieve an output rate of 124 blocks per hour. The moulds can easily he changed, making it possible to produce blocks of different sizes and types, including perforated blocks.

Development Alternatives / TARA

Development Alternatives (DA) is a nonprofit, self-financing corporate organization, established in 1983. Its main objectives are to design and promote better approaches for the sustainable development of India.

The prime commercial partner of DA is its sister organization, TARA (Technology and Action for Rural Advancement). TARA manufactures and markets all products of DA and provides feedback on relevant production engineering and market information to the designers of DA to facilitate the continual adaptation and improvement of the technologies.

The operations of TARA are self-financing and conducted through a decentralized network of franchized enterprises. An enterprise can be an individual entrepreneur, a cooperative, a voluntary organization, an existing business, a government agency, or any other entity capable of manufacturing and marketing the products designed by DA.

Under a contractual arrangement between the franchiser (TARA) and the franchisee (the local enterprise), their respective duties are clearly defined. Broadly, TARA is responsible for technology development, technology transfer and training, standardization, networking, common procurement and bulk purchasing, quality control and marketing.

The franchisee is responsible for manufacturing, selling and providing after sales service to the local market. The franchisee pays a nominal royalty and fees to TARA, which in turn pays royalty and service fees to DA.

The technologies and services of DA include:

- **Improved cookstoves (chulhas)**
- **Low cost housing technologies**
- **Mudblock presses***
- **Improved handlooms**
- **Biomass energy systems**
- **Bicycle trailers**
- **Paper, board making equipment**
- **Pottery products**
- **Energy plantations**

- **Solar energy systems**
- **Water and sanitation**
- **Environment management**

ECO Systems Concrete Rooftile Machine

Manufacturer
ECO Systems
P. O. Box 938
Blantyre
Malawi
Tel. [. . 265] 603 818 or 603 846
Fax. [. . 265] 603 803

Description

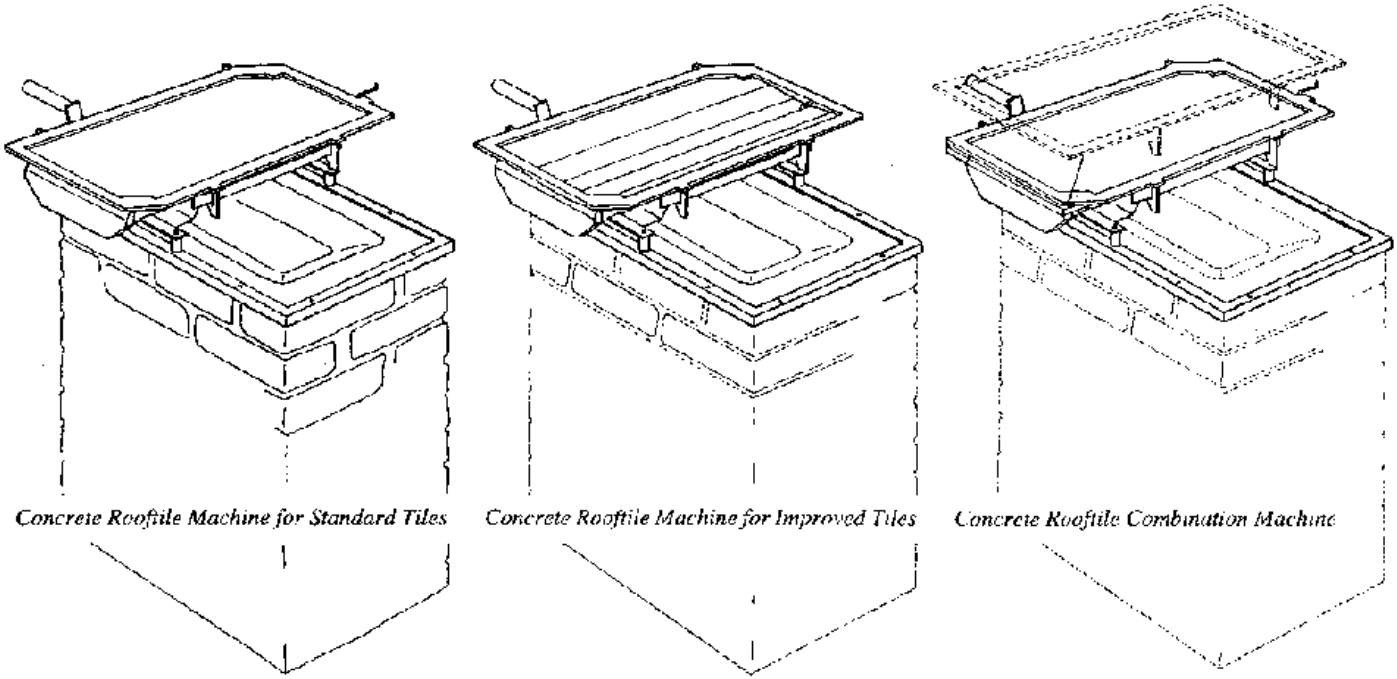
Since 1986 ECO Systems has been producing rooftiles and rooftile machines. The original tiles were manufactured according to the specifications of the Malawi Government Rural Housing Project (RHP) staff.

The RHP/ECO machine, which is basically a wooden box, is vibrated by two flat metal springs that hit it from underneath at a frequency of 2000 per minute. This is achieved by turning a handle, which requires little manual effort to operate.

A disadvantage of the earlier versions of the machine was the noise they produced. Therefore, the machines are now fixed firmly to a brick socle (instead of a light steel frame), reducing the noise and increasing the vibration intensity.

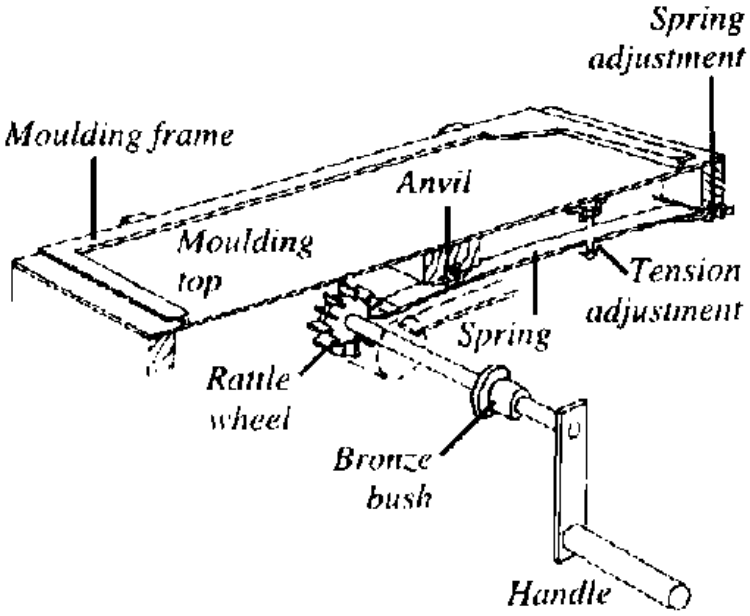
Two types of screeding machines are available: with a flat top for standard tiles and with a concave top for improved tiles (which are 9 mm thick at the troughs and 6.5 mm at the ridges). Thus, with the improved tile machine, a separate machine is required for making moulds and ridge tiles. If standard tiles are to be produced, only a combination machine is needed, which has interchangeable frames to make moulds and ridge tiles.

The concept of ECO Systems is to produce all roofing components *without fibres*. The MCR mix generally comprises 1 part cement to 2.5 parts river sand. For higher qualities, a mix of 1 part cement to 1 part quarry dust (or fine sharp sand) to 2.5 parts quarry stone of 3 to 4 mm (or similar small pebbles) is recommended.



Concrete Rooftile Machine for Standard Tiles *Concrete Rooftile Machine for Improved Tiles* *Concrete Rooftile Combination Machine*

Concrete Rooftile Machine



Section through screeding machine

Technical Details **ECO Systems Concrete Rooftile Machine**

Size of machine (length x width x height) ..... 65 x 45 x 15 cm (25 x 18 x 6 in)

Weight of machine (combination machine) ..... 15 kg

Size of crate for shipment ..... 80 x 76 x 25 cm (32 x 30 x

10 in)

Weight of packed machine ..... 29 kg

Standard tile size / weight ..... 60 x 28.5 x 0.65 cm (23.6 x 11.2 x 0.26 in) / 2.45 kg

Improved tile size / weight ..... 60 x 28.5 x 0.65/0.9 cm (23.6 x 11.2 x 0.26/0.35 in) / 3.15 kg

Energy input ..... manual

No. of tiles per cycle/output rate ..... 1 / 30 - 60 tiles per hour

Labour force required (incl. mixing and stacking) ..... 6 men

Price (ex works)	Standard tile machine	250 US$
	Improved tile machine	290 US$
valid	Combination machine for standard tile	325 US$
June 1991	Mould and ridge machine	245 US$
	Mother mould / Ridge mould	22/8 US$

Concrete mould ..... 0.5 US$

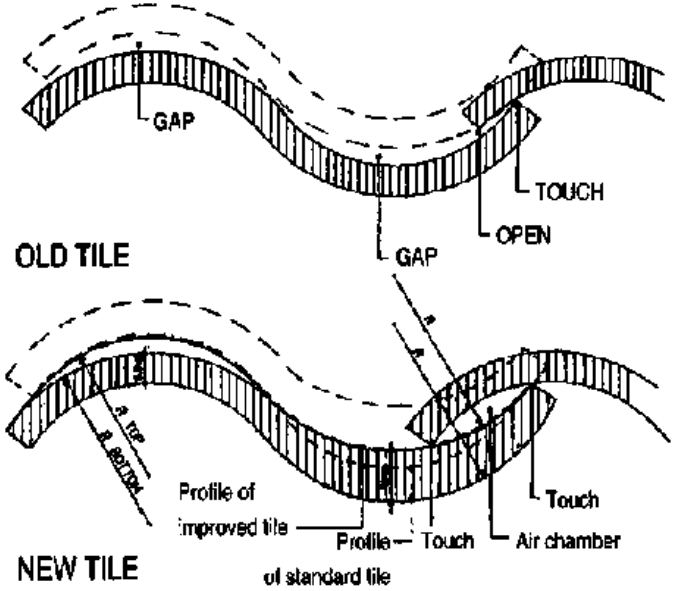
Stacking frame ..... 10 US$

The Moulding System

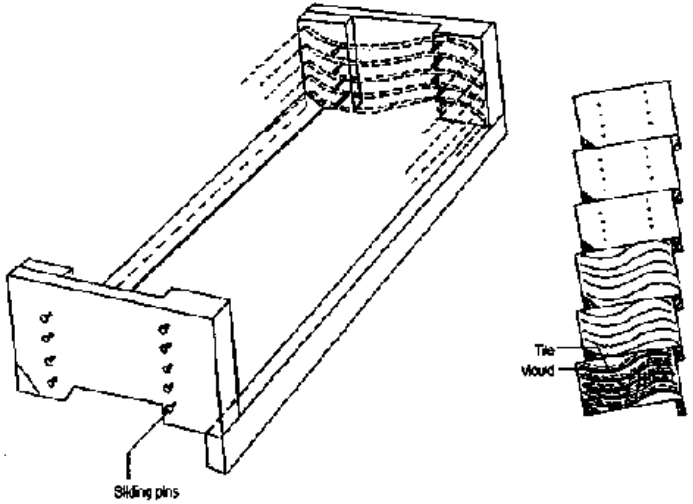
The profile of the tiles has been optimized to provide a closer fit at the overlaps (see profile sketches). This is achieved by making the crest of the tiles thinner (ie 6.5 mm) than the valley thickness (ie 9 mm). In order to obtain these different thicknesses, the screeding machine has a concave top and a moulding frame with a curved profile of 2 mm thickness. An additional advantage of this device is that the frame touches the screeding surface only along the narrow strip of 2 mm, avoiding the accumulation of mortar under the frame, improving tile quality and increasing working speed.

The mothermoulds, which were previously made of concrete, are now of preformed plywood, in order to ensure greater uniformity and reduce weight. For the same reasons the grand-mothermould has been omitted.

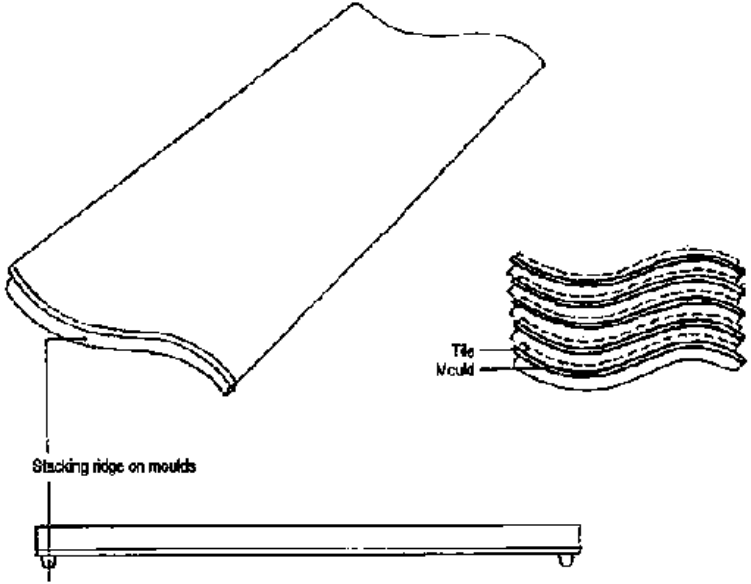
The machines are supplied together with a set of mothermoulds, with which two types of concrete moulds can be produced: with and without stacking brackets. Moulds with stacking brackets can be piled up in stacks of five tiles, while plain moulds, which are made much faster, are stacked in simple wooden frames.



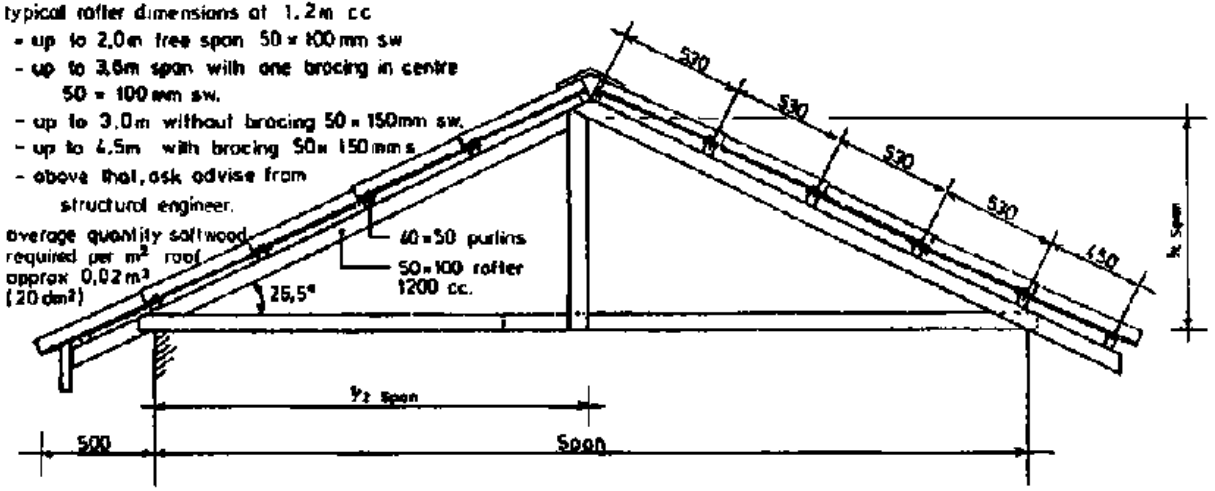
OLD AND NEW TILE PROFILE (Dimensions exaggerated to show differences more clearly)



Plain moulds are stacked in simple wooden frames: 5 tiles and moulds per frame; maximum 7 frames stacked on top of each other.



Tile moulds with stacking ridges can be piled up in stacks of 5 tiles.



TYPICAL ROOF CONSTRUCTION FOR ECO BETON TILES

DCS Foot-Powered Vibrating Table

Manufacturer
Development and Consulting Services
P.O. Box 8
Butwal
Nepal
Tel. [..977] 73-20391
Fax. [.. 977] 73 - 20465
e-mail: bhusan%dcs@umn.mos.com.np

Description

The DCS Foot-Powered Vibrating Table is a one-person operation screeding table, manufactured in Nepal since 1987. The vibrating surface and drive mechanism are mounted on an angle iron frame. Connected to this is a seat, which is adjustable to suit the tile maker's stature, so that he can sit comfortably at the table while making the tile. He rocks the two foot pedals back and forth at an easy speed, driving a bicycle wheel, which in turn drives an eccentric weight assembly beneath the aluminium vibrating surface at a speed of 2500 to 3000 rpm. Careful fitting of all nine sealed bearings ensures easy operation and long life for the machine. The screeding table has a one year guarantee.

The screeding frames for tiles (6 and 8 mm thick) are shaped to provide an "interlock" at the mitre - the diagonal mitre has been replaced by a dog-legged mitre. The frames also provide nib construction boxes for a wind proof fixing of all tiles. Experience shows that wind forces are sufficient to lift tiles, so all tiles are made with a lower fixing nib. A second nib may be made at the top for special conditions (top line of monoslope roofs, edges with long overhangs). When they are not needed, these nib boxes can be swung out of the screeding area (to leave it unobstructed for quick working) and positioned when needed.

The moulds are 535 mm long concrete elements fixed into galvanized sheet stacking frames, which also serve to protect the fresh tile from drying out during setting. DCS sells fitted moulds and frames with the screeding tables. This ensures that the moulds used are accurate and of good quality and allows the entrepreneur to start tile production immediately, so that he soon can produce a

demonstration roof to show interested customers and begin to earn money without delay. He can, however, also buy a fibreglass mother mould, with which he can make his own moulds later (when he has sufficient experience), in order to replace broken moulds or increase his production capacity.

In addition to the screeding table and tile moulds, the following accessories are supplied:

- **a set of batching boxes for fast measurement of cement and sand to correct proportions and workable batch size;**
- **a set of tile maker's scoops to enable correct batching of the wet mortar as tiles are made;**
- **a tile thickness gauge for checking finished tiles according to the standard;**
- **a batten gauge to aid quick and accurate roof building.**

Entrepreneurs may purchase extra tools for quality checking:

- **standard vessel to measure water for mixing;**
- **prism mould, loading jig and thickness gauge for checking mortar strength.**

DCS also supplies sieves for screening sand and fine aggregate, shovels, trowels, pliers, tile stack covers, interface plastics etc.

Maintenance

The screeding table is maintenance free for up to 5 years, if cleaned regularly during tile making. The tile frame and screeding surface must be cleaned after each tile is screeded, in order to avoid distorting them. Bearings are protected by seals and cover plates. The bushes for the frame clamping arms and for the vibrating drive should be lubricated before the machine is stored for a period of no production, to avoid seizure from rust. The screeding surface mounting rubbers need replacing every year, as they absorb/damp vibration when they are perished. Replacement rubbers can be hand made from a scrap truck tyre; footwear repairers always have this type of rubber available.

Moulds need regular cleaning to avoid build-up of spilt mortar. Daily cleaning with a cloth or handful of fibre is quick and easy. Mortar left longer can be scraped off without fear of damage to the mould, as it has a hard surface.

Figure

Technical Details **DCS Foot-Powered Vibrating Table**

Size of machine (length x width x height) ..... 102 x 74 x 85 cm (40 x 29 x 33 in)

Weight of machine ..... 48 kg

Size of crate for shipment..... 85 x 85 x 90 cm (33 x 33 x 35 in)

Weight of packed machine plus accessories ..... 65 kg

Standard tile size .....50 x 26 x 0.6/0.8 cm (19.7 x 10.2 x 0.24/0.31 in)

Frame for ridge tile ..... 53.5 x 28 cm (21 x 11 in)

Energy input ..... manual

No. of tiles per cycle/output rate..... 1/50 tiles per man-day

Labour force required (incl. mixing and stacking)..... 1-5 people per machine

Price (ex works)	Vibrating Machine	13000 NRs (≈ 260 US$)
valid May 1997	Mould with Frame	130 NRs (≈ 2.60 US$)
NRs = Nepali Rupees	Galvanized Stacking Frame	108 NRs (≈ 2.20 US$)

Training

DCS selects prospective entrepreneurs from applicants for an 11-day training course in FCR/MCR. The training is held in Butwal and includes theory and practical sessions covering

- **production (including raw material selection, quality checks),**
- **tile use (roof types, construction, tile fitting),**
- **entrepreneur motivation,**
- **marketing skills,**
- **case reports and a tour to an established tile producer,**
- **book-keeping,**
- **obtaining finance.**

Operating the DCS Vibrating Table

Before production, the tile maker must adjust the seat to enable him to sit comfortably while working. Also the screeding surface must be levelled before beginning. A small backrest is provided to give the light support needed while operating the foot pedals and screeding the mortar. Pedalling is not heavy work for the operator's legs.

When the mortar has been batched and mixed, the operator sits at the table, places a plastic interface sheet on the screeding table, then clamps down the appropriate tile frame. Using the corresponding scoop, a measured lump of mixed mortar is placed on the screeding table, and then this is trowelled out to an even thickness within the tile frame, while generating the vibration by rocking the foot pedals back and forth. When the screed surface is smooth and level with the screeding frame, the nib on the lower tile end is made by swinging the nib

construction box into place, filling it with mortar under vibration, and inserting a wire loop for fixing on the supporting roof batten. Depending on the roof design, some of the tiles will need a second nib on the upper end, for which another nib box is provided.

After the nibs are made, the plastic sheet with the screeded mortar is lifted onto the next empty mould. This mould is then moved to the stack of newly moulded tiles and the position of the screed on the mould is checked. It is covered with the next mould and screed, or a mould cover if it is at the top of the stack, to prevent the mortar from drying.

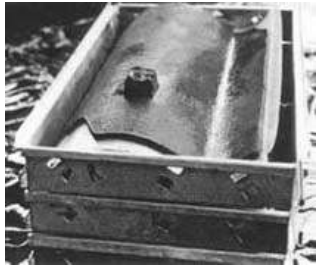
The tiles are removed from the moulds after about 24 hours and subsequently cured for 2 weeks in water tanks or vapour curing beds.

1. Placing mortar on the screeding surface

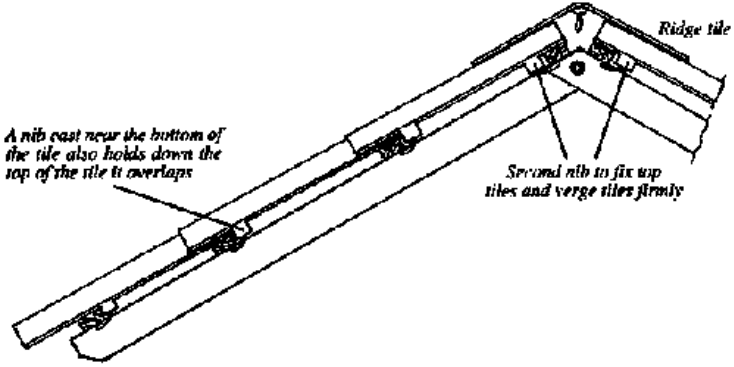
2. Spreading the mortar under vibration

3. Lifting the plastic sheet with the screeded mortar to place it on the mould

4. Detail of the bicycle wheel drive mechanism



5. Mould stack with fresh rooftile



A Simple Windproof Tile Fixing Method

APPRO-TECHNO Tegulamatic Roof Tile Plant

Manufacturer
APPRO-TECHNO SA
26 Rue de la Rize
B-5660 Couvin (Cul-des-Sarts)
Belgium
Tel. [..32] 60-37 76 71
Fax. [.. 32] 60 - 37 78 87

Description

The Tegulamatic is a roof tile screeding machine that produces 2 tiles at a time. It is supplied with a complete production plant, which, in addition to the screeding machine, comprises 3 frames:

- **1 for 2 overlapping pantiles 49 x 23.5 cm,**
- **1 for 1 overlapping under-ridge tile and 1 overlapping edge tile (each 49 x 23.5 cm),**
- **1 for 2 49 cm long ridge tiles,**

a concrete mixer, a roll of plastic sheeting to be cut locally into 1000 interface sheets, a measuring scoop for mortar, a rubber box to hold fresh mortar, a float, a balance, a 10 litre bucket, a jig to trim the tiles, quality control devices and samples of fibres and colourants. The main bulk of the plant is the set of double tile moulds, supplied in sets of 100 to 400 moulds, depending on the desired production rates (between 190 and 700 tiles per day).

The screeding table is an especially robust steel construction, designed for intensive use over long periods. The electric vibrator has the following characteristics: 3000 rpm, 0.095 kW, 220 V monophase, 220/380 V triphase, 50/60 Herz (tropicalization on request), 24 or 12 V direct or alternating current (also available on request).

The standard thickness of the screeding frames is 8 mm, but frames of 10 mm thickness are also available to produce more resistant tiles.

The self-stacking double moulds are made of galvanized steel. There are 2 different types, one for pantiles and one for ridge tiles. Each double mould is 108 cm long and weighs 4 kg. The following table shows the different sets available for different output rates:

Type	pantile moulds	ridge tile moulds	No of tiles/day	m^2 of roof/day

				m² of roof/day
AP 100	95	5	190	15
AP 150	145	5	290	23
AP 200	190	10	380	30
AP 250	235	15	470	37
AP 300	280	20	560	44
AP 350	325	25	650	52
AP 400	375	25	700	56

In each case, the nominal output is slightly less than the number of moulds provided, so that the operator can already begin the day's work with the unused moulds of the previous day, while the rest are being demoulded and cleaned.

Figure

Technical Details **Tegulamatic AP 100**

Size of screeding table (l x w x h) .....10 x 50 x 100 cm

(43 x 20 x 39 in)

Weight of screeding table..... 148 kg

Sizes of crates for shipment	a. Machine & accessories .....177 x 135 x 112 cm (70 x 53 x 44 in)
	b. 100 moulds .....20 x 120 x 50 cm (47 x 47 x 20 in)
Weight of the two crates	a + b (450 + 600 kg) ..... 1050 kg

Standard tile size / weight ..... 49 x 23.5 x 0.8 cm (19.3 x 9.3 x 0.31 in) / 2.1 kg

Energy input ..... electrical (95 watts)

No. of tiles per cycle/output rate ..... 2 / 60 tiles per hour

Labour force required (incl. Mixing and stacking) ..... 4 men

Price (ex works)	Tegulamatic AP 100 ..... 145000 FB (≈ 4200 US$)
valid June 1991	Tegulamatic AP 400 ..... 325000 FB (≈ 9300 US$)

FB = Belgian Francs

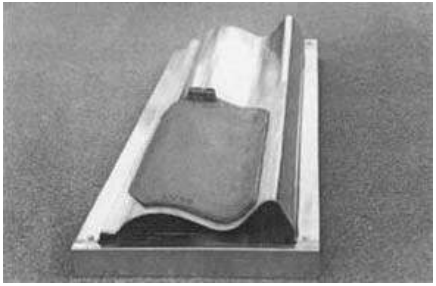
Training

Professional training courses (covering both the technology and management aspects) are conducted by APPRO-TECHNO in Belgium or in Abidjan / Ivory Coast, or elsewhere at the customer's request.

1. Spreading and smoothing the mortar under vibration

2. With the frame lifted off the screeding surface, the plastic sheets and screeded mortar are pulled carefully over the mould.

3. The mould is placed on the mould stack for the fresh tiles to cure for 24 hours.



4. View of a Tegulamatic double mould with one tile placed on it.

Operating the Tegulamatic

A variety of design details have been incorporated in the Tegulamatic screeding table to simplify the operator's work. These are, for instance:

- **a tray extending on the side of the table to hold the rubber mortar box at working height;**

- **a foot pedal to clamp down and release the screeding frame, leaving the hands free to do other things, eg hold down the nibs when lifting off the frame (a hand operated lever can also be used instead of the loot pedal, if necessary):**

- **adjustable screws at the 3 clumping points to ensure a tight lit of the frame on the screeding surface;**

- **4 bolts to adjust the level of the table, indicated by 2 water gauges fixed at visible points on the table;**

- **3 standardized hinges to facilitate the changing of frames;**

- **a second foot pedal to switch the vibrator on and off;**

- **2 adjustable and retractable brackets to hold the mould and permit the plastic interface sheets and screeded mortar to slip smoothly over the mould.**

The production of FCR or MCR tiles on the Tegulamatic is essentially the same as on other screeding machines: clamping down a plastic sheet with the screeding frame, placing measured amounts of mortar on the screeding surfaces, spreading it out under vibration and smoothing the surface, filling the nib construction boxes, lifting the screeding frame, removing the plastic sheets with the screeded mortar and placing them on a the mould for setting. The main difference is that a part of the work is done by means of foot pedals, leaving the operator's hands free to carry out the work more efficiently. Furthermore, the output rate is higher,

since two tiles are made per cycle.

After demoulding the tiles the next day, the recommended duration for curing under water is 5 days and subsequent dry curing in a shaded place is 15 to 20 days, after which the tiles are ready for use.

Other APPRO-TECHNO Equipment

APPRO-TECHNO has a long experience record in the manufacture of high standard equipment for the production of building materials. Apart from the Tegulamatic Roof Tile Plant, these are:

1. TERSTARAM, a manually operated mobile soil block press with interchangeable moulds, which can also be used to mould clay bricks and roof tiles:

2. SEMI-TERSTAMATIQUE, a motorized (electric or diesel powered) soil block press with interchangeable moulds, functioning in much the same way as the TERSTARAM, but with a much higher output.

3. TERSTARAM Ground Breaker, a mobile (electric or diesel powered) earth pulverizer, with which the dry clay lumps in the raw material are disintegrated to produce a homogenious soil for brick production.

4. TERSTAMIX (also available under the trade name TETRAMIX), a mobile (electric or diesel powered) two-paddle planetary mixer, required to prepare the soil for block production but also to prepare mortars and

renderings.

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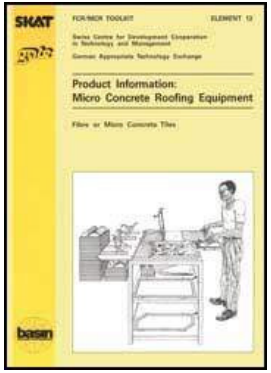


Product Information: Micro Concrete Roofing Equipment - Fibre or Micro Concrete Tiles (BASIN - GTZ GATE - SKAT, 1997, 38 p.)

- ***(introduction...)***
- **Introduction**
- **Fibre Concrete / Micro Concrete Roofing Equipment**
- **CECAT TEVI - Unit de production de tuiles en micro-bton**
- **TEJACRETO Plana**
- **TEJACRETO Escalera**
- **TEJACRETO Romana**
- **TEJACRETO Colonial**
- **TEJACRETO Pantile**
- **Product Information: MCR/FCR Equipment**
- **Equipment and Tools for Basic Module for Fibre Concrete Tiles Production TEJACRETO - Peru**
- **HABITECH - BUILDING - SYSTEM**

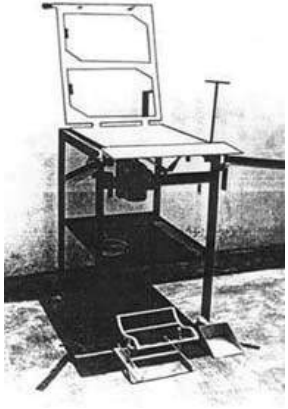
Equipment and Tools for Basic Module for Fibre Concrete Tiles Production

TEJACRETO - Peru

CESEDEM

Centro de Servicios para el Desarrollo Empresarial S.R.L.

VIBRO SCREEDING MACHINE



Figure

AS A PRODUCT OF AN INVESTIGATION AND EXPERIMENTATION PROCESS, THAT BEGAN IN 1990, WE HAVE AN EQUIPMENT TOTALLY PRODUCED IN PERU.

CHARACTERISTICS

a) Vibrating table with metallic framework "Vibratej", with a vibrating unit propelled by an electric 0.5 H.P motor.

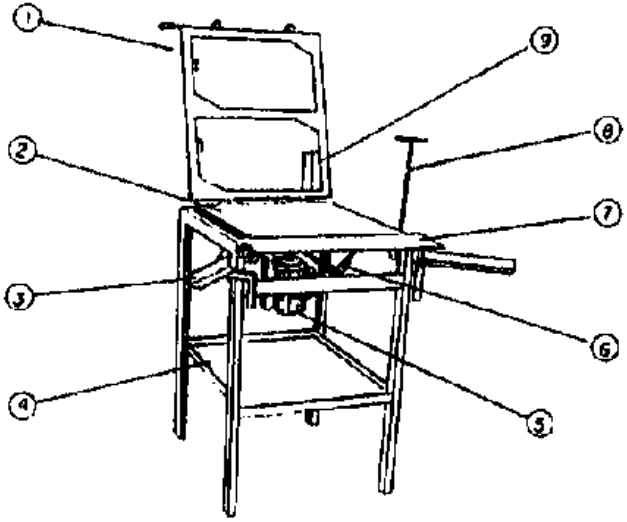
b) It is operated by one person, and has a production capacity of 400 to 500 tiles for each 8 hours work turn.

c) This machine produces 2 tile units for each vibration, and is also useful to produce floor and wall tiles.

d) It is easy to maintain, which is a guarantee of effective operation in every country region.

1. Double Frame
2. Vibrating base
3. Mould holder
4. Bottom base tray
5. Vibrating box
6. Fastener handle
7. Flap
8. Frame support
9. Frame stop bar

PRODUCERS



Figure

- **ACONTEC S.A.: Calle 13, Mz. N, lote 4, Parque Ind. "El Asesor", Ate - Vitarte, Lima-Per. Telf. (51-1) 351-0770 Telefax (51-1) 438-2522.**

- **CARPINTERA METLICA "MARCOS": Zafiros 1734 Mz. N . Las Flores 78 La Basilea San Juan de Lurigancho, Lima-Per Telf. (51-1) 458-1816.**

FOB PRICE: US$ 1,20000

ADVICE

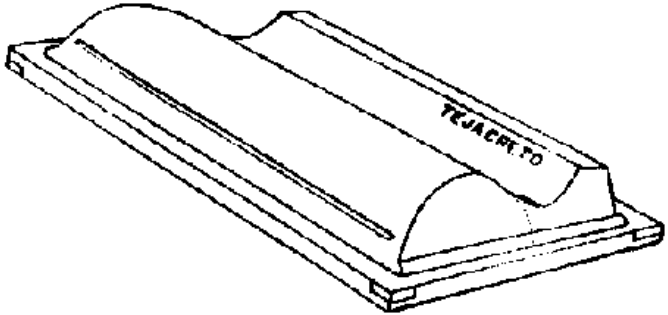
- **CESEDEM S.R.L: Calle Jos del Llano Zapata 331 Of. 401, Miraflores Lima-**

Per. Telf. (51-1) 441-8614 Telefax (51-1) 438-2522.

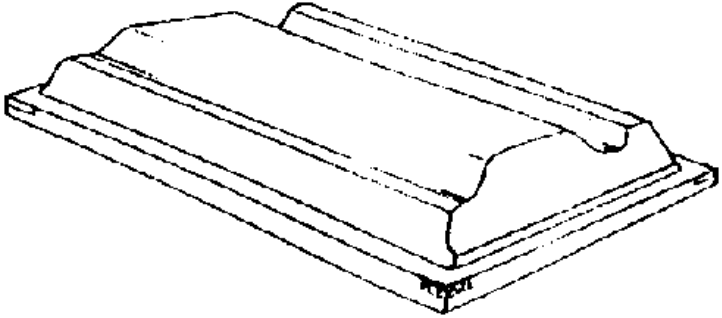
TEJACRETO ®

JOSE DEL LLANO ZAPATA N° 331 OF. 401 MIRAFLORES LIMA 18
TELEFAX. (51-1) 441-8614

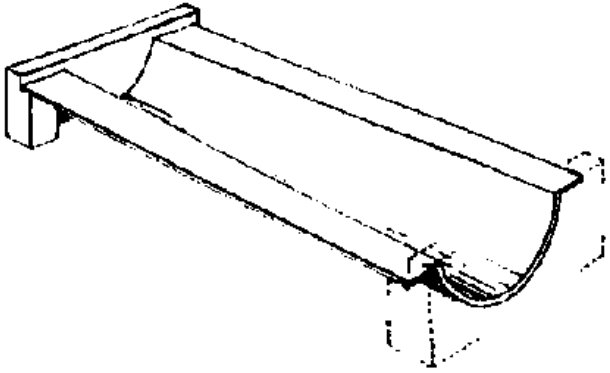
TILE MOULDS



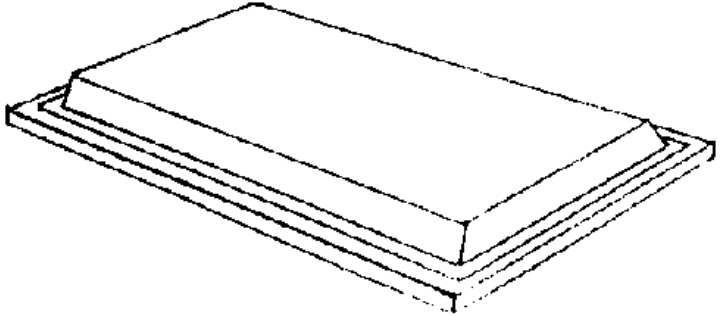
1. PANTILE MOULD



2. ROMAN MOULD



3. COLONIAL MOULD (ridge)



4. PLAIN MOULD

1. PANTILE MOULD: Based on original model evolutions, it is produced in Peru since 1990 It is the most used tile in all highland and amazonic zones, because of its similarity to colonial tiles.

2. ROMAN MOULD: Cuban moulds TFVL were introduced since 1995 At the present time, they are not produced in Peru anymore.

3. COLONIAL MOULD: It was created in Peru and used as roofing, ridge, gutter (roof valley) It is also used as complement for other models. They are produced in different styles, in order to compete with similar artisan and industrial tiles.

4. PLAIN MOULD: It was also created in Peru and it is used as ornamental roofing on exclusive residential house roofing in the city and on the beach.

FOB PRICES

PANTILE M:	US$	7.50

COLONIAL M.:	US$	6.00
PLAIN M	US$	700

*** We also produce complementary tools for tile fabrication.**

JOSE DEL LLANO ZAPATA N° 331 OF. 401 MIRAFLORES LIMA 18
TELEFAX. (51-1) 441-8614

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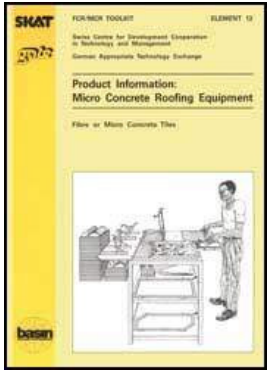


Product Information: Micro Concrete Roofing Equipment - Fibre or Micro Concrete Tiles (BASIN - GTZ GATE - SKAT, 1997, 38 p.)

- **HABITECH - BUILDING - SYSTEM**
  - **Roofing ROOF STRUCTURE MCR Tiles Installation**
  - **Roofing WORKSTATION Micro Concrete Roofing Tiles**
  - **Ralisations en Tuiles Fibro-Mortier - Realizations in Fibre-Mortar Tiles**
  - **Processus de Fabrication - Production Process**

Product Information: Micro Concrete Roofing Equipment - Fibre or Micro Concrete Tiles (BASIN - GTZ GATE - SKAT, 1997, 38 p.)

HABITECH - BUILDING - SYSTEM

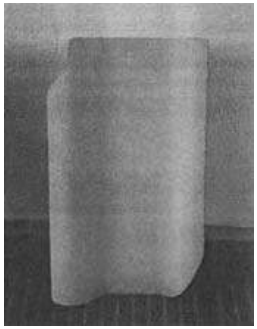
Roofing ROOF STRUCTURE MCR Tiles Installation

Manufacturer
Domtec Company Limited
1005/29 Soi Prachachuen 30
Bangsue, Bangkok 10800, Thailand

Tel: 910-1463,910-1465
Fax. (66-2) 910-1465

WHAT IS MCR?

The Micro Concrete Roofing (MCR) technology is a relatively new technology that can be used to produce inexpensive and reliable concrete tiles for roof cover. The tiles are light, durable and can be made by using locally available raw materials: cement, sand and stone-dust.



Figure

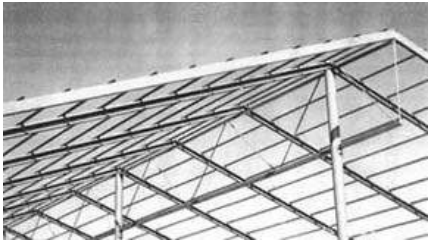
ROOF STRUCTURE:

A roof constitutes the most important part of the building. Hence it is inevitable to take special care during the preparation of the roof and its elements. In order to construct a durable roof, not only the covering material must be of a good quality, but also the entire root structure and cover must function as a coherent system adapted to local conditions such as climate, available skill and structural materials. Roof structures are affected by the following factors:

Load: Conventional concrete and clay tiles weigh 50 to 80 kg per square meter whereas the MCR tiles weigh much less. The load of the MCR tiles on the roof structure depends on its thickness. The following Table shows weight factor for specific thickness grades of tiles:

Tile Thickness	Weight / Unit	/ Unit / Weight / sq.m. sq.m.

6 mm.	1.6 kg	12.5	20.0 kg
8 mm.	2.2 kg	12.5	27.5 kg
10 mm	3.0 kg	12.5	37.5 kg



Figure

In addition to the load from the tiles themselves, it is necessary to consider the wind and repair loads, and in some cases the snow load as well, depending on local weather conditions. The most crucial load in most locations is the wind load. Strong winds or storm can cause great damage to a roof if it is not well made and securely fixed to the building. In general a maximum wind speed of 150 km/h is taken into account which is equivalent to a storm capable of uprooting trees. This results in suction forces on the roof of up to 70 kg/ sq.m. The wind can also create pressure of up to 30 kg/sq.m. on the roof.

Slope: The minimum slope required for the MCR tile roofs is 22° in areas with moderate climate and 30 to 40° in areas with severe driving rains. The slope of the roof is also determined by additional criteria such as aesthetic, form and function.

MCR Tile Characteristics:

Use for:	Roof covering
Materials Used:	Concrete (cement, sand, fine aggregate and water) rectangular with broken wedges (special tiles arc manufactured for ridges and edges)
Shape:	
Profile:	Corrugated
Standard Size:	25 cm. x 50 cm.
Effective cover:	20 cm. x 40 cm. (1 2.5 tiles per sq.m. area)
Thickness:	6 mm, 8 mm. and 10 mm.
Weight:	1.6 kg., 2.2 kg and 2.8 kg.
Bearing Capacity:	30 kg, 50 kg, and 80 kg.
Production Capacity:	200 tiles per day per workstation

Battens: The setting of battens is the most important part of MCR roofing on which the proper laying of the tiles and water-tightness depend. The spacing of the battens is 40 cm. The battens can be of wood or steel sections which should be able to bear the weight of the tiles and a man (about 80 kg.) for the safety of the workers during construction and maintenance.

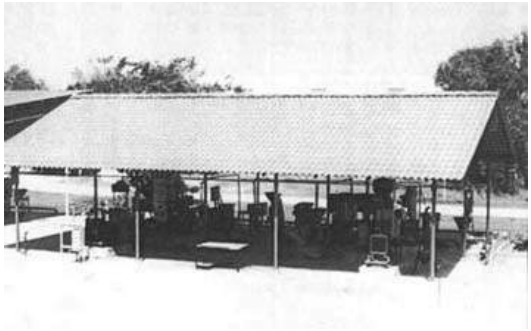
Structure: The section and spacing of the purlins and rafters are calculated according to the slope, climate conditions, and weight of the tile. The roof

structure needed for MCR roofing is simple and uses light triangular roof trusses. The trusses may be made of wood or metal. But with the increasing scarcity of good quality timber, metal structures are becoming more and more a competitive alternative in roof construction. The main advantage of the metal structure is that it is highly accurate and constitutes an even and stable under-structure for the tiles.

TILE INSTALLATION

To ensure watertightness, a proper installation of the MCR tiles is required, specially in the most exposed areas, that is, the installation of the side and wall plates. The battens supporting the tiles should be fixed by a skilled roofer.

Laying: For the better interlocking of the MCR tiles, they should be first laid from the lower left-hand corner of the slope with the next one overlapping on the top part and then on to form a first vertical row. Then the roofer proceeds with the second and succeeding vertical rows in the same manner. In order to obtain a good interlocking of tiles, it is recommended to install first a complete horizontal row from edge to edge. To align perfectly the columns, it is possible to trace vertical lines with a rope maintained at the top and bottom.



Figure

When the first slope is completed, the second slope is also laid in the same way. The ridge tiles should be installed gradually as soon as enough columns are completed on the second slope. This avoids the need of climbing on the finished part of the roof.

Fastening: For the wind-prone areas, it is very necessary for the tiles to be fastened. In general, all the tiles are fastened by tying the batten with the wire passed through the nib's wire of the tile.

Ridge: The ridge line is covered with specially designed tiles and finally bedded in mortar or pre-casted concrete ridge blocks are glued to allow dry fixing of ridge tiles. Ridge tiles overlap by 50 mm. minimum or may be laid with a double row of ridges.

Figure

Edge: Lateral edges can be made with specially designed tiles; the joint between wall and tiles can be made with a carefully prepared mortar. If there is a roof overhang, a good solution consists in using a fascia board.

Hip and Valley: Hip tiles are specially-designed tiles binded with mortar; valley gutters are most often made of galvanized iron sheet under the cut edge of the tile.

Figure

TRAINING:

Training in the MCR tile production as well as training in installation with the tiles can be provided by the manufacturer. Group training may carried out either at the manufacturer's own training center or at a project site with the equipment provided.

The training costs are established on a case by case basis. For more information and details, please write to the manufacturer.

Roofing WORKSTATION Micro Concrete Roofing Tiles

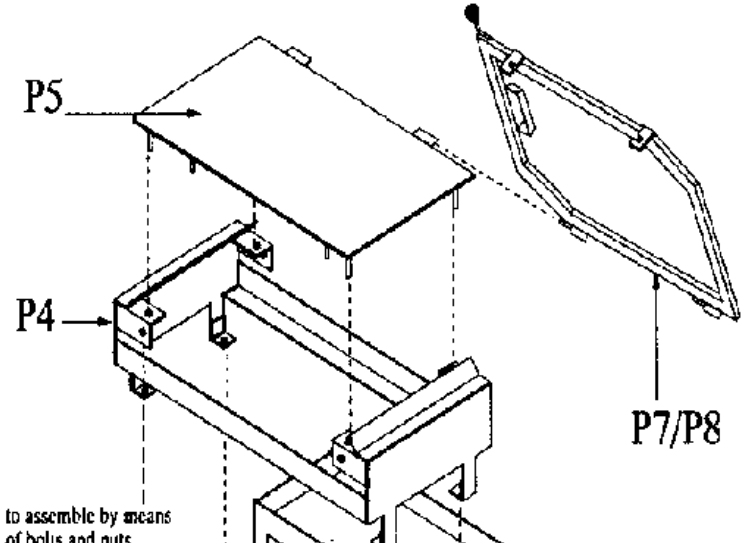
Manufacturer
Domtec Company Limited

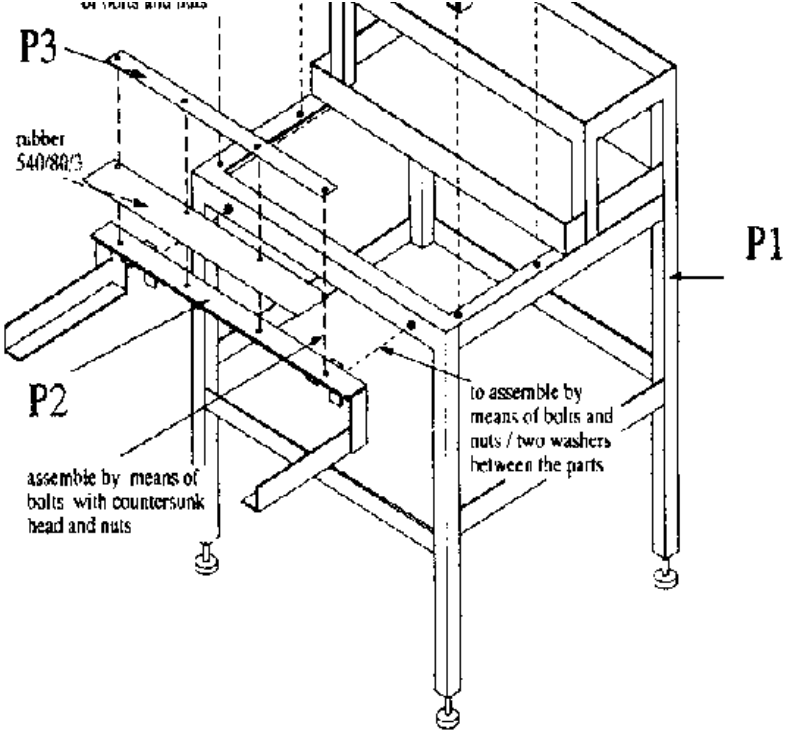
1005/29 Soi Prachachuen 30
Bangsue, Bangkok 10800, Thailand

Tel: (66-2) 910-1463
Fax. (66-2) 910-1465

Description:

A complete workstations for producing Micro Concrete Roofing (MCR) tiles consists of a vibrating table, an electric motor, 200 plastic moulds and interface sheets, an admixture container and testing equipment for quality control.





Figure

The vibrating table consists of a screeding table and a steel chassis. An electric motor is bolted to the machine in order to vibrate the mixture for compaction.

A container is used to keep fresh concrete mixture to produce tiles. It is made of a

steel box (60 cm x 65 cm x 20 cm) fixed on a steel chassis. The box has a sloped front in order to take out the mixture easily.

Moulds are of two types: the moulds for regular tiles are made of ABS plastic and are rectangular in shape with broken wedges. The profile of the tiles is corrugated. The moulds for the ridge tiles are made of wood and steel and have a V-shaped profile.

Figure

Interface sheets are used to transfer fresh mixture from the vibrating table to the moulds. They are placed on the vibrating table under the screeding frame before the mixture is scooped onto it.

The testing equipment used for Bending and Nib Tensile tests consists of a steel frame with two angular sections fixed at a distance of 400 mm.

Figure

MCR Tile Characteristics:

Used for:	Covering the roof of different types of buildings
Materials Used:	Concrete mixture of cement, sand and aggregates.
Shape:	Rectangular with broken wedges (special tiles can be produced for ridges and edges)
Profile:	Corrugated
Standard Size:	25 cm. x 50 cm.
Effective cover:	20 cm. x 40 cm. (12.5 tiles per sq.m. area)
Thickness:	6 mm, 8 mm. and 10 mm.
Weight:	1.6 kg., 2.2 kg and 2.8 kg.
Bearing Capacity:	30 kg, 50 kg. and 80 kg.
Production	200 tiles per day per workstation

Capacity:

MICRO CONCRETE

The Micro Concrete Roofing technology is a relatively new technology that can be used to produce inexpensive and reliable concrete tiles for roof cover. The tiles are light, durable and can be made using locally available raw materials: cement, sand and stone-dust.

Figure

RAW MATERIALS:

Cement: Portland cement needs to be used in the production of MCR tiles. The cement should be of the standard required for normal concretework. The amount of the cement required for a tile of 8 mm. thickness is 0.45 kg.

Sand: The sand should be well graded, clean and free of organic materials. The clay and silt content of the sand should not exceed 4%. Sand should be seived

with a mesh size of 2 mm.

Stone-dust: It should have the same characteristics and properties as sand. The maximum size of the aggregate should not exceed two-thirds of the tile thickness. They should be as clean and free from clay as the sand.

Water: The water should be clean and fresh, and free of salt. If the water quality is doubtful, it can be tested in laboratory for salt content and other chemical contamination.

Colourant: The MCR tiles are naturally light grey in colour. To achieve a more attractive product they may be coloured by using additives to the admixture such as iron oxides or carbon black (darker grey tiles) or, they can be painted using a spray gun or brushes.

Placement: Metal wire is used for fixing the tiles to the roof structure. Galvanized steel wire of 2 mm. diameter should be used for this purpose as it will not corrode. These wires are placed in the nibs when the tiles are fabricated.

PRODUCTION PROCESS:

The general steps are the following:

- **Mortar Preparation**
- **Vibrating and moulding**
- **24 hrs mould curing**
- **Demoulding**

- Curing / storage
- Quality control

Figure

ROOF STRUCTURE:

In order to construct a reliable roof, not only the roofing material must be of good quality, but also the entire roof must function as a coherent system adapted to local conditions such as the climate, the available skills and structural materials. Roof structures are affected by the following factors:

Load: Conventional concrete and clay tiles weigh 50 to 80 kg per square meter whereas MCR tiles on the roof structure varies from 20 to 37.5 kg per sq.m. depending on thickness. Consideration should be given to live loads such as wind and rain depending on local conditions.

Slope: The minimum slope required for the MCR tile roofs is 22° in areas with moderate climate and 30 to 40° in areas with severe driving rains.

Battens: The spacing of the battens for MCR tiles is 40 cm. The battens can be of wood or steel sections.

Structure: The section and spacing of the purlins and rafters arc calculated according to the type of materials, slope, climatic conditions, and weight of the tiles.

TRAINING:

Training in production of MCR tiles and in managing production units can be provided by Habitech Center at its typical production facilities on AIT campus. Follow-ups and testing for quality control of the production are provided as an integral part of the training.

The training cost is established on a case by case basis. For information and details, please contact:

Habitech Center

Asian Institute of Technology
G.P.O. Box 2754, Bangkok 10501
Tel: (66-2)524-5611
Fax: (66-2) 516-2128

Equipment Characteristics:

Size and Weight of Vibrating Table	60 cm x 64 cm x 92 cm	78 kg
Size and weight of Container	60 cm x 70 cm x 91 cm	28 kg

Size and Weight of 200 Plastic Mould	36 cm x 6 1 cm x 120 cm	120 kg
Size and Weight of 200 Interlace Sheets	31 cm x 50 cm x 30 cm	14 kg
Weight of Tools	39 kg	
Total Weight of Equipment	279 kg	
Shipment of equipment	arranged by manufacturer	
Cost of the Equipment (ex - work)	US$	

APPRO-TECHNO S.A.

Ralisations en Tuiles Fibro-Mortier - Realizations in Fibre-Mortar Tiles

Figure

Figure

Figure

Figure

Figure

Figure

Figure

Processus de Fabrication - Production Process

1. Dosage et mlange du sable, ciment, colorant et fibres. ***Dosage and mixing of sand, cement, colourant and fibres.***

2. Etalement grossier du mlange. ***Rough spreading of the mix.***

3. Vibration et lissage final du mlange. ***Vibration and final smoothing of the mix*****.**

4. Ouverture automatique du cadre *Automatic opening of the frame.*

5. Mise en forme avec l'interface sur le support double. *Giving the final shape with the interface on to the double support.*

6. Empilage des supports pour la premire cure de 24 heures. *Stacking of the supports for the first 24 hour cure.*

7. Dmoulage de la tuile et bavurage *Demoulding of the rite and removal of the excess flashes.*

8. Bassins de cure (5 6 jours). *Curing tanks (5 to 6 days).*

1.1. What are fibro concrete roofing tiles or micro concrete roofing tiles ?

Fibre concrete or micro concrete roofing tiles are an excellent covering material with very high insulating (thermal and accoustic) qualities; their durability and resistance are also worth mentioning especially in comparison with galvanized roofing sheets. These qualities, together with other macro and micro economic aspects of the so called «locally productible building materials» make this type of roofing particularly appropriate to the realities of developping countries.

The raw materials consist of sand (average granulometry or «well graded» i.e. 0,06 to 0,2 mm), Portland Cement (CPA 35), organic or synthetic fibres (or aggregates) and possibly colourants (chemical pigments).

The tiles can be 8 or 10 mm tiles. We strongly advice against the production of 6 mm thick thiles due to their brittleness, bad resistence to violent winds (hurricanes) and to the problems encountered during their implementation. The money saved in terms of raw material does not compensate these disadvantages.

The manufacturing process is relatively easy. However, one should keep in mind that the productivity and the products quality are directly related to a good knowledge of the material and of the equipment as well as to a rational organisation of the work stations; this is the reason why APPRO-TECHNO offers and strongly advices a complete and professional training (see 2.9.).

The technological process can be summed up as follows *:

- cement and sand (ratio varying between 1:2 and 1:3) are drymixed into a mortar in a concrete mixer. Organic (15 mm long chopped pieces) or synthetic fibres are then added (so called «Fibre Concrete Roofing tiles» or F.C.R.).

If, for one or another reason, it is not possible or preferable to use vegetal or synthetic fibres, they can be replaced by aggregates (granulometry not bigger than 2/3 of the final roofing tile thickness). In that case, the final product is referred to as «Micro Concrete Roofing tile» (M.C.R.).

- the mortar is then laid on a plastic interface (already on the vibrating table) inside the screeding frame thanks to a mortar scoop. The mortar should be vibrated ± 45 seconds. The quality and duration of the vibration play an essential part in the quality of the final product (for instance, too long a vibration prevents the distribution of the various elements from being homogeneous, since the heavier elements tend to sink). The nib is also moulded during that time.

- the vibrated mortar is then gently transferred onto a support, which will give its final shape to the tile.

- at this level, the galvanized iron loop is inserted into the nib (to fix the tile on the roof).

- the tile should then remain on the support for 24 hours for shaping and drying and be covered with a plastic sheet to avoid cracks. The tiles are then put in a curing tank for 5 days (the humidity rate being 100 %) and stocked 15/20 days in a shed for final curing. From then on, they can be used or sold.

*** a thorough description can also be found in the book by G. Brys, Tuiles en Fibro mortier, procd de production et pose en toiture, Genve, B.I.T., 1988.**

1.2. Advantages.

FCR/MCR have many advantages which often make them the ideal solution as far

as the roofing issue is concerned in developping countries. These advantages can be identified on severals levels:

Qualities of the roofing material as such:

For the man in street, one of the essential things in every day's life is to have an irreproachable weatherproof roofing material above his head. In this respect, FCR/MCR meet this expectation. But, once again, as for any industrial product, a strict, permanent and intransigent quality control has to be set up. The first function of a roof is to protect its inhabitants from outside elements such as rain and sun.

As far as rain is concerned, FCR/MCR are perfectly waterproof. Moreover, their accoustic insulating qualities are such that no comparison can be made between a FCR/MCR roof and a roof covered with galvanized iron sheets when it rains.

Furthermore, it has been possible to verify the excellent resistance of the FCR/MCR roofs to violent winds in comparison to galvanized iron sheets on the occasion of the «Hugo» hurricane in 1989: most FCR/MCR roofs have not been affected by the hurricane whereas most other roofs have been blown away. In some «risky» areas, it is even advisable to use «hurricane tiles» (with a double fixing device) or thicker tiles (10 mm).

As far as thermic insulation is concerned, they can simply not be compared with galvanized iron sheets, which actually heat houses rather than cool them. This advantage is decisive in areas where coolness is so much looked for and so expensive.

Their mechanical resistance and resistance to shocks are also worth mentioning (a 8 mm tile should resist to a hanging weight of 50 kg). This is important since many galvanized iron sheets roofs are damaged by stones or fruits.

Their life expectancy can be estimated to 15 years at least, which makes their purchase by the final customer very profitable.

Last but not least, a look at the front cover picture will convince you of the esthetic qualities of this roofing material (available in various colours).

Economic advantages:

Beside the quality of the covering material itself, the price at which it can be produced or sold plays an essential part. This price logically varries according to local conditions (raw material, workforce, competitors,...) but, generally speaking, it can be claimed without much risk of error that the cost price of a FCR/MCR roof is cheaper than for other types of roofing (e.g. galvanized iron sheets or fired roofing tiles). It is important to make this comparison in terms of «roof» and not of «product» (i.e. tiles). It is obvious that the roof substructure is different for FCR/MCR and for galvanized iron sheets. For instance, the substructure for FCR/MCR roofing is much lighter (1 m^2 = 26,6 kg) and consequently cheaper than for fired tiles roofing.

Many casestudies have shown that 30 to 60 % of the cost price of a roof can be saved with a FCR/MCR roofing in comparison with other types of roofing. In one word, the biggest trump of FCR/MCR is its cost price.

On a macroeconomic level, it is worth noting some advantages likely to encourage the dissimination of this technology and the official support of the local authorities.

First of all, the type of industrial unit that is proposed (see 2.5.) allows to some extend a decentralisation of the industry of building materials. On its scale of course, it enables the authorities to struggle against the process of rural exodus and wild urbanization which affect most developping countries by using local workforce in several production units situated in rural or peri-urban areas.

Beside the creation of jobs in different areas, the part of value added locally is much more important than for imported materials.

Little initial investment and little energy input in production being required, FCR/MCR also means substential savings in terms of foreign exchange.

Several studies have shown (e.g. in Kenya*) that the part of foreign exchange used for FCR/MCR is by far lower than for galvanized iron sheet:

- 66 to 75 % of the cost price of the galvanized iron sheets.
- 17 % of the cost price of FCR/MCR.

*** P. Coughlin: «Steel vs tile roofing. What's appropriate for Kenya», Nairobi, Kenya, Economic Department, University of Nairobi, 1985.**

Environemental advantages:

the main advantage on this level is that, little energy input being required, no firewood (fired roofing tiles) or other combustible (as for the manufacture of iron sheets) will be necessary. This may be a major asset in the struggle against desertification.

Technological simplicity:

A last major advantage is the technological simplicity of the production process of FCR/MCR. As a matter of fact, building and running a kiln (even a simple one) is not very easy. Manufacturing galvanized iron sheet requires a heavy industry. Producing FCR/MCR is relatively simple. But one must keep in mind that the production of good quality FCR/MCR can only be reached by respecting all the production parameters very carefully. This is the reason why we insist (see also 2.9.) very much on a professional training.

2. Description of the TEGULAMATIC unit.

2.1. Brief description of the double vibrating table.

Thanks to its robustness and its conception, the TEGULAMATIC can conply with an intensive use by unskilled workforce.

The frame of the table consists of sectional steel sheets which give the necessary robustness for ideal vibration.

The basic vibrator is made in one piece and has the following characteristics: 3000 r/m, 0,095 kw, 220 V monophase. 220/380 V triphase, 50/60 Herz

(tropicalization also on request), 24 or 12 V in continuous and alternating current are also available on request. This is very important since the quality of the final product greatly depends on the ratio quality of vibration / time of vibration.

This type of vibration makes it also possible to produce vibrated concrete tiles.

Its output capacity can reach 700 tiles/day; it depends on the quantity of double supports available.

2.2. Simplification of the work.

The conception of the vibrating table is such that the operator's work is simplified to a maximum: in this way, he can exclusively concentrate on the quality of the final product thanks to the following devices:

1) Placing to the operator's disposal of:

- **the 200 micron plastic interface sheet**
- **the rubber mortar box (52 x 32 x 22 cm)**
- **the metallic screeding trowel.**

2) 2 adjustable and retractable stringers allowing a soft «gliding» of whatever type of tile on its support.

3) The sectional sheet of the vibrating surface allows a simultaneous blocking of the frame in 3 different places by a simple pressure by the operator's foot or hand (double control).

4) Each blocking point is individually adjustable, which avoids the use of a waterproofness joint between the frame and the vibrating table.

5) The change of frame (to manufacture other types of tiles) is facilitated by the use of 3 standardized hinges.

6) An automatic opening system of the frame enables the operator to hold the 2 nibs with his thumbs.

7) The vibrator is also controlled by a pedal on the same axis as the pedal used for the blocking of the frame.

8) The level of the table can be adjusted by 4 bolts; checking is permanent thanks to 2 water-gauges fixed on visible places.

2.3. Basic equipment accompanying each Tegulamatic unit.

- 1 Frame for 2 overlapping pantiles 490 x 235 (12,5 tiles/m^2)

- 1 Frame

for 1 overlapping under-ridge (same dimensions)
for 1 overlapping edgetiles (same dimensions)

- 1 Frame for two 490 mm long ridges (overlapping: 70 to 80 mm)

- 1 Concrete-mixer (140 I)

- 1 Roll of 300 mm wide and 200 micron thick plastic sheet to be locally cut into 1000 interface sheets (500 mm long)

- 1 Mortar scoop for 8 mm pantiles (1 scoop = 1 tile)

- 1 Mortar box 52 x 32 x 22 cm (30 I)

- 1 metallic screeding trowel

- 1 balance (4 kgs)

- 1 ten liter (graduated) rubber bucket

- 1 hand-drill for the twisting of the loop

- 1 quality control material (resistence to shocks)

- 1 quality control material (resistence to flexion)

- 1 sample of synthetic fibres

- 1 sample of red colourant

2.4. Double supports

These galvanized steel double supports are 8 mm thick. This provides a better solidity and a longer life expectancy to the supports, which are, eventually, the most expensive part of the production unit. Moreover, the fact that the supports

are made out of galvanized steel allows the operator to clean them in an easier way and to remove the cement sticking to their surface than if they were made out of plastic.

They are 1080 mm long so that 2 tiles can be laid on each support. 1 complete double support for pantiles weights 4,03 kg (not packed); 1 complete double support for ridges weights 4,8 kgs (not packed).

2 galvanized steel lateral distance-pieces provided with each support are screwed and allow to stack the supports with 40 mm space between each support.

Due to the cost of the supports, we offer 7 types of TEGULAMATIC units AP, as detained in the following table.

For an optimal use of the vibrating table and for a double pitch roof, we advice the following:

- **375 supports for 650 pantiles**
- **25 supports for 50 ridges**

This quantity enables the operator to start the day with a reserve of 50 supports (not used the day before).

2.5. 7 types of unit

Type	Qty sup. pantiles	Qty sup. ridges	Daily production	M2 / roof daily
AP 100	95	5	190 tuiles	$15m^2$

AP 150	145	5	290 tuiles	23m^2
AP 200	190	10	380 tuiles	30m^2
AP 250	235	15	470 tuiles	37m^2
AP 300	280	20	560 tuiles	44m^2
AP 350	325	25	650 tuiles	52m^2
AP 400	375	25	700 tuiles	56m^2

2.6. Raw material for one month production (25 days/690 tiles) for the production of 17 250 tiles (8 mm).

- 22,5 m^3 sand

- 9,375 T. cement

- 187,5 kg sisal or 18,75 kg synthetic fibre

- 281,250 kg colourant

- 9 kg galvanized wire (1 mm)

It should be noted that fibre can be replaced by aggregates (max. 6 mm);
the quantity is determined by the type of aggregate.

- 4 874 l water

2.7. 30 daily mixing operations for 690 tiles in a 140 l concrete-mixer (real capacity = 110 L)

(1 mix = 23 tiles (8 mm))

- 30 liters sand = 3 buckets of 10 liters
- 10 liters cement = 1 buckets of 10 liters
- 250 gr sisal (natural fibre) or 25 gr synthetic fibre (for aggregate see ratio density/volume)
- 375 gr of colourant
- 6,5 l water

2.8. Cost price of 1 tile or 1 m^2 of roof.

On your request, we can provide with you with a complete feasibility study free of charge for financing purposes.

Therefore, on your request, we can send you a questionary enabling us to calculate the cost price of 1 m^2 of roof according to local parameters; the reliability of your study will mainly depend on the correctness of your answers.

The above-mentioned quantities will already give you a rough idea for the comparison with the existing materials in your area.

Moreover, we remind you that 12,5 tiles are necessary to cover 1 m^2 of roof,

which means a lighter framework (26,6 kg (8 mm tiles)/m^2).

2.9. Training.

Training (be it from APPRO-TECHNO or from a training center known for the quality of its transfer of technology) is essential and can be considered as an investment at the same level as equipment. The optimal production of good quality FCR/MCR and the correct dissimination of the technology are greatly bound to a theoretical but also practical training (technology and management).

This is the reason why APPRO-TECHNO offers a training on the site or in Abidjan (Ivory Coast). For further information on this subject, please contact us.

2.10. Packing details.

AP 100: 1.225 kg (total gross weight)

3,53 m3: - 1 seaworthy case 1,77 X 1,35 X 1,12 m, NW 300 kg / GW 450 kg

- 1 reinforced seaworthy case (supports) 1,20 X 1,20 X 0,60 m., NW 680 kg / GW 750 kg

AP 150: 1.625 kg (total gross weight)

3,82 m3: - 1 seaworthy case 1,77 X 1,35 X 1,12 m, NW 360 kg / GW 475 kg

- 1 reinforced seaworthy case (supports) 1,20 X 1,20 X 0,80 m., NW 1.000

kg / GW 1.150 kg

AP 200: 2.050 kg (total gross weight)

4,03 m3: - 1 seaworthy case 1,77 X 1,35 X 1,12 m, NW 475 kg / GW 600 kg

- 1 reinforced seaworthy case (supports) 1,20 X 1,20 X 0,95 m., NW 1.300 kg / GW 1.450 kg

AP 250: 2.430 kg (total gross weight)

4,28 m3: - 1 seaworthy case 1,77 X 1,35 X 1,12 m, NW 450 kg / GW 600 kg

- 1 reinforced seaworthy case (supports) 1,20 X 1,20 X 1,12 m., NW 1.720 kg / GW 1.830 kg

AP 300: 2.810 kg (total gross weight)

4,57 m3: - 1 seaworthy case 1,77 X 1,35 X 1,12 m, NW 450 kg / GW 600 kg

- 1 reinforced seaworthy case (supports) 1,20 X 1,20 X 1,32 m., NW 2.100 kg/GW 2.210 kg

AP 350: 3.075 kg (total gross weight)

5,57 m3: - 1 seaworthy case 1,77 X 1,35 X 1,12 m, NW 550 kg / GW 690 kg

- 1 reinforced seaworthy case (supports) 1,20 X 1,20 X 2,02 m., NW 2.200

kg / GW 2.385 kg

AP 400: 3.345 kg (total gross weight)

4,83 m3: - 1 seaworthy case 1,77 X 1,35 X 1,12 m, NW 1.205 kg / GW 1.365 kg

- 1 reinforced seaworthy case (supports) 1,20 X 1,20 X 1,50 m., NW 1.780 kg / GW 1.980 kg

TEXTE FRANAIS

1.1. Qu'est-ce que la tuile en fibro-mortier ou en micro-mortier ?

La tuile en fibro-mortier est un matriau de couverture dont les qualits d'isolation (thermique et accoustique), la durabilit et la rsistance mcanique et aux impacts sont remarquables; ces caractristiques lies aux aspects micro et macro-conomiques des matriaux de construction localement productibles rendent ce type de couverture particulirement adapte aux ralits des pays en voie de dveloppement.

Les matires premires utilises sont du sable de granulomtrie moyenne (granulomtrie de 0,06 2 mm homogne), du ciment Portland CPA 45 ou CPA 35 (ou quivalent), des fibres vgtales (ou des graveleux latritiques) ou ventuellement du colorant.

Les tuiles peuvent tre produites en paisseur de 8 ou 10 mm. Nous dconseillons fortement la fabrication de tuiles de 6 mm d'paisseur vu les problmes de fragilit, mise en œuvre et mauvaise tenue aux vents violents. L'conomie ralise au niveau

des matires premires est donc une fausse conomie.

Le processus technologique de fabrication est relativement simple (et certainement adapte la main d'oeuvre locale). Toutefois, il faut bien garder l'esprit organisation rationnelle de tous les postes de travail. C'est la raison pour laquelle APPRO-TECHNO propose et conseille vivement une formation (voir 2.9.). Le processus technologique peut se rsumer comme suit:

- un mortier de ciment-sable (ratio variant de 1:2 1:3) est prpar dans un mlangeur. On y ajoute ensuite les fibres vgtales trononnes au pralable en morceau de 15 mm ou synthtiques (appel le fibro-mortier).

Si pour une raison ou une autre, il n'est pas possible ou prfrable d'utiliser des fibres, on peut les remplacer par du graveleux latritique (dont la granulomtrie ne dpasse pas 2/3 de l'paisseur du produit final) appel le micro-mortier).

- Le mortier est ensuite dpos l'aide d'une pelle doseuse sur un interface en plastique pos sur la table vibrante, l'intrieur du cadre de vibration. Le mortier doit tre vibr pendant environ 45 secondes. La qualit et la dure de vibration jouent un rle trs important dans la qualit du produit final (par exemple, une vibration trop longue rend la rpartition des diffrents lments peu homogne car les lments plus lourds ont tendance redescendre). On moule galement pendant ce temps le talon d'accrochage.

- ensuite, le mortier vibr est transfr en douceur sur un support de mise en forme qui a la mme forme que la tuile finale.

- ce stade, on noie un fil de fer galvanis dans le talon de la tuile (pour l'accrochage la charpente).

- ensuite, on laisse la tuile sur un support pendant 24 heures pour la mise en forme et le schage; elle doit tre recouverte d'un plastique pour viter les fissures.

- Le lendemain, les tuiles de la veille sont retires dlicatement de leurs supports et sont bavures avec un couteau. Les tuiles sont ensuite mises curer pendant 5 jours en milieu humide (100% d'humidit) et 15 20 jours sous abri. A partir de ce moment, elles peuvent tre mises en œuvre ou vendues.

1.2. Avantages.

La tuile fibro ou micro-mortier prsente de nombreux avantages qui en font dans de nombreux cas la solution idale au problme de la couverture dans les pays en voie de dveloppement. Ces avantages se situent plusieurs niveaux.

Qualits du matriau en tant que tel.

L'avantage le plus important au niveau de la vie quotidienne est de pouvoir disposer d'un matriau de couverture d'une qualit irrprochable. A cet gard, plusieurs aspects peuvent tre souligns tout en gardant bien l'esprit que comme pour tout produit industriel un contrle de qualit strict, permanent et intransigeant doit tre mis en place.

La fonction premire d'une toiture est de protger les habitants contre des lments extrieurs tels que la pluie et le soleil.

A ce propos, les tuiles fibro ou micro-mortier offrent dans le premier cas (la pluie) une protection absolue puisqu'elles sont parfaitement impermables. De plus, leurs qualits d'isolation accoustique les rendent incomparables par rapport aux tles lorsqu'il pleut.

Par ailleurs, le cyclone «Hugo» de 1989 dans les Antilles a permis de vrifier la bonne tenue des toitures en fibro-mortier aux vents violents par rapport aux tles ondules. De plus, dans les zones risques, il est possible et mme recommand d'utiliser des tuiles «ouragan» double accrochage ou des tuiles plus paisses (10 mm).

De plus, leur isolation thermique est incomparable par rapport la tle ondule traditionnelle qui rchauffe plutt qu'elle ne rafrachit les maisons dans des pays o la fracheur des maisons constitue l'aspiration de chacun malgr son cot lev.

Ensuite, la tuile fibro-mortier a une excellente rsistance mcanique (une tuile de ce type d'une paisseur de 8 mm doit pouvoir rsister au minimum une charge suspendue de 50 kg) et surtout une trs bonne rsistance aux impacts. L o, par exemple, les impacts de pierres ou de fruits abment les tles ondules de faon irrmdiable, les tuiles fibro-mortier font preuve d'une excellente rsistance ce genre de choc.

Leur esprance de vie est d'au moins quinze ans, ce qui rend leur achat trs rentable pour le client final.

Enfin, elles redonnent naissance un style traditionnel disparu au profit d'un non-style. Un simple coup d'œil aux photos vous en convaincra. De plus, la tuile est ralisable en plusieurs couleurs.

Avantages d'ordre conomique.

Outre la qualit du matriau de couverture lui-mme, le prix auquel il peut tre produit ou vendu joue un rle essentiel. Il est certain que ces prix sont en fonction des conditions locales (prix des matires premires, de la main d'oeuvre, concurence, etc...) mais, de faon gnrale, on peut affirmer que le prix de revient des toitures en tuiles fibro ou micro-mortier est nettement moins lev que celui des autres types de couverture (tles galvanises et tuiles en terre cuite pour ne citer que les principales). Nous parlons bien ici de «toiture». En effet, il ne faut pas se limiter au seul produit (la tuile) mais bien s'tendre la toiture dans sa globalit. Sans entrer dans les dtails, il est vident que les tuiles en terre cuite (trs lourdes), les tuiles en fibro-mortier ou les tles galvanises ne requirent pas le mme type de charpente. A titre d'exemple, les tuiles en fibro-mortier demandent une toiture beaucoup plus lgre et donc beaucoup moins coteuse que la terre cuite (les tuiles en fibro-mortier de 8 mm d'paisseur ne psent que 26,6 kg/m2).

De nombreuses tudes ont montr que l'conomie ralise grce une couverture en fibro ou micro-mortier va de 30 60 % par rapport aux autres variantes (terre cuite, tle galvanise). Il faut donc reconnatre que, la tuile fibro-mortier a un norme atout pour elle: son prix !

Au niveau macro-conomique, les avantages sont considrables pour les pays en vole de dveloppement. Ceci devrait encourager la dissimination de la technologie

et l'aide officielle des autorits locales.

En premier lieu, le petit type d'unit industrielle (voir 2.5.) propose (qui sont par ailleurs modulables en fonction du nombre de supports) permet une certaine dcentralisation de l'industrie. Elle permet, son chelle bien entendu, d'enrayer le processus d'exode rural et d'urbanisation galoppante qui frappe de faon cruelle la plupart des pays en voie de dveloppement en employant la main d'oeuvre en de nombreux points de production (zone urbaine, zone pri-urbaine et zone rurale). A ct de cette cration d'emploi, aspect non-ngligeable, une plus value locale relativement (certainement par rapport aux matriaux imports) importante est cre.

Ensuite, la dpendance par rapport aux devises est nettement moins importante que dans le cas de tles importes vu l'investissement de dpart rduit et l'emploi restreint d'nergie. A ce propos, plusieurs tudes ont montr (notamment au Kenya *) que la part des devises utilise pour les tles ondules:

- 66 75 % du prix de vente de la tle ondule.
- 17% du prix de vente des tuiles fibro-mortier.

*** P. Coughlin: «Steel vs tile roofing, What's appropriate for Kenya», Nairobi, Kenya, Economic Department, University of Nairobi, 1985.**

Avantages pour l'environnement:

A ce niveau, le principal avantage est constitu par l'emploi restreint d'nergie: ni le bois de chauffe (tuiles cuites), ni quelqu'autre combustible n'est ncessaire. Ceci constitue certainement un argument de poids dans la lutte actuelle contre la

dsertification.

Simplicit technologique

Un dernier avantage important dont nous avons dj touch un mot est la simplicit technologique du processus de production de tuiles fibro-mortier En effet, construire un four (mme relativement simple) et le faire fonctionner correctement n'est pas simple. Fabriquer des tles ondules ncessite une industrie lourde. Produire des tuiles fibro-mortier est relativement simple. Encore faut-il qu'elles soient de bonne qualit! Seul le respect de tous les paramtres de fabrication garantit cette qualit. C'est la raison pour laquelle, nous tenons insister qu'une formation professionnelle (voir galement 2.9.) est souvent souhaitable.

2. Description de l'unit TEGULAMATIC.

2.1. Description sommaire de la table vibrante double.

Sa robustesse et sa conception lui permettent de rpondre un usage intensif et une utilisation par une main d'œuvre peu qualifie.

Le bti de la table est constitu de tles profiles qui lui confrent la robustesse ncessaire pour une vibration idale.

Le vibrateur de base est de conception monobloc - 3000 T/M - 0,095 KW/ 220 V MONO. Sur demande 220/380 V triphas, 50 ou 60 priodes (la protection tropicalise peut tre obtenue sur demande) ou 24 V et 12 V en courant continu et alternatif peuvent tre obtenus. Cet lment est extrmement important puisque la

qualit du produit final dpend en bonne partie du rapport qualit de la vibration / temps de vibration.

Le type de vibration permet de raliser galement des tuiles en bton vibr (sans sisal).

Sa capacit de production peut aller jusqu' 700 tuiles/jour; elle dpend du nombre de supports doubles disponibles.

2.2. Simplification des oprations.

Sa conception est telle que le travail de l'oprateur est simplifi au maximum; il peut ainsi se concentrer uniquement sur la qualit du produit final notamment grce aux diffrents dtails repris ci-dessous:

1) Mise disposition porte de main de l'oprateur de:

- **La feuille de PVC appele interface de 200 MICRONS.**
- **Un bac mortier en caoutchouc de 52 X 32 X 22 cm (30 L)**
- **Un emplacement pour la taloche mtallique.**

2) 2 longerons rglables en hauteur et rtractables permettant un glissement en douceur de la tuile quel que soit le modle.

3) Le profil de la surface vibrante permet un blocage du cadre de la tuile trois endroits simultans par une simple manœuvre commande au pied ou la main (commande double).

4) Chaque point de blocage est rglable individuellement, ce qui vite l'emploi d'un joint d'tanchit entre le cadre et la surface vibrante de la table.

5) La permutation des cadres permettant de raliser les diffrentes tuiles se fait facilement par l'emploi de 3 charnires normalises.

6) Un systme automatique d'ouverture du cadre permet l'oprateur de maintenir avec les 2 pouces les talons des 2 tuiles.

7) La commande du vibrateur se fait galement par une pdale au pied monte sur le mme axe que le blocage du cadre.

8) Le niveau de la table est assur par 4 boulons et le contrle est permanent grce 2 niveaux fixs des endroits visuels,

2.3. Equipement de base.

Avec chaque table vibrante double, nous fournissons:

- 1 cadre pour 2 tuiles recouvrement de 490 X 235 M/M -12,5 tuiles/m2.

- 1 cadre pour 1 tuile recouvrement sous faitire (mmes dimensions).

- 1 cadre pour 1 tuile recouvrement de rive (mmes dimensions).

- 1 cadre pour 2 tuiles faitires de 490 M/M (recouvrement de 70 80).

- 1 btonnire de 140 L,

- 1 rouleau de PVC de 300 MM de largeur appel interface de 200 microns dcouper localement en 1000 feuilles de 500 MM de long.

- 1 pelle doseuse pour tuile 8 M/M (1 pelle = 1 tuile).

- 1 bac mortier de 52 X 32 X 22 cm (30 litres).

- 1 taloche mtallique.

- 1 balance 4 kgs (750 gr de colorant et 500 gr de sisal pour 46 tuiles de 8 m/m).

- 1 seau de 10 L gradu en caoutchouc.

- 1 drille pour le torsadage du fil de fer.

- Matriel de contrle de qualit des tuiles (rsistance aux chocs).

- Matriel de contrle de qualit des tuiles (rsistance la flexion).

- 1 chantillon de fibre synthtique.

- 1 chantillon de colorant rouge.

2.4. Supports doubles de mise en forme de schage.

Ces supports doubles en acier galvanis ont 0,8 M d'paisseur. Ceci permet d'assurer une solidit et une esprance de vie beaucoup plus longue des supports (qui

constituent en fin de compte une des parties les plus onreuses de toute unit de production de tuiles fibro-mortier). De plus, le fait que la matire premire soit de l'acier galvanis permet de nettoyer les supports plus facilement que ceux conus en plastique et d'liminer notamment tout rsidu de ciment qui viendrait s'y coller.

Les supports doubles ont une longueur de 1080 M/M afin de dposer facilement 2 tuiles sur un seul support. 1 support double complet pour tuile recouvrement pse 4,03 kg (non emball); 1 support double complet pour tuile faitire pse 4,8 kg (non emball).

Les 2 entretoises latrales en acier galvanis fournies avec le support sont boulonnes et permettent d'obtenir un empilage parfait en laissant 40 M/M d'espace pour les 2 tuiles.

Vu le cot de ces supports, nous offrons 7 propositions type AP dtailles dans le tableau suivant.

Pour une utilisation optimale de la table vibrante et de la demande normale pour un toit deux versants, nous conseillons la formule suivante:

- **375 supports pour le schage de 650 tuiles recouvrement.**
- **25 supports pour le schage de 50 tuiles faitires.**

Cette quantit de supports permet de dmarrer la journe de travail avec une rserve de 50 supports non utiliss la veille.

2.5.7 TYPES D'UNIT.

Type	Qty recouvrement	Qty Faitires	Production / jour	M2 / jour
AP 100	95	5	190 tuiles	15m^2
AP 150	145	5	290 tuiles	23m^2
AP 200	190	10	380 tuiles	30m^2
AP 250	235	15	470 tuiles	37m^2
AP 300	280	20	560 tuiles	44m^2
AP 350	325	25	650 tuiles	52m^2
AP 400	375	25	700 tuiles	56m^2

2.6. Matire premire prvoir mensuellement (25 jours 690 tuiles) pour la production de 17.250 tuiles de 8 mm.

- 22,5 m3 de sable

- 9,375 T de ciment

- 187,5 kg de fibre de sisal ou 18,75 kg de fibre synthtique

- 281,250 kg de colorant

- 9 kg de fil de fer galvanis de 1 mm

Il est noter que la fibre peut tre remplace par du graveleux latrique de 6

mm maximum (quantit dterminer en fonction du type de graveleux).

- 4.874 l d'eau

2.7. 30 mlanges prvoir par journes de 690 tuiles dans un mlangeur de 140 litres (capacit de 110 litres) 1 mlange = 23 tuiles de 8 mm d'paisseur.

- 30 litres de sable = 3 seaux de 10 litres

- 10 litres de ciment = 1 seau de 10 litres

- 250 gr de fibre de sisal ou 25 gr de fibermesh (pour le graveleux, cfr le paramtre rapport densit/volume)

- 375 gr de colorant

- 6,5 l d'eau

2.8. Calcul du prix de revient de la tuile ou du m2 de toiture.

A votre demande, nous pouvons vous raliser gratuitement l'tude de faisabilit bancaire.

Un questionnaire nous permettant d'tablir le prix de revient du m2 de toiture en fonction des paramtres locaux vous sera envoy votre simple demande; la fiabilit de notre tude dpendra essentiellement de l'exactitude de vos rponses.

Les quantits des matires premires reprises ci-dessus vous permettent dj de

comparer avec les matriaux existants dans votre rgion.

De plus nous vous rappelons qu'il faut 12,5 tuiles au m2 ce qui reprsente un poids de 26,6 kg par m2 pour de la tuile de 8 mm d'paisseur et donc une charpente plus lgre.

2.9. Formation.

Prvoir une formation (qu'elle soit d'APPRO-TECHNO ou de tout autre institut de formation reconnu pour la qualit de son transfert de technologie) est trs important et peut tre considr comme un investissement au mme titre que le matriel. La fabrication optimale de tuiles fibro-mortier de qualit et la russite de la dissmination de la technologie sont largement lies une formation thorique et surtout pratique (technologie et gestion).

C'est pour ces raisons qu'APPRO-TECHNO propose une formation soit sur le site soit Abidjan (Cte d'Ivoire). Pour plus de renseignements ce sujet, veuillez nous contacter.

2.10 Dtails du collissage.

AP 100: 1.225 kg (poids brut total)

3,53 m3:
- 1 caisse maritime 1,77 X 1,35 X 1,12 m, PN 300 kg / PB 450 kg
- 1 caisse maritime renforce (supports) 1,20 X 1,20 X 0,60 m., PN 680 kg / PB 750 kg

AP 150: 1.625 kg (poids brut total)

3,82 m3: - 1 caisse maritime 1,77 X 1,35 X 1,12 m, PN 360 kg / PB 475 kg

- 1 caisse maritime renforce (supports) 1,20 X 1,20 X 0,80 m., PN 1.000 kg / PB 1.150 kg

AP 200: 2.050 kg (poids brut total)

4,03 m3: - 1 caisse maritime 1,77 X 1,35 X 1,12 m, PN 475 kg / PB 600 kg

- 1 caisse maritime renforce (supports) 1,20 X 1,20 X 0,95 m., PN 1.300 kg / PB 1.450 kg

AP 250: 2.430 kg (poids brut total)

4,28 m3: - 1 caisse maritime 1,77 X 1,35 X 1,12 m, PN 450 kg / PB 600 kg

- 1 caisse maritime renforce (supports) 1,20 X 1,20 X 1,12 m., PN 1.720 kg / PB 1.830 kg

AP 300: 2.810 kg (poids brut total)

4,57 m3: - 1 caisse maritime 1,77 X 1,35 X 1,12 m, PN 450 kg / PB 600 kg

- 1 caisse maritime renforce (supports) 1,20 X 1,20 X 1,32 m., PN 2.100 kg/ PB 2.210 kg

AP 2.975 kg (poids brut total)

AP 350: 3.075 kg (poids brut total)

5,57 m3: - 1 caisse maritime 1,77 X 1,35 X 1,12 m, PN 550 kg / PB 690 kg

- 1 caisse maritime renforce (supports) 1,20 X 1,20 X 2,02 m., PN 2.200 kg / PB 2.385 kg

AP 400: 3.345 kg (poids brut total)

4,83 m3: - 1 caisse maritime 1,77 X 1,35 X 1,12 m, PN 1.205 kg / PB 1.365 kg

- 1 caisse maritime renforce (supports) 1,20 X 1,20 X 1,50 m., PN 1.780 kg / PB 1.980 kg

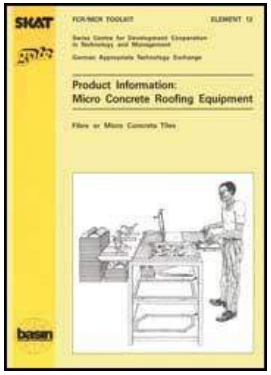
DEALER:

Home"" """"> ar.cn.de.en.es.fr.id.it.ph.po.ru.sw

Product Information: Micro Concrete Roofing Equipment - Fibre or Micro Concrete Tiles (BASIN - GTZ GATE - SKAT, 1997, 38 p.)

(introduction...)

Introduction



- **Fibre Concrete / Micro Concrete Roofing Equipment**
- **CECAT TEVI - Unit de production de tuiles en micro-bton**
- **TEJACRETO Plana**
- **TEJACRETO Escalera**
- **TEJACRETO Romana**
- **TEJACRETO Colonial**
- **TEJACRETO Pantile**
- **Product Information: MCR/FCR Equipment**
- **Equipment and Tools for Basic Module for Fibre Concrete Tiles Production TEJACRETO - Peru**
- **HABITECH - BUILDING - SYSTEM**

Introduction

What are FCR and MCR

FCR (Fibre Concrete Roofing) is a roofing technology developed in the eighties. It consists of concrete tiles made of cement mortar mixed with a small amount of natural or synthetic fibre.

MCR (Micro Concrete Roofing) is a further developed technology of FCR that does not use fibres. The production of FCR tiles is very exacting. Therefore SKAT recommends MCR technology because it is easier to use.

The FCR/MCR Toolkit

This guide is one element of the FCR/MCR Toolkit. This kit mediates the entire know-how that is required in the filed of the FCR-technology, covering all technical aspects. The toolkit-overview shows the structure of its contents.

The entire kit or elements of it are available from SKAT.

What you find in this tool

A product information about FCR/MCR equipment. It contains the collection of brochures of world wide equipment producers.

What you will NOT find in this tool

The tool is intended for persons who already know the basics of FCR/MCR or who are already producing FCR/MCR elements. Consequently it does not contain:

- **the basic information required for new-comers such as advantages and the disadvantages, and guidelines to be considered as first steps towards FCR/MCR**
- **the rules for the production**
- **information on production management**
- **specifications of cost and profit**
- **information about particular problems in particular countries**

Note

Note

• Prices and rates as mentioned in the brochures of the producers are subject to change. Hence, they have to be considered as approximately.

• The judgement of quality expressed in the brochures are those of the particular authors or producers and not necessarily those of the publisher.

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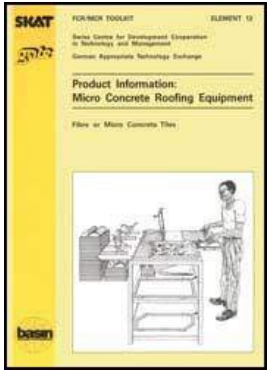

Product Information: Micro Concrete Roofing Equipment - Fibre or Micro Concrete Tiles (BASIN - GTZ GATE - SKAT, 1997, 38 p.)

- ***(introduction...)***
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Product Information: MCR/FCR Equipment

Equipment and Tools for Basic Module for Fibre Concrete Tiles Production TEJACRETO - Peru

HABITECH - BUILDING - SYSTEM

Fibre Concrete / Micro Concrete Roofing Equipment

Equipment

Apart from a set of ordinary masonry implements (e.g. spades pans, wheelbar-rows, sieves, trowels, sand and cement batching boxes, balance and the like), the production of FCR and MCR elements requires some special equipment:

- **screeding machines**
- **moulds**
- **testing equipment**

Screeding machine

- **This comprises a vibrating screeding surface and interchangeable, hinged frame (for products of different shapes and thicknesses). The machine can be a small, portable "mini plant", or a stationary workstation.**

- **The vibrating mechanism requires an energy source, which can be electricity (from a mains outlet, converted to 12 volt DC power by a transformer-rectifier, or from a car battery), hand-power (crank with pulley system or metal springs), foot-power (treadle or bicycle pedal system), or flywheel energy (hand-operated).**

Advantages and problems of the various screeding machines

- ***Electric machines:***

  + relatively quiet, do not tire out the user, produce uniform, good quality elements, recommended for a sustainable business;

  - dependent on reliable power supplies for operating the machines or recharging batteries, risk of production setback due to bad battery maintenance.

- ***Hand-powered machines:***

  + independent of power supplies and can thus be used in remote rural areas;

  - relatively noisy and tiring and needs 2 people to operate, uniformity of vibration dependent on the way the handle is turned, thus possibility of non-uniform quality of products.

- ***Foot-powered machines:***

  ± more or less the same advantages and disadvantages as hand-powered machines, except that, depending on the design, the second worker can be omitted, as the hands remain free to spread the mortar during vibration.

- ***Flywheel-powered machines***

+ incorporate all the advantages of electric and hand-powered machines and can be operated by a single person;

- cost about the same as electric machines.

Setting moulds

- **These can be of various shapes and sizes, depending on the local requirements and are needed in large numbers - at least as many as the number of components produced in two working days, because the tiles are demoulded after 24 hours.**

- **The moulds can be made of different materials, such as vacuum formed PVC (polyvinyl chloride) and fibreglass. FCR and MCR producers in developing countries have devised methods of making moulds out of concrete. These are produced in 3 stages: first making a concrete "mother mould" from which several concrete "mother moulds" are formed and sold to local tilemakers, who make the actual concrete moulds themselves. More recently, plywood "mother moulds" have been devised, eliminating the "grandmother mould"**

- **The PVC and fibreglass moulds are designed for self-stacking; in most cases, the concrete moulds are placed in special wooden racks for initial curing, but self-stacking concrete moulds (either entirely concrete or with metal frames) have also been developed.**

Advantages and problems of the various types of setting moulds

- ***PVC moulds:***

  + produced industrially and hence uniform and of good quality, extremely lightweight and easy to handle, can be stacked airtight (vital requirement for curing) and save storage space;

  - most expensive moulds, production in developing countries limited.

- ***Fibreglass moulds:***

  + similar advantages as PVC moulds, can be produced locally if the materials and skills are available

  - tend to be less accurate than PVC moulds.

- ***Concrete moulds (not recommended):***

  + cheap and can be produced by the tilemaker himself;

  - heavy and less accurate than PVC, and if not self-stacking and not airtight, the rack in which they are placed has to be well covered with a plastic sheet (which is often not done carefully, causing the green tiles to crack due to non-uniform drying)

Testing Equipment

- **Several tests should be carried out before, during and after the production process to ensure the MCR products are of consistently good**

quality. The tests are generally very simple and only a few need special equipment.

- **Some MCR machines are equipped with a *demoulding jig,* on which the 24 hour old tiles are placed upside down, together with the setting mould, which can be lifted off. Subsequently, the plastic sheet can be peeled off carefully and the rough edges trimmed off. A close fit of the tile and the edges being in line with those of the jig show that the tile has exactly the right shape.**

- **After curing and drying, random samples of tiles from each batch produced should be tested.**

- **These and many other tests are described in greater detail in the FCR/MCR toolkit No. 23, *Quality Control Guidelines,* which can be obtained from the *Roofing Advisory Service of SKAT, Vadianstr. 42, 9000 St. Gallen, Switzerland.***

Criteria for Selection and Purchase

General Considerations

MCR being relatively new technologies, the number of equipment suppliers are still very few. In the early stages of development, the equipment used was locally made by research institutes and appropriate technology groups, which mainly experimented with the production of large sheets. No equipment was commercially available.

ITW of Cradley Heath, U.K., who were the first to develop small roofing components and a method to produce them by vibrating, were also the first to supply equipment on a commercial basis. The earliest equipment was the portable "Mini Plant" (1983), which was followed two years later by an "Industrial" version of the same production process, and a series of other modified and improved equipment later on.

While this equipment was principally available all over the world, the relatively high capital and transport costs, prohibitive currency exchange rates and import restrictions in many developing countries led to the local production of equipment. Thus there are several types of FCR/MCR equipment on the market and it may be difficult for a newcomer to this technology to decide which one should be bought. The following points will help the potential buyer to make a good choice.

Due to quality reasons, SKAT/RAS has decided in 1993 to promote MCR tiles of at least 8 mm thickness only. The production of FCR tiles and sheets is very delicate and therefore not recommended. In spite of this, there are still many producers who promote semisheets and FCR tiles.

Figure

Design of Screeding Machine

- **The design of a screeding machine is the result of several stages of development:**

  - **Development and design of prototype**
  - **Testing and modification of prototype**
  - **Field testing of 5 to 10 prototypes for at least 1 year**
  - **Modifications resulting from field tests**
  - **Finalization of design, production manual, accessories, etc.**

These steps can only be followed if appropriate workshop facilities, qualified engineering capacity, qualified production and quality control capacity and sufficient funds are available. Depending on the extent to which these

requirements are met, there are great differences in the quality of machines available.

- **If a MCR tile production plant is to operate successfully in a developing country, the equipment must be capable of *withstanding rough use.* If possible, machines that have been in use under such conditions for a reasonably long time (say 3 to 4 months) should be inspected to check, for example, whether the screeding surface and/or the hinged frame is warped of damaged, handles or switches are broken off, and so on.**

- **Special consideration should be given to the *working conditions* for the production team, especially with regard to operation procedures and handling of products, that is, avoidance of dangerous or exceptionally hard manual work and activities that have to be done in a bent position.**

- **A balance must be found between the desired output rate, quality standard and level of sophistication. Complicated mechanical devices often necessitate special training and experience for *maintenance and repairs.* Spare parts can be expensive and, if imported, may be difficult and take long to procedure.**

- **The choice of screeding machine will also depend on the *tile size* required, which is basically a choice between the pantile (or Roman tile, depending on the mould) of 50 to 60 cm length, 25 to 29 cm width and 6 mm thickness (requiring 8 to 12 tiles to cover 1 m^2), and the larger semisheet, which is 60 x 60 cm and 8 mm thick (requiring 4 elements to**

cover 1 m^2).

Energy Sources

- **The type of energy required to operate the vibration mechanism is one of the most important selection criteria. Hand or foot operated machines can be used anywhere, and are the only viable option in *remote areas,* where power supplies are unreliable or not available. If electric machines with car batteries are used in such areas, it may be possible to recharge the batteries with a pholtovoltaic solar energy system, but such devices have so far not proved successful.**

- **The *vibration mechanism* normally consists of rapidly rotating eccentric weights. With two shafts rotating in opposite directions, the horizontal component of vibrations can be neutralised, so that the screeding surface is subjected to a simple harmonic motion in the vertical direction only.**

- **A less common vibration method is with flat metal springs, which hit the underside of the screeding plate at a rate of about 2000 times per minute, by turning a rattle wheel. With this method it is more difficult to achieve uniform vibration frequency, but the machine is very cheap to construct and easy to repair, but on the other hand very noisy.**

Design of Setting Moulds

- **Since a very large number of moulds are needed, they represent the highest single cost factor. The industrially produced *PVC moulds* are the**

best in all respects, but the most expensive. World-wide experience shows that the quality of tiles is strongly linked with the quality of moulds. Hence, SKAT/RAS recommends the use of PVC moulds only.

- **The most successful locally made moulds are *concrete moulds* (as described above). However, great care is needed in production and handling. The usual practice for initial curing is to put the moulds with the fresh tiles in special wooden racks, which have been covered with plastic sheets to retain the moisture in the tiles. If this is not done properly, parts of the tiles may dry out earlier, causing cracks. Therefore, self-stacking concrete moulds should be preferred.**

Material quality

- **With good equipment, good tiles can be produced, but if the ingredients are of poor quality or prepared incorrectly, good equipment is not likely to produce good tiles. Therefore, *quality control* must begin with the selection and preparation of the ingredients.**

- **Broken tiles, leaking roofs and other serious problems associated with FCR in the early stages of development have shown the extreme importance of strict quality control during all phases of tile production, roof construction and installation of tiles. A tile testing kit, as described under *Testing Equipment,* is essential in every MCR production plant.**

- **But above all, the main prerequisite for good quality products is a thorough *professional training* of the production team and supervisory**

staff, and *efficient management.*

Manufacturer

- **Equipment suppliers are basically of two types:**
  - **private, commercial producers**
  - **non-government organisations (NGO's) based in developing countries.**

The advantages of *private producers* are:

+ their dependency on good sales, and hence the need to produce good equipment, as failures of bad service would seriously harm their reputation and ultimately stop business;

+ their experience in international trade and good administrative backing, making them reliable business partners.

However, the need to support a qualified technical and administrative staff with modern equipment, to maintain a consistently high standard and respond to changing needs, makes their products expensive. Importing these into a developing country not only increases the costs considerably (high exchange rates, transport costs, insurances, duty, etc.) but also can be extremely difficult (due to import facilities and restrictions, long delivery time, problems due to breakage in transit, etc).

The advantages of *NGO's* are:

+ their high motivation and closeness to the target group, enabling them to adapt their methods and products to local requirements, and provide assistance and advice whenever needed;

+ their low overhead and production costs, and if their equipment is sold locally, the additional savings on foreign exchange, transport costs, duty, the trouble with important formalities and delivery time, and the like.

However, these groups do not always have required funds, technical staff and workshop facilities to carry through all the tests and modifications that the maturing of a new product need. Unfortunately, this problem is sometimes underestimated.

- ***Personal visits*** **to the manufacturer and/or sites at which their machines are in use should be undertaken as far as possible. The value of *reference lists* is to be able to meet or correspond with users, to learn about their experiences. If such lists do not contain addresses, these should be specially asked for.**

Professional Training Courses

- **Of special importance are *training courses* offered by all good equipment suppliers. As far as possible, these courses should be conducted at a place where the whole production team can participate.**

- **There should be no preconditions for participating in the courses, other than knowledge of the language used. The method and content must be**

understandable for people without special skills or formal school education, and the course should cover all phases of tile production, roof construction and laying of the tiles, as well as administration and marketing.

Purchase of Machine

- **The *"FOB" price* (free on board) includes packaging, transportation and insurance costs of the machine within the retailer's country. This price can be artificially inflated in order to compensate for the reduction offered on the factory price.**

- **As regards *sales or rental conditions,* one must be suspicious of contracts providing for price indexing based on the number of tiles produced or for payment of royalties for patent use, which is often not justified. A patent is not necessarily a proof of guaranteed quality and constructors frequently apply for patents for processes that are already of the public domain.**

- **It is advisable to include a *penalty clause* in the contract, to safeguard against late delivery.**

- **In the case of an *after sales service contract,* the waiting period for repairs and maintenance must be clearly indicated. A detailed handbook should be provided, including specifications of all spare parts and a maintenance plan, indicating operations necessary and expected maintenance frequency.**

Checklist for Potential Buyers

Checklist for Potential Buyers

The following is a summary of the main points to be considered when selecting MCR tile production equipment:

- *Available financial resources* (budget restraints can limit the choice to locally available equipment).

- *Required size and shape of MCR tiles* (smaller components are easier to produce and handle, and suitable for all sloped roofs; pantiles are less sensitive to inaccuracies than Roman tiles; semisheets are quicker to produce and install per unit area, but less suitable for complex roofs, as semi-sheets are more wasteful to cut than tiles).

- *Required production rate* (this depends on the expected market demand and determines the quantity of equipment needed).

- *Available energy sources* (not only the costs must be considered, but also the frequency of power failures; manual operation is always appropriate, but can be very tiring).

- *Availability of spares and skilled technicians for maintenance and repairs* (machines with standardized parts create less problems).

- *Professional training* (this is a must to guarantee a successful business)

- *Operational safety* (this is not usually a problem in FCR/ MCR tile production).

- *References* (contacts with equipment users should be sought whenever possible).

• *Conditions of purchase* (since machines of similar types are available, *comparisons* of prices, discounts for large orders, delivery time, etc. *are urgently recommended,* but also - if applicable - import restrictions, after sales service, guarantee period, etc. should be taken into account).

• *After sales services* (not only should the manufacturers be fair enough to rectify defects of their machines by providing technical assistance or supplying spare parts at minimum or no-costs; users should also take the trouble to send accounts of their experiences and suggestions for improvements to the manufacturers, for without this *feedback,* no effective development is possible).

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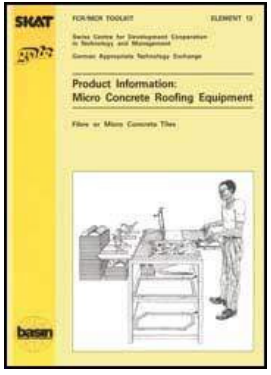


Product Information: Micro Concrete Roofing Equipment - Fibre or Micro Concrete Tiles (BASIN - GTZ GATE - SKAT, 1997, 38 p.)

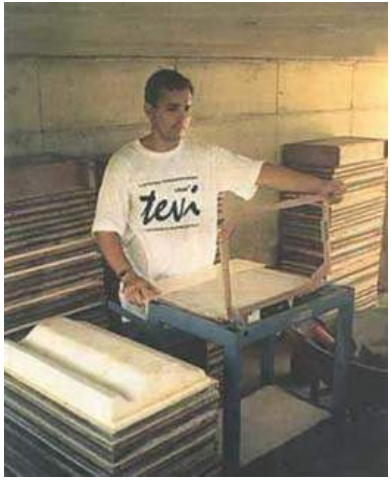
TEJACRETO Colonial
TEJACRETO Pantile

Product Information: MCR/FCR Equipment

Equipment and Tools for Basic Module for Fibre Concrete Tiles Production TEJACRETO - Peru

HABITECH - BUILDING - SYSTEM

CECAT TEVI - Unit de production de tuiles en micro-bton



Figure

CRACTRISTIQUES

La machine TEVI produit des tuiles de taille moyenne de grande qualit bas prix. Ceci base de mortier de sable et ciment vibrs.

Les tuiles sont adquates pour couvrir des maisons, des coles, des ateliers, des magasins et d'autres installations productives ou sociales.

La technologie permet de satisfaire les demandes de petits entrepreneurs, de producteurs de matriaux de couverture, de fournisseurs (grossistes ou au dtail) de ces matriaux ainsi que de tous ceux qui dsirent construire eux-mmes leur toit.

Les units de production offertes peuvent tre utiles aux autorits publiques ou des organisations non gouvernementales pour appuyer des programmes sociaux de dveloppement.

L'quipement est facile INSTALLER ET manipuler. Les frais d'investissement sont minimaux et sont amortis rapidement. Les frais de main-d'oeuvre et de matires premires sont basses et permettent une bonne marge de bnfice tout en maintenant des prix de vente concurrentiels.

L'unit de production TEVI constitue un quipement utile, conomique et facilement mis en place qui offre des toits srs et un cadre de vie agrable.

Cette technologie permet en option d'laborer de carrelage pour sols et parois ainsi que des plaques pour faux-plafonds.

CAPACIT DE PRODUCTION

Par iourne de 8 heures	200 tuiles

En 240 jours par an	48'000 tuiles
Production annuelles minimale	3600 m^2

En une anne, on peut couvrir 72 maisons de 50 m^2

COMPOSANTES DE L'UNIT

Vibreur

Modle TEVI avec chssis mtallique. Unit de vibration silencieuse et de faible consommation d'nergie. Alimentation lectrique de 12 Volts au moyen d'une batterie de voiture ou d'un transformateur AC/DC (en option). Inclut deux cadres mtalliques pour la fabrication de tuiles normales et fatires de 8 ou 10 mm d'paisseur selon la demande.

Moules pour tuiles romaines

Modle TEVI en polystyrne de haute densit moul par injection haute pression garantissant des moules rigides et trs durables. Permet de produire des tuiles sans dformations et avec un ajustement parfait entre elles. 200 moules sont fournis (moules supplmentaires sur demande).

Feuilles plastiques pour le moulage des tuiles.

Ces feuilles sont utilises pour transfrer le mortier depuis l table vibrante jusque sur le moule. Peuvent tre utilises 100 fois si traites correctement. 400 feuilles sont fournies.

Permet de mettre la quantit exacte de mortier sur la table vibrante selon l'paisseur de la tuile fabriquer. Une truelle correspondant l'paisseur du cadre des tuiles est fournie

Dispositif pour dmouler

Facilite le dmoulage et le retrait de la feuille de plastique aprs un sjour minimum de 16 heures de la tuile dans le moule. Il permet de raliser un premier contrle de la forme du produit. Un exemplaire est inclus.

Documentation technique

Inclut un manuel d'utilisation avec des informations pour l'organisation et l'exploitation de l'unit de production et pour le montage des toits, ainsi qu'un manuel de contrle de qualit du processus de fabrication. Il s'agit de documents en franais abondamment illustrs.

Options

Transformateur AC/DC-chargeur de batteries.

Equipement pour tes essais de rsistance la flexion des produits finis.

Dispositif pour les essais d'impacts des produits finis.

Cadre mtallique pour la production de plaques pour faux-plafonds.

LE PRODUIT

Figure

Tuiles de type romaine

Fabriques avec des moyens de fixations diffrentes suivant que la charpente soit en bois, mtal ou bton.

Dimensions (mm):	490 x 250	
Tuiles par m^2:	12.5	
Epaisseur:	8 mm	10 mm
Poids de chaque tuile (kg)	2.5	3.0
Poids par m^2 (kg):	31.25	37.5

Tuiles fatires

Assurent l'tanchit lors des changements de pente. Se posent sur les tuiles normales

Dimensions (mm):	500 x 250 x 10

Tuiles par mtre linaire:	2.5
Poids de chaque tuile (en kg)	2.6

Figure

INFORMATION ET VENTE

Distributeur Cuba:

Comercial Mercadu S.A. 13 No 951 CP 12300 Vedado,
La Habana, Cuba. Telf. 33 38 93 / 33 30 87
Fax. (537) 333028/332429

Distributeur pour les autres pays:

EcoTec / Economy Ecology Technology
Schatzgutstr. 9
8750 Glarus, Suisse

Tel et fax (41) (58) 61 1081
E-Mail: 1011326.217@compuserve.com

Figure

OFFRES DE SERVICES

Les services additionnels suivants sont proposs:

- **Conseils pour le montage des units de productions**
- **Cours thorique et pratique de production**
- **Solution de problmes techniques lors de la fabrication ou lors de la couverture du toit**
- **Dessin de systmes de contrle pour amliorer la production et diminuer les cots.**

10 AVANTAGES

- **Ces tuiles ont des bonnes caractristiques en matire d'isolation phoniques et thermiques. Elles ne ncessitent pas de cuisson, sont lgres, inoxydables,**

impermables, rsistantes au feu, de bon aspect et trs longue dure de vie

- **Seuls deux matriaux sont ncessaires pour la production: le ciment et le sable**

- **Elles permettent une grande conomie de matriaux et d'argent: avec un sac de ciment de 50 kg, on peut couvrir entre 5 et 6 m^2 de toit. Pour couvrir 60 m^2 de toit, il faut seulement un m^3 de sable.**

- **Les tuiles peuvent tre poses sur des lattes de bois ou autre sans qu'il n'y ait besoin d'une sous-couverture.**

- **La machine est compacte, facile installer et utiliser, de faible encombrement, et ne ncessite pas d'oprateurs ou d'outils trs spcialiss.**

- **Il s'agit d'une unit de production propre qui ne produit pas de bruits excessifs ni de dchets polluants l'environnement ou qui mettent en danger la sant des travailleurs.**

- **La machine consomme trs peu d'nergie et possde une grande autonomie, elle peut ainsi tre installe en ville, dans les villages, la campagne, dans la fort, sur une montagne ou sur une le.**

- **Les caractristiques de la machine facilitent l'augmentation progressive de la production sans modification de l'quipement, il suffit d'ajouter des moules et/ou des machines selon les besoins.**

- **L'investissement de base est trs faible et peut tre rcupr rapidement.**

• **l'utilisation de cette technologie renforce la collaboration entre pays en voie de dveloppement pour la recherche de solutions efficaces aux problmes de l'habitat sous de conditions spcifiques.**

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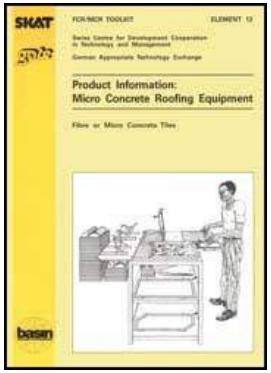

TEJACRETO Plana

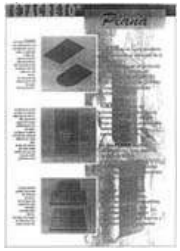

Figure 1

Figure 2

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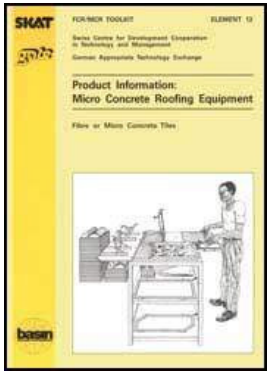

TEJACRETO Escalera

Figure 1

Figure 2

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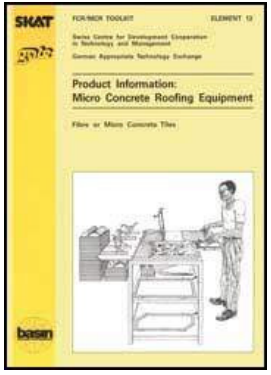

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- ***(introduction...)***
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- **Fibre Concrete / Micro Concrete Roofing Equipment**
- **CECAT TEVI - Unit de production de tuiles en micro-bton**
- **TEJACRETO Plana**
- **TEJACRETO Escalera**
- **TEJACRETO Romana**
- **TEJACRETO Colonial**

TEJACRETO Pantile
Product Information: MCR/FCR Equipment

Equipment and Tools for Basic Module for Fibre Concrete Tiles Production TEJACRETO - Peru

HABITECH - BUILDING - SYSTEM

TEJACRETO Romana

Figure 1

Figure 2

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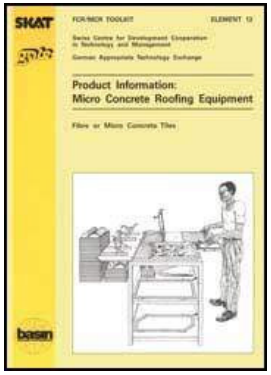

TEJACRETO Colonial

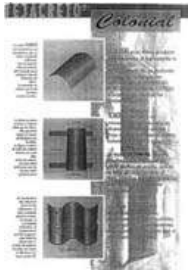

Figure 1

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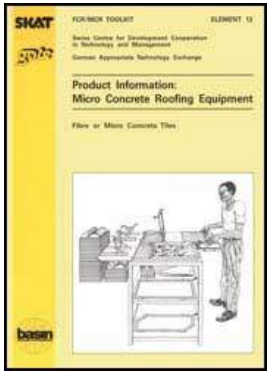
(introduction...)



TEJACRETO Pantile

Figure 1

Figure 2

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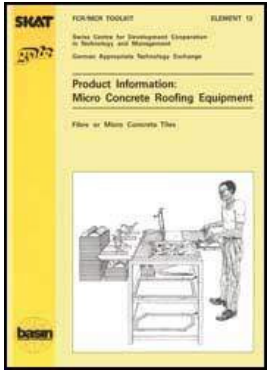

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- **TEJACRETO Escalera**
- **TEJACRETO Romana**
- **TEJACRETO Colonial**

- TEJACRETO Pantile
- Product Information: MCR/FCR Equipment
  - Parry/ITW Electric and Hand Powered Vibration Screeding Machines
  - Development Alternatives TARAcrete MCR Tile Production Kit
  - ECO Systems Concrete Rooftile Machine
  - DCS Foot-Powered Vibrating Table
  - APPRO-TECHNO Tegulamatic Roof Tile Plant
- Equipment and Tools for Basic Module for Fibre Concrete Tiles Production TEJACRETO - Peru
- HABITECH - BUILDING - SYSTEM
  - Roofing ROOF STRUCTURE MCR Tiles Installation
  - Roofing WORKSTATION Micro Concrete Roofing Tiles
  - Ralisations en Tuiles Fibro-Mortier - Realizations in Fibre-Mortar Tiles
  - Processus de Fabrication - Production Process