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MCR - Roofing System

Technical Data

Building system	Roofing
Size of tile	500 x 250 x 10 mm
Tiles per m²	12.5
Weight per tile	3.0 kg
Weight per m² of installed tiles	37.5 kg
Production capacity	200 tiles / machine / day (depends on number of moulds used)
Resistance to earthquakes	Good
Resistance to typhoons	Satisfactory
Resistance to rain	Good
Resistance to insects	Good
Climatic suitability	All climates
Stage of experience	Mature technology
Production costs of tiles per m²	Rp. 26,000
Production costs of system per m²	Rp. 90,000 (timber)
Durability	15-20 years

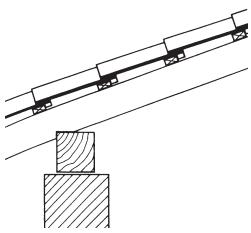
Short Description

- The roofing system consists of the roofing cover, which are MCR (Micro Concrete Roofing) tiles, and the roofing sub-structure. The substructure can be made of timber or metal
- There are 2 types of substructure: Single Leaf Roofing and Double Leaf Roofing
- The roofing system can be used for lean-to roofs or gable roofs

Optional Types

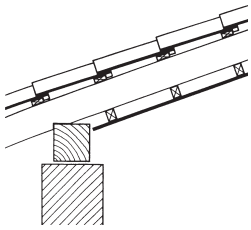
MCR with Single Leaf Roofing:

- This is the simplest and cheapest method of MCR roofing



MCR with Double Leaf Roofing:

- This is a more sophisticated method of MCR roofing, using an inner leaf along the roof slope
- This can be fixed from the inside onto the rafters and forms a sloped ceiling
- The space between the tiles and the ceiling is ventilated by special openings or simply by the gaps between the tiles



Advantages

MCR with Single Leaf Roofing:

- Inexpensive
- Simple construction
- Maintenance is easy from the inside
- Control of leakage is easy

MCR with Double Leaf Roofing:

- Improved thermal performance
- Dust, insect proof
- Moderate wind proof
- Proper surface from the inside

Disadvantages

MCR with Single Leaf Roofing:

- Relatively poor thermal insulation
- Not air and insect proof

MCR with Double Leaf Roofing:

- Higher costs
- Leakage cannot be easily detected from the inside
- Changing tiles from the inside is difficult
- Uncontrollable space between tiles and ceiling (rats, etc.)

Limits of Application

- Regular and good maintenance required (suitable rather for private than public buildings)
- Solid substructure required (metal structure); Most damages to MCR tiles on roofs can be tracked down to faults in the roof structure, and in the way the tiles were placed and fixed
- If chosen wooden substructure, good quality timber should be used

Construction Requirements

- Simple design of the roof
- The minimum pitch is 22°
- The minimum pitch should be 30° in areas with heavy rains
- The span of the rafters should not exceed 3.5m for lean-to roofs, and 6m for gable roofs
- Triangular trusses are used for wider spans up to 10m
- Roof structure should be designed to wind suction forces

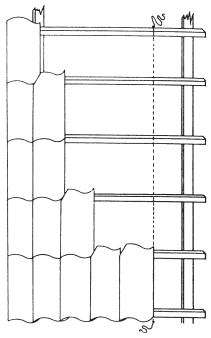
Installation Equipment

- Ordinary carpenter's and masonry equipment

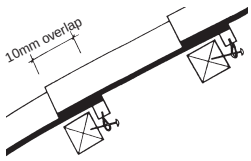
Installation Process

MCR with Single Leaf Roofing:

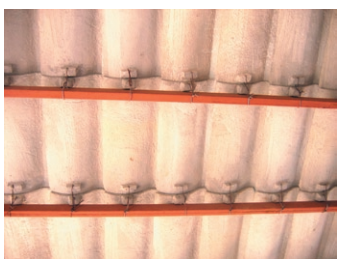
- Calculate the amount of tiles and length of rafters and laths according to Roof Cover Guide
- Length of rafter = (no. of tiles x 400mm) – 50mm
- Length of lath = (no. of tiles x 190mm) – 40mm
- Put together and place a roof truss (timber or metal) according to Roof Truss Guide
- Fix laths or steel angles onto the rafters/truss spaced at 400mm
- Lay first tiles in vertical lines as reference
- Place the rest of the tiles in horizontal rows starting from below using the vertical reference lines

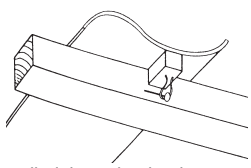


- Let overlap the tiles each other in direction of roof slope by 100mm; (tiles rest on the lath by means of a nib)
- Fix the tiles with wire loops, nails or tie them onto the timber laths or steel angles using the integrated wire loop in the nib



Fixing to upper batten

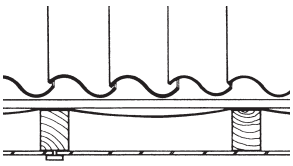




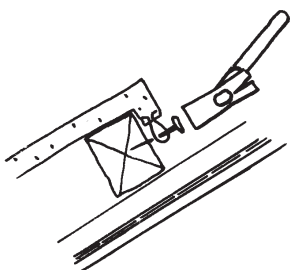
Nailed through a hook

MCR with Double Leaf Roofing:

- Calculate the amount of tiles and length of rafters and laths according to Roof Cover Guide
- Put together and place a roof truss (timber or metal) according to Roof Truss Guide
- Nail plywood or another material onto the rafters from the inside
- Place a strong plastic foil over the rafters
- Fix laths or steel angles onto the rafters/truss spaced at 40cm
- Lay first tiles in vertical lines as reference



- Place the rest of the tiles in horizontal rows starting from below using the vertical reference lines
- Let overlap the tiles each other in direction of roof slope by 100mm; (tiles rest on the lath by means of a nib)
- Fix the tiles with wire loops, nails or tie them onto the timber laths or steel angles using the integrated wire loop in the nib



Hip ridge:

- At the hip ridge, the tiles are carefully chopped to exactly the required shape, with an electronic hand-operated cutter
- The open gap is covered with ridge caps, laid in an overlapping pattern

Valley of the roof:

- Chop the tiles at the valley carefully with an electronic hand-operated cutter
- A metal gutter should be used

Skills Required

- Specialised carpenters and tile-makers skills

Further Reading

- Roof Cover Guide by Paul Gut, Skat/Basin
- The Basics of Concrete Roofing Elements, Skat/Basin
- Roofing Primer by Roland Stulz, Skat/Basin
- Roof Truss Guide, Skat/Basin

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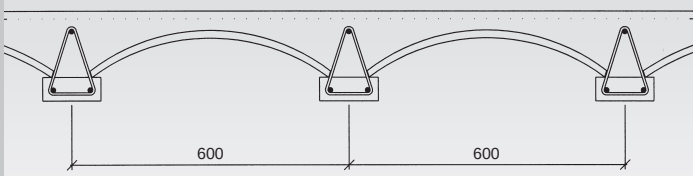
Slab System



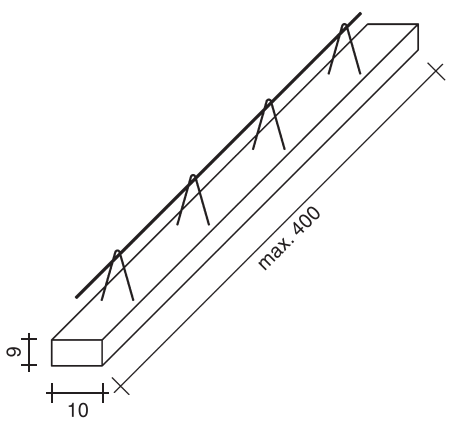
Technical Data

Building system	Floor
Size	Beam: 10 x 6 x max. 400 cm Tile: 30 x 60 x 2 cm
Weight per m² of installed beams and tiles	78 kg
Resistance to earthquakes	Very good
Resistance to typhoons	Very good
Resistance to rain	Very good
Resistance to insects	Very good
Climatic suitability	All climates
Stage of experience	Experimental
Production costs of system per m²	Rp. 100,000- 125,000
Durability	Approx. 30 years

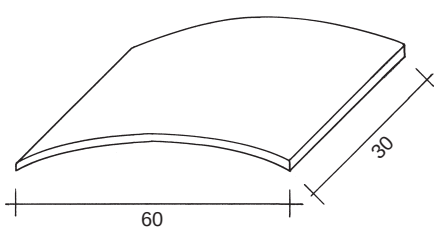
Short Description

- The Slab System consists of 2 elements:

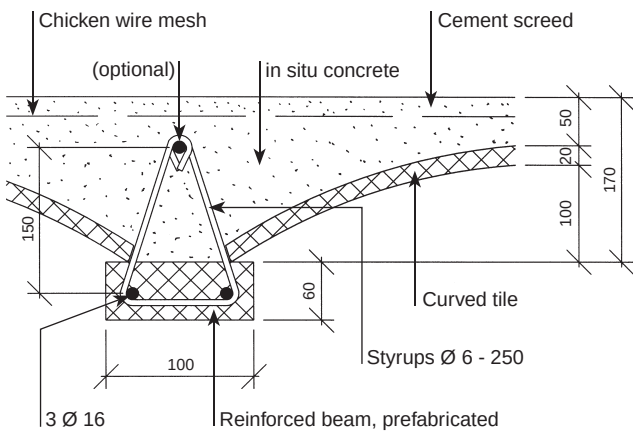
  1) Prefabricated reinforced concrete beams with integrated iron brackets



  2) Prefabricated curved concrete tiles, which are laid at the nibs of the beams



- A lean concrete layer is applied from the top to cover beam and curved tiles in order to hold the elements together and to produce a neat floor
- Common span lengths are 3m
- The Slab System is used for flat roofs and slabs
- Appropriate dimensions for the reinforcement have to be calculated according to span length and load
- Steel reinforcement: U 24, U 39



Advantages

Technical advantages

- High structural strength
- Fast construction
- No shuttering required
- Can be used as intermediate floor
- Attractive design
- No plastering needed

Economic advantages

- Savings in material, such as concrete filling
- Savings in time because of faster construction

Limits of Application

- Max. span length is 4m
- Skilled labourers and engineers required
- Engineer has to calculate reinforcement dimensions and details
- Requires exact planning: Size of rooms has to be adjusted to grid mass of beam and channel system

Installation Equipment

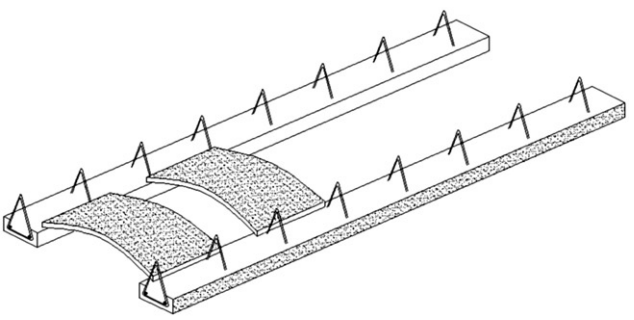
- Masonry equipment

Installation Process

- Install beams with supporting wooden pillars at construction site
- Place the channels at the nibs of the beams
- Apply a concrete layer from the top to cover beam and channels in order to hold the elements together and to produce a neat floor. Use a chicken wire mesh for reinforcement of the floor
- Take off supporting wooden pillars after 2 weeks

Skills Required

- Special training is needed
- Engineer has to calculate reinforcement of beams



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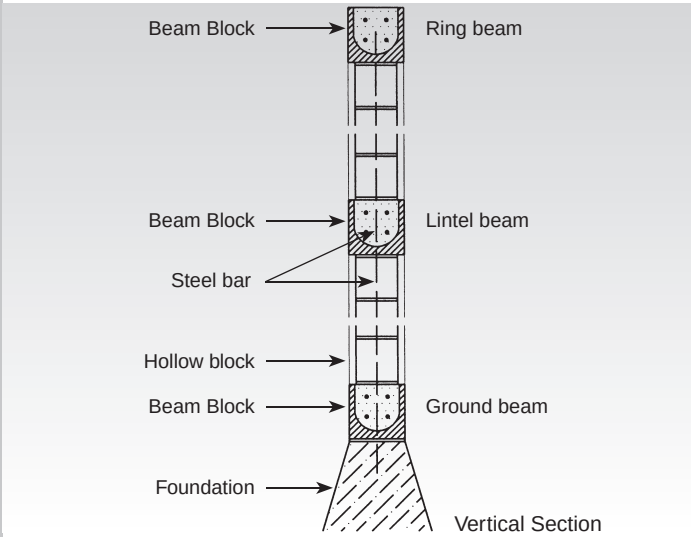
Frame Block Walling System

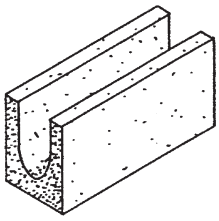


Technical Data

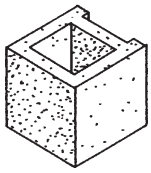
Building system	Walling
Sizes	Beam Block (U Type): 290 x 145 x 140 mm Concrete Hollow Block: 290 (145) x 145 x 140 mm
Resistance to earthquakes	Good
Resistance to typhoons	Satisfactory
Resistance to rain	Good
Resistance to insects	Good
Climatic suitability	All climates
Stage of experience	Widely used method
Production costs of system per m³	Rp. ***Please fill in!***
Durability	Approx. 30 years

Short Description

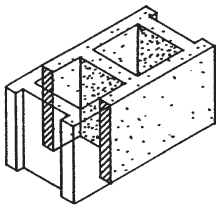
- Frame Block Walling System uses Beam Blocks for reinforced ground beams, lintels, and ring beams



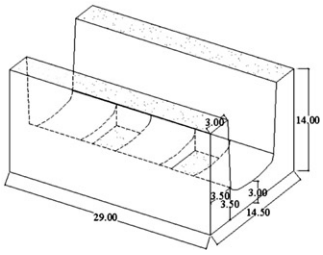
- Half Hollow Blocks are used for reinforced columns

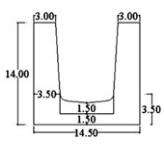


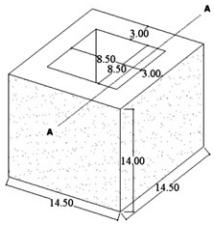
- Hollow Blocks are used for walling in between the Beam Blocks

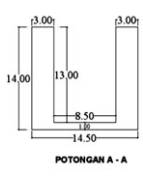


- Reinforcement is placed in the empty spaces, which are then filled with concrete









Advantages

Technical Advantages

- Very good stability
- For strong and light walls
- Rapid construction
- Voids can be filled with steel bars and concrete, achieving high earthquake resistance
- The cavity provides good thermal insulation

Economic Advantages

- Less working time required for brick laying work with concrete blocks
- Less mortar consumption

Limits of Application

- Special masonry knowledge and experience is needed

Construction Requirements

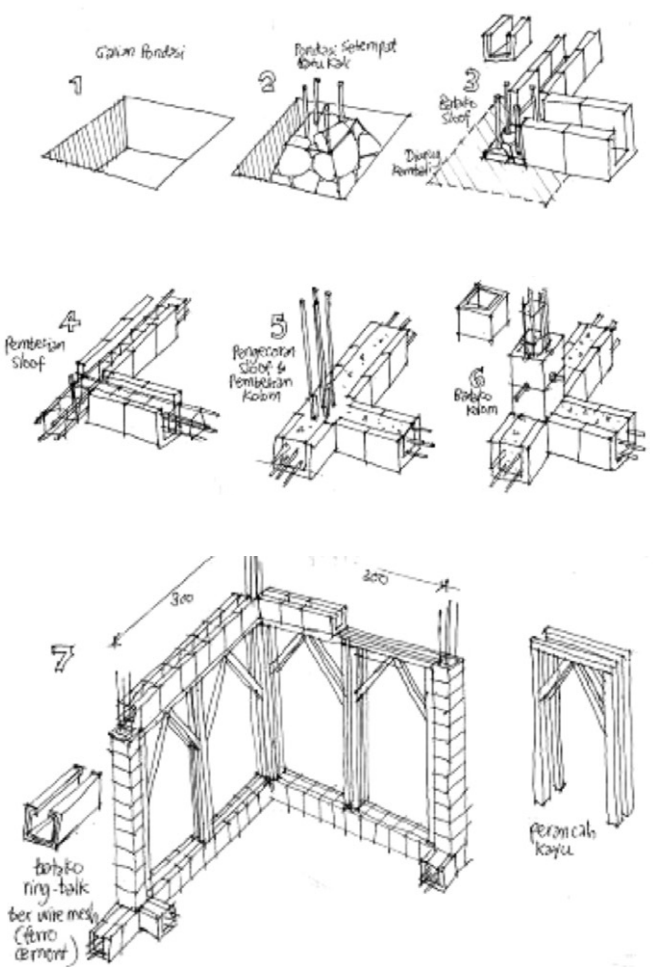
- Solid foundation underneath is needed
- Simple design of walls

Installation Equipment

- Masonry tools

Installation Process

- Build foundation and prepare it for walling
- Lay Beam Blocks as ground beams
- Install reinforcement with iron bars (8-12mm diameter)
- Fill Beam Blocks with concrete (recommended cement/ aggregate ratio is 1:5; recommended water-cement ratio of concrete is 0.6)
- Build up reinforced columns with Hollow Blocks
- Put up supporting scaffold
- Lay Beam Blocks as lintel or horizontal ring beam
- Install reinforcement with iron bars (8-12mm diameter)
- Fill Beam Blocks with concrete (recommended cement/ aggregate ratio is 1:5; recommended water-cement ratio of concrete is 0.6)
- Fill the empty spaces between beams and columns with Hollow Blocks



Skills Required

- Specialised masonry skills

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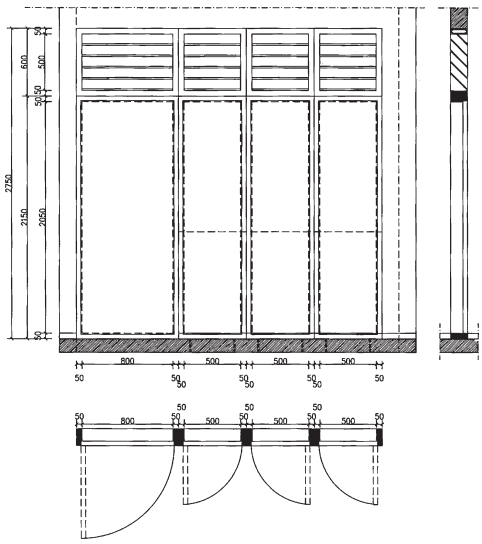
Frame and Shutter System



Technical Data

Building system	Door and window frames with shutters
Size	Various sizes
Resistance to earthquakes	Very good
Resistance to typhoons	Very good
Resistance to rain	Very good
Resistance to insects	Very good
Climatic suitability	All climates
Stage of experience	Commonly used
Production costs of system per m²	Rp. ***Please fill in!***
Durability	Approx. 30 years

Short Description

- The Frame and Shutter System consists of 2 elements:
  1) Prefabricated door and window frames (concrete) with integrated iron hinges and locks
  2) Door (wood or PVC) or window (wood) elements

Advantages

Technical Advantages

- Good weather resistance
- Long lasting
- Fast construction
- Easy installation
- Frames can be adjusted to the building design
- Easy maintenance

Economic Advantages

- Savings in working time through fast construction
- Woodless construction

Limits of Application

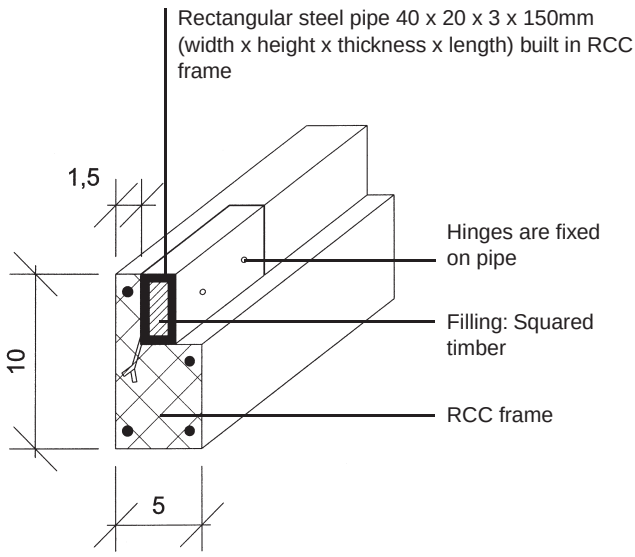
- Doors and window shutters must match with concrete frames
- Special knowledge and experience of the installation process is needed
- Hinges and lock must match with frames and shutters

Installation Equipment

- Masonry and carpentry equipment

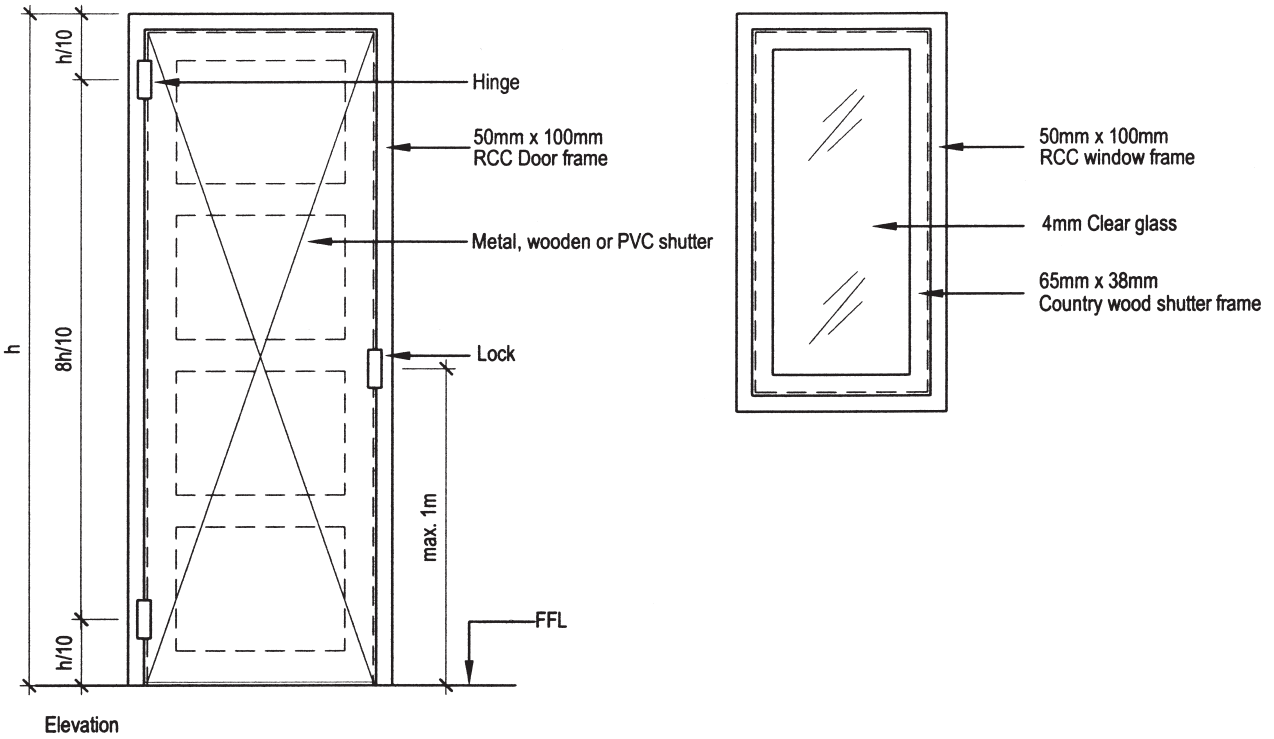
Installation Process

- Prepare clean and neat wall openings
- Set the prefabricated concrete frames into the openings
- Fix them with light layer of mortar
- Install door or window using the prepared hinges and locks



Skills Required

- Special training is needed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Metal, wooden or PVC shutter
Lock
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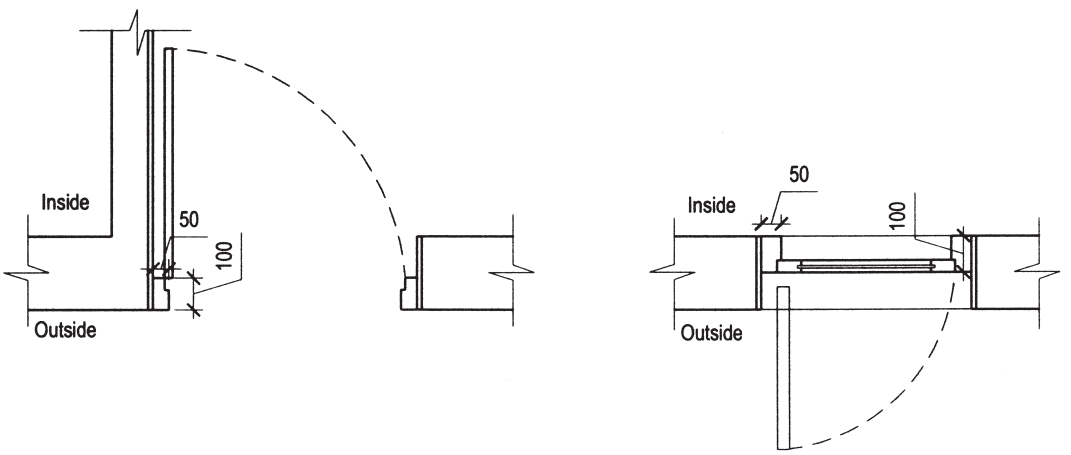
RCC window frame
4mm Clear glass
65mm x 38mm
Country wood shutter frame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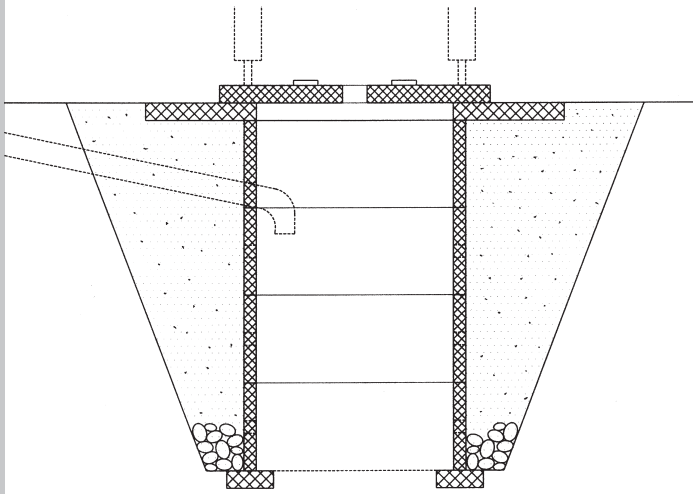
Latrine System



Technical Data

Building system	Latrine
Size	90 x 140cm (diameter x max. height); using 4 well rings
Weight per unit (90 x 35cm)	125 kg
Resistance to earthquakes	Very good
Resistance to typhoons	Very good
Resistance to rain	Very good
Resistance to insects	Very good
Climatic suitability	All climates
Stage of experience	Widely used method
Production costs per system	Rp. ***Please fill in!***
Durability	Approx. 30 years

Short Description

Latrine System consists of well rings, which form the latrine, and a covering foundation slab with a squatting slab.

A maximum of 4 well rings can be piled to form a latrine. The two lowest well rings are provided with holes (10 cm diameter per hole).

The highest well ring is covered with a precast foundation and/or a squatting slab

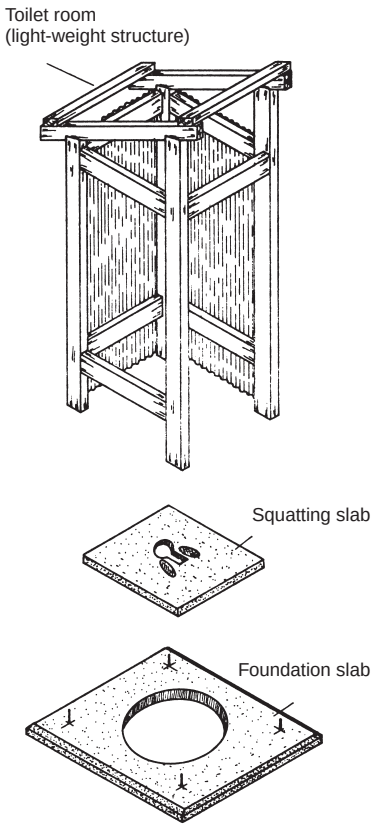
A toilet room can be installed on top of the latrine well rings; or the well rings are linked with pipe to a pour flush latrine.

The system should be placed at least 6m away from any house, and at least 30m away from any water source (well, bore hole or stream).

It should never be located uphill from a water source.

The volume of the latrine is calculated by using a rough figure of at least 0.06 cubic metres per person per year.

Note: Human wastes which have not been composted for at least 6 months should never be used as fertilizer.



Advantages

Technical Advantages

- Resistance to weathering, impact and abrasion
- Very good stability
- Easy to build
- Very hygenic

Economic Advantages

- Cheap sanitation system
- Production can be started with little capital
- Can be mass produced
- Is an attractive business for small-scale enterprises

Limits of Application

- Limited capacity of usage (can become full quickly when there are too many users)
- Has to be made properly; risk to contaminate nearby wells or surface water
- Has to be installed according to the height of the ground water table

Installation Equipment

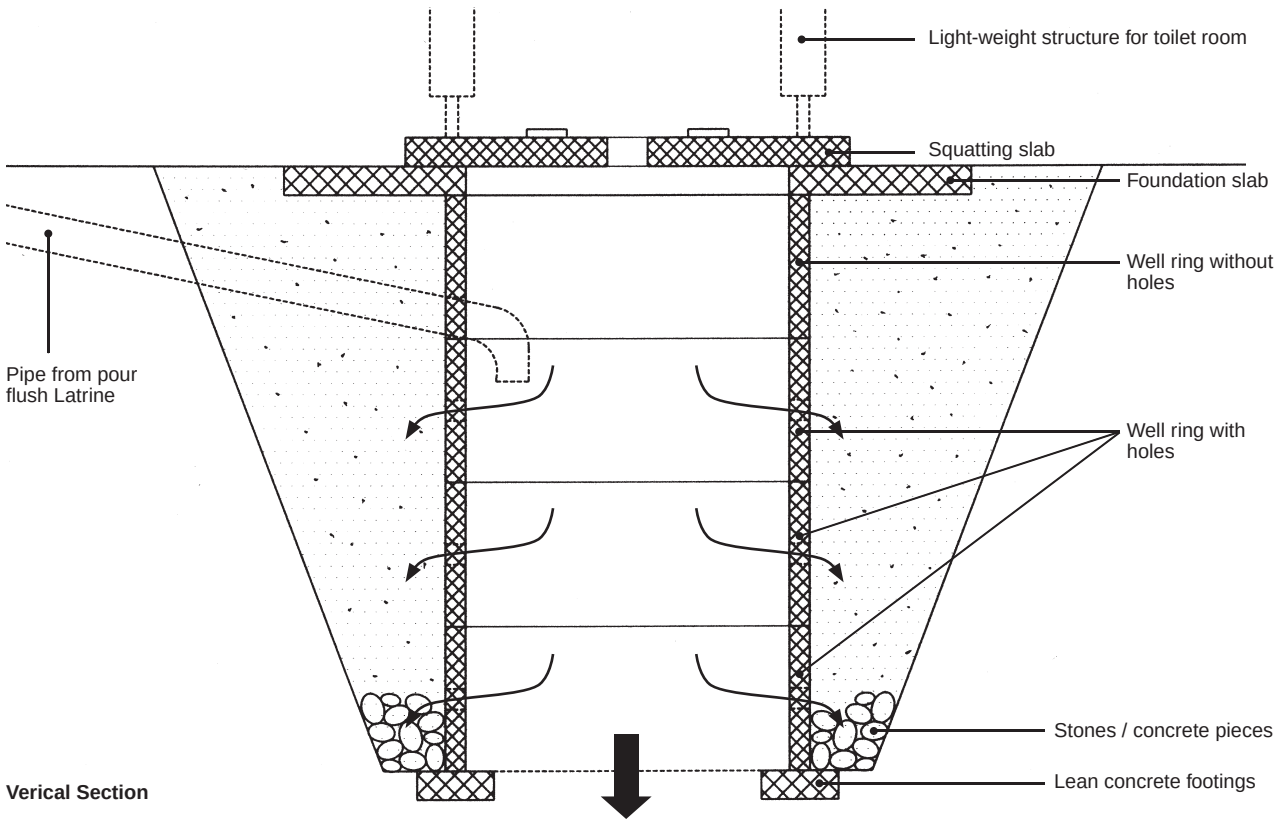
- Ordinary masonry tools
- Carpentry tools

Installation Process

- Dig a big hole at least 3 x 3 x 1.40m (width x length x depth)
- Prepare clean, neat and plane surface
- Apply a layer of lean concrete (min. 7cm) underneath rings only, as footings
- Lay carefully the prefabricated well rings, max. 4 units above each other; Use well rings with openings as the lowest rings
- Fix the well rings against each other with thin layer of cement mortar, forming the latrine
- Fill the gap between well rings and soil with stones or concrete pieces (7-20 cm diameter)
- Place a prefabricated foundation slab on top of the latrine and fix it
- Place a prefabricated squatting slab on top of the foundation slab
- Build a toilet room (light weighted made of metal or wood) on top of the foundation slab

Skills Required

- Masonry and carpentry skills



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Water Tank System

Technical Data

Building system	Water tank
Size	90 x max. 140cm (diameter x height)
Weight per unit (90 x 35cm)	125 kg
Resistance to earthquakes	Very good
Resistance to typhoons	Very good
Resistance to rain	Very good
Resistance to insects	Very good
Climatic suitability	All climates
Stage of experience	Widely used method
Production costs per system	Rp. ***Please fill in!***
Durability	Approx. 30 years

Short Description

Water Tank System consists of well rings, which form the water tank and the necessary piping linked to a water harvesting system (rain water or gravity fed).

Water tanks can be applied as surface or underground systems.

They can be used for storage of drinking and non-drinking water.

For surface systems, maximum of 4 well rings can be piled to form a water tank.

The Water Tank System includes an iron lid which is painted with an anti-corrosion coat. The lid protects small children falling into the water tank, and is also preventing Anopheles mosquitos (Malaria risk).

Limits of Application

- Raw materials must be locally available of good quality and economically viable
- Relative large amount of cement is needed which can be expensive and difficult to obtain
- If not properly covered, risk of contamination

Installation Equipment

- Ordinary masonry tools

Advantages

Technical Advantages

- Resistance to weathering, impact and abrasion
- Very good stability
- Easy to produce locally
- Rapid construction
- Long lasting

Economic Advantages

- Production can be started with little capital
- Can be mass produced
- Is an attractive business for small-scale enterprises
- Cheaper than PVC system

Installation Process

- Prepare clean, neat and plane surface
- Apply a layer of lean concrete (min. 5cm)
- Lay carefully the prefabricated well rings: max. 4 units above each other; fix the well rings against each other with thin layer of cement mortar
- Connect tank with pipes to the harvesting water system of the house
- Install water tap, min. 25 cm above tank ground
- If used for drinking water, a good cover lid has to be installed

Skills Required

- Concrete making and masonry skills

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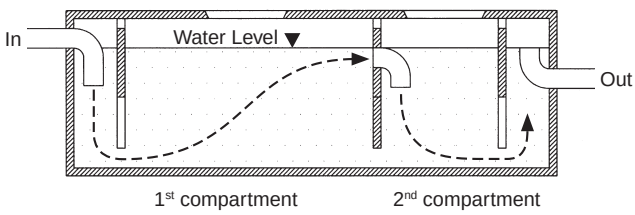
Septic Tank System

Technical Data

Building system	Septic tank
Size	85 x 250cm (diameter x length)
Weight	ca. 1000kg incl. reinforcement
Resistance to earthquakes	Good
Resistance to typhoons	Very good
Resistance to rain	Very good
Resistance to insects	Very good
Climatic suitability	All climates
Stage of experience	Commonly used
Production costs per unit	Rp. ***Please fill in!***
Durability	Approx. 30 years

Short Description

- The system is used where the ground water table is high
- The system is horizontally placed. It consists of:
  1) Prefabricated concrete cylinder shaped unit with two maintenance holes
  2) Pipe connections from the domestic waste water to the septic tank
- It is designed in such a way that the waste water takes at least 24 hrs to pass through the tank system; the heavier solids settle to the bottom, forming sludge
- During the process, the solids are gradually broken down and become much more reduced in volume
- The system has two compartments: the first compartment is twice the size of the second compartment
- The sludge has to be removed from the tank every few years, whenever it becomes 1/3 full



Advantages

Technical Advantages

- High structural strength
- Fast construction
- Easy installation
- Easy maintenance
- Can be used in situations where the ground water table is very high

Economic Advantages

- Savings in working time through fast construction
- Long lasting

Limits of Application

- Prefabricated concrete tanks must be of good quality
- Good knowledge and experience of the installation process is recommended
- Capacity for one house only

Installation Equipment

- Masonry equipment
- Lifting equipment is required

Installation Process

- Prepare clean and neat trench in the soil (min. depth 100cm)
- Apply a layer of lean concrete (min. 4cm) or tramped sand
- Lay carefully the prefabricated tank
- Connect tank with pipes to the waste water system of the house

Skills Required

- Special training is needed; provided by ArCli

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