Ferrocement Cast-in-place Water Tank (45 Cu. M.)

Designed by:

ACECOMS, IFIC
School of Civil Engineering
Asian Institute of Technology (AIT)

Designed for:

United Nations High Commissioner for Refugees (UNHCR)

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### Key Features

<table>
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<tr>
<th>Capacity</th>
<th>45 Cu. m</th>
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<tbody>
<tr>
<td>Diameter</td>
<td>5300</td>
</tr>
<tr>
<td>Height</td>
<td>2700</td>
</tr>
<tr>
<td>Foundation</td>
<td>Compacted Sand/Soil (thk. = 500) Retained by Hollow Blocks/Masonry Bricks</td>
</tr>
<tr>
<td>Base Slab</td>
<td>Reinforced Concrete (thk. = 120)</td>
</tr>
<tr>
<td>Wall</td>
<td>Ferrocement (thk. = 30) Stiffened by Embedded Steel Channels</td>
</tr>
<tr>
<td>Roof</td>
<td>Ferrocement (thk. = 30) Stiffened by Embedded Trusses</td>
</tr>
<tr>
<td>Central Column</td>
<td>GI Pipe (Diameter = 150) Filled with Mortar</td>
</tr>
<tr>
<td>Access Opening</td>
<td>Diameter = 600 (in Roof)</td>
</tr>
<tr>
<td>Pipe Work</td>
<td>Intel, Outlet and Over Flow Pipes</td>
</tr>
<tr>
<td>Finishing</td>
<td>Inside Plastering Only, Outside Ordinary Paint, No Special Paint/Additives</td>
</tr>
</tbody>
</table>

**Examples for Connecting Multiple Tanks**

- **For Same Water Head**
  - Plan - 2 Tanks
  - Plan - 3 Tanks
  - Plan - 4 Tanks

- **For Different Water Head (Overflow Type Connection)**

**Note:**
- RB = Round Bar
- GI = Galvanized Iron
- All dimensions are in millimeter
- Foundation height depends upon water head required

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**Ferrocement Cast-in-place Water Tank**

*(45 Cu.m.)*

**Designated by:**

ACECOMS

School of Civil Engineering (AIT)

**Drawing Title:**

Key Features

**Scale:** Not to Scale

**Client:** UNHCR

**Date:** March 2002

**Drawing No:** CD45-01
Ferrocement Cast-in-place Water Tank
(45 Cu.m.)

Section 1-1

Foundation
(thk. = 500)
Concrete Slab
(thk. = 120)
Ferrocement Wall
(thk. = 30)
Ferrocement Roof
(thk. = 30)
GI Pipe filled with Mortar
(dia. = 150)
Overflow Pipe
Outlet Pipe
Inlet Pipe
Overflow Pipe

Note:
- RB = Round Bar
- GI = Galvanized Iron
- All dimensions are in millimeter
- Foundation height depends upon water head required

Elevation

Roof Plan

Plan, Elevation and Section

Designed by
UNHCR

School of Civil Engineering (AIT)

Scale: Not to Scale
Client: UNHCR

Date: March 2002

Drawing Title:
Plan, Elevation and Section

Drawing No:
CD45-02
Concrete Base Slab
Lean Concrete
( Optional )
Compacted Sand
or Crushed Stone
Compacted Soil

Section 2-2: Foundation Detail

Masonry Brick Layout

Ferrocement Wall
Concrete Base Slab
Lean Concrete
( Optional )
Compacted Sand
or Crushed Stone
Masonry Blocks
Compacted Soil
Natural Ground

Foundation Plan
(L evel + 620 )

Masonry Bricks
Ferrocement Wall
Concrete Slab

Note:
- RB = Round Bar
- GI = Galvanized Iron
- All dimensions are in millimeter

Drawing Title: Foundation Details
Drawing No: CD45-03

Section 2-2: Foundation Detail

Ferrocement Cast-in-place Water Tank
( 45 Cu.m. )

UNHCR
ACEMOS
School of Civil Engineering (AIFT)

Designed by

Scale: Not to Scale
Client: UNHCR
Date: March 2002
Water Tank Plan

Section 3-3: Slab Detail

Base Slab Reinforcement Detail

Note: - RB = Round Bar
- GI = Galvanized Iron
- All dimensions are in millimeter
Section 4-4: Water Tank Wall Section

Section 5-5
- Construction Joint 1
- RB 9 mm @ 100 (WV1 and WV2 alternated: see detail 2 in Dwg. CD45-04)
- RB 9 mm @ 200 (WH1)
- Chicken Mesh (WM1)
- Chicken Mesh (WM2)

Section 6-6
- Construction Joint 1
- RB 9 mm @ 200 (WH1)
- Chicken Mesh (WM1)
- Chicken Mesh (WM2)
- Steel Channel 73 x 37.5

Section 7-7: Central Column Detail

Steel Plate 300x300x12
4 x RB 9 Welded with Steel Plate
GI Pipe Filled with Mortar (dia. = 150)
RB 6 @ 200 (CH1)
4 x RB 9 (CV1)
4 x RB 9 SL1 (see Detail 1 in dwg no: CD45-04)

Truss
45°

Note:
- RB = Round Bar
- GI = Galvanized Iron
- All dimensions are in millimeter
Section 9-9: Roof Framing Plan

- Steel Channel 75 x 37.5
- Truss (see Section 11-11)

Section 10-10: Roof Slab Detail

- Chicken Mesh (RM1 & RM2)
- Chicken Mesh (RW1)
- Chicken Mesh (RW2)
- Diagonal Member (RB 6: see Detail 4)
- Truss Lower Cord (RB 9: see Detail 3)
- Truss Upper Cord (RB 9 mm: see Detail 3)

Section 11-11: Truss Detail

- Chicken Mesh (RM2)
- Chicken Mesh (RM1)
- Diagonal Member (RB 6: see Detail 4)
- Truss Lower Cord (RB 9: see Detail 3)
- Truss Upper Cord (RB 9 mm: see Detail 3)

Section 8-8: Truss Section

Note:
- RB = Round Bar
- GI = Galvanized Iron
- All dimensions are in millimeter
Steel Plate 300 x 300 thk. 120
4 x RB9 (CV1)
RB 6 @ 200 (CH1)
RB 6 @ 200 (RC1)
Truss (see dwg. CD45-06)
Steel Chanel 75 x 37.5
RB 9 @ 200 (WV2)
RB 9 @ 200 (WH1)
RB 9 @ 200 (WV1)
RB 9 @ 200 # ST1
4 RB 9

Note: Only Selected Typical Elements Shown

Note: - RB = Round Bar
- GI = Galvanized Iron
- All dimensions are in milimeter
Construction Main Steps

Step 1: Selection of Site
Step 2: Site Clearance
Step 3: Preparation of Foundation
Step 4: Preparation of Lean Concrete Base
Step 5: Preparation of Base Slab Reinforcement
Step 6: Laying Base Slab Reinforcement
Step 7: Erecting L-bars Along the Wall-Base Junction
Step 8: Placing Vertical Dowel/Plate/Bars for Central Column
Step 9: Casting the Base Slab
Step 10: Erection of Vertical Reinforcement and Stiffeners for Wall
Step 11: Keeping Openings for Construction and Pipe Works
Step 12: Fixing Wire (Chicken) Mesh (WM1 and WM2)
Step 13: Preparation and Fixing the Central Column
Step 14: Plastering the Wall
Step 15: Preparation of Roof Shallow Truss
Step 16: Fixing Roof Trusses (Roof Stiffeners)
Step 17: Placing Roof Reinforcements
Step 18: Fixing the Roof Mesh
Step 19: Providing Openings in the Roof
Step 20: Plastering Roof Trusses
Step 21: Temporary Formwork for Plastering of Roof Surface
Step 22: Plastering Roof Surface
Step 23: Plastering Temporary Openings
Step 24: Finishing the Surface

[For Construction Procedure Details Refer to "How to Manual"]
Material Specification

Cement: Use ordinary Portland cement Type I or II for tropical countries and Type II for cold climates

Sand:
1. Use well graded sand. Sand that is too fine or too coarse is not suitable
2. Separate sand from stone using 6.4 mm (1/4 inch) mesh screen.
3. No organic or chemical impurities. If quality is in doubt, wash with clean water.
4. Desirable sand grading is as follow:
   - Sieve 3/8 in (9.5mm) Percent passing 100
   - No. 4 (4.75mm) 95 to 100
   - No. 8 (2.36 mm) 80 to 100
   - No. 14 (1.18mm) 50 to 85
   - No. 30 (600um) 25 to 60
   - No. 100 (150um) 2 to 10

Water:
1. Water fit for drinking is suitable.
2. Salty water should never be used.

Wire Mesh:
1. Must be easy to handle and flexible enough to be bent around corners.
2. Galvanized wire mesh is preferred as it is less likely to rust or corrode.
3. Use 0.5 mm to 1.00 mm diameter with 10 mm to 25 mm mesh opening.
4. Free from grease, oil, rust and anything that might reduce bond.

Skeletal Steel:
1. Free from grease, oil detergents, organic matter, cracks of blow holes.
2. Bars are acceptable if no cracks appear after the following field test:
   "Bend bar into U shape and then straighten it out. Bend it again in U shape in the opposite direction and straighten it out."
3. Grade SR24: Yield strength = 2400-2600 ksc

Steel Channel:
1. Free from grease, oil detergents, organic matter, cracks of blow holes
2. Size 7.50 cm x 3.75 cm (height x width)
3. Grade Fy = 2400-2600 ksc (34-36 ksi) and FU = 4,000-4,500 ksc (57-64 ksi)

Tie Wire: Use annealed (soft) galvanized wires of 24 or 26 gauge. Cut pieces of wire from meshes could also be used for tying.

Material Quantity Summary (45 cu. m.)

<table>
<thead>
<tr>
<th>Items</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
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<tr>
<td>Coarse Sand</td>
<td>14</td>
<td>m2</td>
</tr>
<tr>
<td>Hollow Blocks</td>
<td>150</td>
<td>pieces</td>
</tr>
<tr>
<td>Cement</td>
<td>3267</td>
<td>kg</td>
</tr>
<tr>
<td>Sand</td>
<td>4.26</td>
<td>m2</td>
</tr>
<tr>
<td>Stone</td>
<td>5</td>
<td>m2</td>
</tr>
<tr>
<td>Water</td>
<td>1.67</td>
<td>m2</td>
</tr>
<tr>
<td>RB 6 mm</td>
<td>164</td>
<td>m</td>
</tr>
<tr>
<td>RB 9 mm</td>
<td>1452</td>
<td>m</td>
</tr>
<tr>
<td>Steel Channel (7.50 cm x 3.75 cm)</td>
<td>18</td>
<td>m</td>
</tr>
<tr>
<td>Chicken Mesh</td>
<td>123</td>
<td>m2</td>
</tr>
<tr>
<td>GI Pipe</td>
<td>2.7</td>
<td>m</td>
</tr>
<tr>
<td>Steel Plate</td>
<td>0.09</td>
<td>m2</td>
</tr>
</tbody>
</table>

Mix Proportions

Lean Concrete = 1:4:8 (Cement: Sand: Aggregate by weight)
Slab Concrete = 1:2:4 (Cement: Sand: Aggregate by weight)
Ferrocement Mortar = 1:2:0.4 (Cement: Sand: Water by weight)