Ferrocement Cast-in-place Water Tank (90 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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Ferrocement Cast-in-place Water Tank
(90 Cu.m.)

Key Features

<table>
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<tr>
<th>Capacity</th>
<th>90 Cu. m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>7300</td>
</tr>
<tr>
<td>Height</td>
<td>2700</td>
</tr>
<tr>
<td></td>
<td>(2200+500)</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</td>
</tr>
<tr>
<td></td>
<td>Outside Ordinary Paint</td>
</tr>
<tr>
<td></td>
<td>No Special Paint/Additives</td>
</tr>
</tbody>
</table>

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

Examples for Connecting Multiple Tanks

For Same Water Head

For Different Water Head (Overflow Type Connection)

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School of Civil Engineering (AIT)

Drawing Title: Key Features
Ferrocement Cast-in-place Water Tank
(90 Cu.m.)

Drawing No: CD90-01
Scale: Not to Scale
Client: UNHCR
Date: March 2002

Client: UNHCR

Examples for Connecting Multiple Tanks

Pipe dia. 50 -100
T1
T2
T1
T2
T1
T2
Pipe dia. 50 -100
Pipe dia. 50 -100
T1
T2
T1
T2
T1
T2

Plan - 2 Tanks
Plan - 3 Tanks
Plan - 4 Tanks
Section 1-1

Ferrocement Cast-in-place Water Tank (90 Cu.m.)

Designed by

Drawing Title: Plan, Elevation and Section

Drawing No: CD90-02

Date: March 2002

Scale: Not to Scale
Client: UNHCR

Note:
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Section 2-2: Foundation Detail

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

Ferrocement Wall

Foundation Plan
(Level + 620)

Masonry Bricks
Ferrocement Wall

Concrete Slab

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

Section 5-5

Section 6-6

Section 7-7: Central Column Detail

Note:
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- All dimensions are in millimeter
Section 8-8: Truss Section

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

Section 9-9: Roof Framing Plan

- Ferrocement Wall
- RB 9 @ 200 (RC1)
- RB 9 @ 400 (RD1)
- RB 9 @ 400 (RD2)
- 2 layers of Chicken Mesh (RM1 & RM2)

Section 10-10: Roof Slab Detail

- Chicken Mesh (RW1)
- Chicken Mesh (RW2)
- RB 9 @ 200 (RC1)
- RB 9 mm @ 200 (RD1 & RD2: Alternated)
- welded to upper and lower chord

Section 11-11: Truss Detail

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

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

UNHCR

School of Civil Engineering (AIT)

Designed by

ACECOMS

Drawing Title: Roof Details

Drawing No: CD90-06

Scale: Not to Scale

Client: UNHCR

Date: March 2002
Steel Plate 300 x 300 thk. 120
4 x RB9 (CV1)
RB 6 @ 200 (CH1)
RB 6 @ 200 (RC1)
Truss (see dwg. CD45-06)
RB 9 @ 400 (RD1)
RB 9 @ 400 (RD2)
RB 9 @ 200 # ST1
4 RB 9

Chicken Mesh (RM2)

Chicken Mesh (RM1)

Steel Chanel 75 x 37.5
RB 9 @ 200 (WV1)
RB 9 @ 200 (WH1)
RB 9 @ 200 (WV2)
Chicken Mesh (WM1)
Chicken Mesh (WM2)

RB 9 @ 200 # ST1
RB 9 @ 200 # SB1

RB 9 @ 100 (SL1; see Detail 1)

Note: Only Selected Typical Elements Shown

Note:
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- All dimensions are in millimeter
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

(Ferrocement Construction Tools)
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:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 in (9.5mm)</td>
<td>100</td>
</tr>
<tr>
<td>No. 4 (4.75mm)</td>
<td>95 to 100</td>
</tr>
<tr>
<td>No. 8 (2.36 mm)</td>
<td>80 to 100</td>
</tr>
<tr>
<td>No. 14 (1.18mm)</td>
<td>50 to 85</td>
</tr>
<tr>
<td>No. 30 (600um)</td>
<td>25 to 60</td>
</tr>
<tr>
<td>No. 100 (150um)</td>
<td>2 to 10</td>
</tr>
</tbody>
</table>

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."

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 (90 cu. m.)

<table>
<thead>
<tr>
<th>Items</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Sand</td>
<td>25</td>
<td>m2</td>
</tr>
<tr>
<td>Hollow Blocks</td>
<td>195</td>
<td>pieces</td>
</tr>
<tr>
<td>Cement</td>
<td>5078</td>
<td>kg</td>
</tr>
<tr>
<td>Sand</td>
<td>7</td>
<td>m2</td>
</tr>
<tr>
<td>Stone</td>
<td>7</td>
<td>m2</td>
</tr>
<tr>
<td>Water</td>
<td>2.62</td>
<td>m2</td>
</tr>
<tr>
<td>RB 6 mm</td>
<td>279</td>
<td>m</td>
</tr>
<tr>
<td>RB 9 mm</td>
<td>2375</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>191</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)