

COMPLETION REPORT

OF THE

PILOT PROJECT ON

RAIN WATER HARVESTING IN MANIPUR

Submitted to

Director
Science and Society Division (SSD)
Department of Science and Technology (DST), Govt. of India
Technology Bhavan, New Mehrauli Road, New Delhi – 110016

Project Team :-

Dr. L. Minaketan Singh, Ningchuimi Singnaichui W. Subhash L. Hemanta Singh Tonglunthang N. Jumbojit Singh	P.I. Project Engineer Field Assistant Skilled Mason Skilled Mason Helper
--	---

**MANIPUR SCIENCE & TECHNOLOGY COUNCIL
CENTRAL JAIL ROAD, IMPHAL - 795 001**

Phone:0385-2443451, 2443451; TeleFax:0385-2230037; e-mail: mastec@nic.in

Acknowledgement

The author (PI) takes this opportunity to sincerely thank DST, GoI., New Delhi particularly Dr. (Mrs.)Vinita Sharma, Scientist F/ Director, Science and Society Division (SSD), Department of Science and Technology (DST), GoI, Technology Bhavan, New Delhi for providing financial support to the project “ Pilot Project in Rain Water Harvesting in Manipur ” implemented for the first time in the state by this Council.

The author records immense gratitude and expresses his sincere thanks to Director, Regional Research Laboratory (RRL),CSIR, Jorhat, Assam for allowing our project staffs to undergo training at the Applied Geo-Engineering Department of RRL on construction of ferro-cement water storage tanks. The Head and his colleagues at Applied Geo-engineering Department, RRL, Jorhat are highly acknowledged for giving proper technical guidance to the our project team including project engineer without which construction and installation of ferro-cement tank would have been a very difficult part of the project implementation.

The Member Secretary, Manipur Science and Technology Council (MASTEC) is highly acknowledged for his constant encouragement and providing administrative support during the period of implementation of the project.

Thanks are due to Shri N. Gitchandra Singh, Member Secretary, Manipur Building Centre, Porompat, Imphal East for providing necessary guidance and sharing his expertise as and when required in implementing the project. The author is grateful to Er. L. Somokanta Singh, Executive Engineer, PHED, Manipur, Er. Ng. Dilip Singh, PDA, Imphal, Er. L. Gopal Singh, Assistant Engineer, PHED, Govt. of Manipur for sharing their knowledge and expertise and also actively taking part in the Training Workshop on Rain Water Harvesting as resource persons

The local authorities (Church Committee / Temple Board / Village Chiefs/ School authorities etc.) who helped MASTEC by providing accommodation facilities to the project team during the construction and installation of rain water harvesting structures at select places are highly acknowledged.

The author is thankful to all those who made it possible to complete the project by their assistance and encouragement.

Dr. L. Minaketan Singh
Scientific Officer
P.I.

1. TITLE OF THE PROJECT & DST NO. : PILOT PROJECT ON RAIN WATER HARVESTING IN MANIPUR
SP/TSP/063/2003

2 PI : Dr. L. Minaketan Singh
Manipur Science & Technology Council
Central Jail Road, Imphal – 795001
Phone : 0385-2230037, 2443451
Fax : 0385-2230037
E-mail ; mastec@ nic.in ;
loitongbam@rediffmail.com

3. DATE OF START: June 14, 2004 SCHEDULED DATE OF
COMPLETION : August 31, 2006

4. TOTAL REVISED PROJECT COST :

5. INTRODUCTION

Manipur state (22,327 sq.km in geographical area) is situated in the north eastern corner of the Country comprising of 90% of the total geographical area by hills and the rest (10%) by plains. The Valley of Manipur lies at an altitude of about 780 m above mean sea level and occupies the central portion of the state and it gradually slopes from north to south. The state falls in one of the rain fed regions in the country and receives appreciable amount of unevenly distributed precipitation through out the year with peak rainfall during monsoon period. However, because of the hilly topography, water no longer remains after rainfall. Tap water from state Public Health Engineering Department is not adequate to meet the increasing demands of the people even in the urban areas. Acute shortage of drinking water has been a prominent problem being faced by the people during the past few decades. In the hills, women have to go a long distance to fetch some water from the rivers / streams/ springs etc. Being hilly region, underground water exploration as well as exploitation does not seem feasible (specially in the hill districts) and rooftop rain water harvesting is found to be the appropriate system to be adopted to augment shortage of water supply system to the people.

Roof top rain water harvesting is the technique through which rain water is captured from the roof catchment and stored in reservoirs. The objective of rain water harvesting is to make water available for future use and meet the household needs. Among others, some of the advantages of rain water harvesting might be as follows.

- i) It provides self sufficiency to water supply
 - ii) It provides high quality water, soft and low minerals

- iii) The system is less expensive and less expensive which can be adopted by individuals
- iv) In the hilly terrain, rain water harvesting is preferred for adoption

Roof top rain water harvesting comprises of various components such as roof catchment, gutters to transport water, pipes (Inlet, Overflow, Outwash and water tap etc), filter unit, storage tank. Among the above components, storage tank is the most expensive and critical component and the capacity of the storage tank determines the cost of the system.

Priority to rain water harvesting in Manipur region.

The region experiences sub tropical to temperate climate with appreciable special variation showing highly contrasting meteorological conditions. The annual precipitation varies from 2194 mm to 4516 mm as recorded in the western region and 2943 mm in the south and 1785 mm in the central part of the state. The rainfall is unevenly distributed through out the year.

Out of the existing houses of the state, about 50% of the houses mostly in the rural areas consists of galvanized corrugated iron slanted roofed sheets and about 20% houses mostly in the towns are RCC buildings and the remaining are thatched roofed houses in the village areas. Most of the community halls, churches, Schools, temples etc have CGI roofs. CGI sheets are suitable for rain water collection system.

The present study is an attempt to introduce ferro-cement tank for storage of roof top rain water and install it in some select places as part of rain water harvesting system in the region

6. Objectives of the project :

- Introduction of ferro-cement tank as safe water reservoir
- Fabrication and installation of 15 numbers of demonstration based roof top rain water harvesting structures (five structures in the 1st year and 10 structures in the 2nd year) in the select places in the state.
- Popularisation of rain water harvesting techniques in the state.

7. Project Area

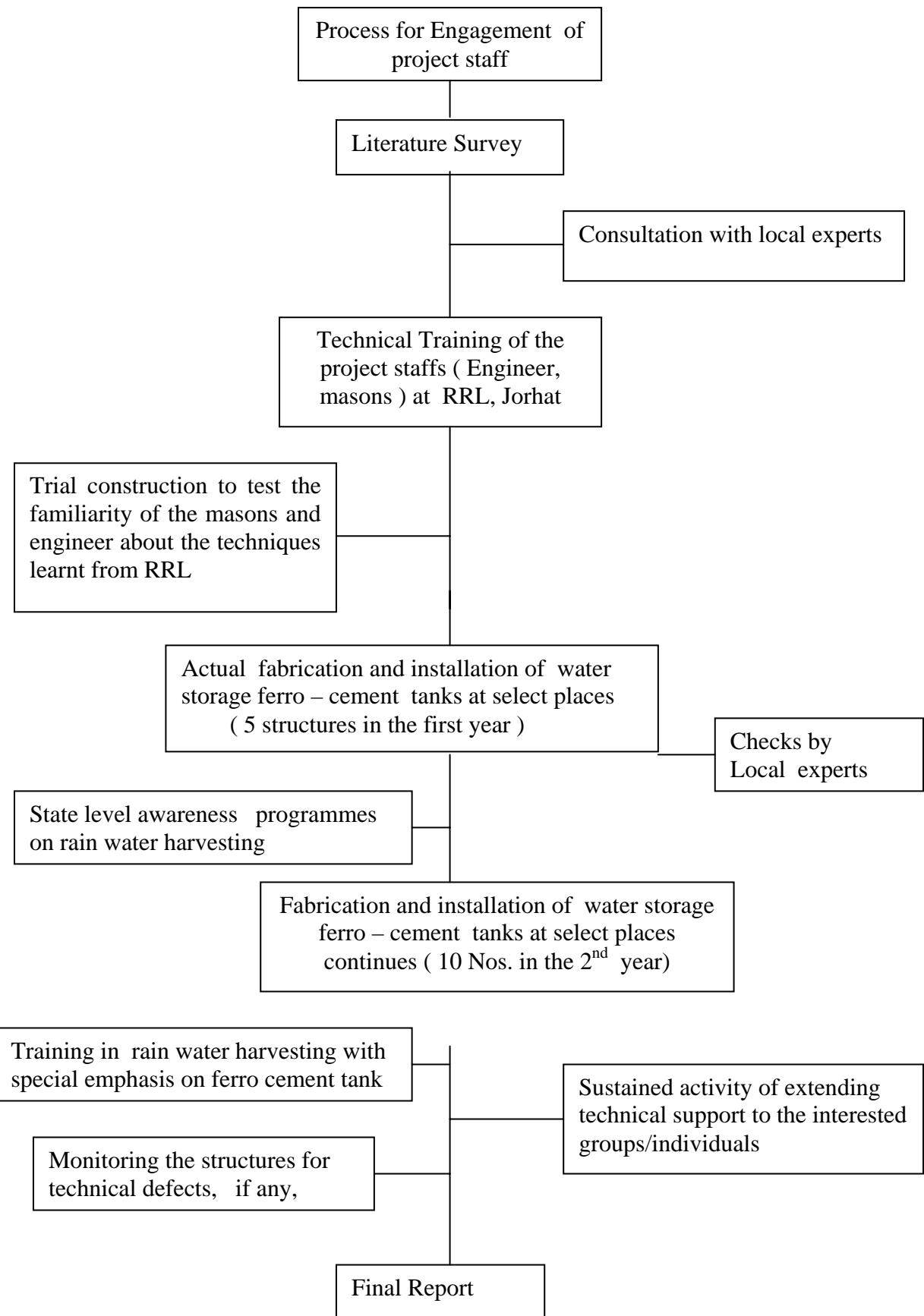
The state of Manipur has altogether nine districts out of which five districts are in the hills and remaining four lies in the plains. The area of implementation covered all the districts of the state i.e. the demonstration based roof top rain water harvesting structures were installed in all districts including hills.

8. Broad Methodology and approach / Steps adopted

- i) Review of existing literature
- ii) Training of the technical project staff at RRL, CSIR, Jorhat, Assam
- iii) Trial construction practice to increase technical confidence of the technology
- iv) Actual Fabrication works at select places and installation
 - a) Steps for actual practical work
 - Preparation of base foundation above which the tank is to be kept.
 - Preparation of bottom portion of the ferro cement tank (skeletal)
 - Fabrication of body skeletal cage and roof portion
 - Fixing of chicken wire mesh in equal distribution
 - Fixing of inflow Pipe, over flow pipe, tap, wash out pipe etc.
 - Plastering using cement mortar
 - Performance test
 - Fixing of water collection system (gutters, pipes etc.) to the roof of the building from where rain water is to be collected and connection of water pipe to the inflow GI pipe of the Tank to flow rain water into it
 - iv) Training activities for popularization of the programme such as awareness training programmes on rain water harvesting during which masons, engineers would be imparted in depth training on construction of various types of ferro cement tanks and they would be provided free hand practical to utilize techniques for fabrication of ferro cement water storage tanks.

8.1

Flow Chart



9 Works done

9.1 Man power including Project Engineer trained

The Director, RRL, Jorhat was kind enough to transfer the technology available with them free of cost on construction of ferro-cement tank for storage of rain water for the benefit of the people of Manipur . Hence. the three Project Staffs (one engineer and two masons) who were engaged in the ongoing project were trained at Regional Research Laboratory (RRL), CSIR, Jorhat (Assam) about fabrication and construction of various types of ferro-cement tanks for storage of water. In addition, RRL provided scientific literature for further reference and guidance.

9.2 Ferro cement water storage tanks

Ferro cement is a strong, versatile, low-cost, long-lasting building material made from a wire reinforced mixture of sand, water, and cement. A ferro-cement structure is usually 2-5 cm thick--- much thinner and lighter than poured concrete structures. Ferro-cement structures have much greater tensile strength and flexibility than ordinary concrete because it has wire reinforcing distributed throughout the structure.

Ferro-cement tanks consist of a framework of steel and wire reinforcing, which is then covered with a cement sand (1: 2 ratio) plaster. They are cost effective, hazard free and have a long life. They offer complete flexibility in shape. However, a form is often used to provide the desired shape. Its maintenance cost is less and amenable to repairs in case of local damage. It can be used as a tank for storage of safe drinking water.

Advantages of ferro- cement tanks:

- i) The walls are thin, light, and easy for transportation
- ii) Normal skills of labour/ mason is required.
- iii) It has high degree of impermeability and resistance to cracking
- iv) It requires little or no maintenance at all
- v) It is economical compared to tanks of steel, concrete or brick.
- vi) It can be of any size and shape (rectangular / circular)

The demonstration based ferro-cement water storage structures for a capacity of 5000 liters were fabricated and installed at the following 15 select places including 5 hill districts in Manipur.

- i) Takyelpat, Imphal West District
- ii) Shri Shri Govindaji Mandir Complex , Imphal East District

- iii) Thangjing Community Mandir (Temple) Complex, Moirang in Bishnupur District
- iv) Little Angels' School Campus , Tangrei, Ukhrul District (ST)
- v) District Hospital Campus, Tamenglong District Hd. Qtr. (ST)
- vi) Wangkhei (Palace compound), Imphal East District
- vii) Leimakhulen Community Hall , Langol Foot Hill
- viii) Langjing Achouba Village, Imphal West District
- ix) Goura Sampradai Mandop, Moreh in Chandel District (ST)
- x) Wangjing New Bazar, Lamding, Thoubal District
- xi) Sangaiporou Kabui Tribal Village (ST), Imphal West
- xii) Church Complex, Motbung, Senapati District (ST)
- xiii) Evangelical Baptist Church (Convention) Complex, Churachandpur District (ST)
- xiv) Don Bosco High School, Imphal
- xiv) Markaz Darul Yatama (Orphanage Home), Atoukhong, Lilong (Muslim Minority Area), Thoubal District

The following major criteria were considered for selection of sites for fabrication and installation of the structures

- i) Whether the site / building really needs to have rain water harvesting structure and for whom to be installed
- ii) Whether the building has suitable rooftop catchment area.
- ii) Whether the site where the building exists is a common venue where people could easily see the structure, if installed.
- iii) Whether it could benefit group of people / community
- iv) Whether a local committee / party is willing to take responsibility for maintenance of the structure at their own cost after handing over to them.

9.2.1 Details of Fabrication of rain water harvesting strutures.

- i) **Fabrication** of Ferro-cement tank at Takyelpat, Imphal West District

The technical staffs (Engineer and masons) after getting proper training from RRL, Jorhat, planned to make first attempt to fabricate a tank of ferro-cement for a capacity of 5000 litres. However, even though proper training was obtained, still the masons had fear of fabricating a big tank of about 5000 litres capacity as they seem themselves to have just started exposing to the new technology. Hence, it was decided to fabricate two tanks of



11.19.2004

Skeletal of bottom portion of the tank



11.16.2004

Fabrication of skeletal cage of tank



Roof cover with man hole (skeletal)



3.7.2000

Roof man hole cover (skeletal)



11.10.2004

Skeletal of tank tied with wire mesh



Plastering inside wall of the skeletal body

smaller sizes of 3000 and 2000 liters capacity respectively under a system that the two tanks are connected by a pipe to flow water from one to another. Hence, the ferro cement water storage tank was successfully fabricated and installed as a demonstration structure of roof top rain water harvesting at Takyelpat, Imphal West District. Steel / iron rods 6 mm and

8 mm, chicken wire mesh, cement, coarse to medium sand, water proof materials, mason's tools etc. were the materials to fabricate tank.

The performance test was done. The water collected from the roof of the building has been then stored in the tank and used for domestic needs. A team consisting of Shri Nganthang Haokip, Hon'ble Minister (S&T), P.L.Thanga,I.A.S. Addl. Chief Secretary, Govt. of Manipur, L.P.Gonmei, IAS, Commissioner (S&T), Director (S&T), Govt. of Manipur and other Govt. Officials visited the site to see the rain water storage structure installed.



Base foundation made of bricks above which one tank was installed



Inspection of construction of Ferro-cement tank at Takyelpat, Imphal West District by a team consisting of Shri Nganthang Haokip, Hon'ble Minister (S&T), P.L.Thanga,I.A.S. Addl. Chief Secretary, Govt. of Manipur, L.P.Gonmei, IAS, Commissioner (S&T), Director (S&T), Govt. of Manipur and other Govt. Officials.

ii) **Fabrication and installation at Shri Shri Govindaji Mandir Complex, Imphal East District**

Shri Shri Govindaji Temple is the biggest temple for Hindus in the State. Thousands of devotees make visits to the temple specially during Hindu festivals and a groups of people including tourists visit the temple daily for worship. The temple is run by a Board so called **the Govindaji temple Board**. In some festivals like the day of Budha Purnima, Holy festival etc., thousands



Engineer supervising mason's team during construction period at Govindajee complex

of people come to the temple for Darshan and also take food (lunch) on pre paid basis.

It was found that the members of the Board had been bearing pressures for quite long for management of drinking water. The tap water supplied for few hours daily by the Water supply Department was not adequate to meet the demand of water for cooking and drinking. The office of the Shri Shri Govindaji Temple Board had approached MASTEC Office for installation of a rain water harvesting structure in the campus for the welfare of the devotees coming daily to the temple for darshan. Besides, it was mandatory to install rain water harvesting structure in a select place like community hall, temple, church etc. where many people could see the structure and made aware of the roof top rain water harvesting. Hence, the Project Engineer made the feasibility study. The CGI roofed portion of the temple was found very large enough to receive rainwater and found quite appropriate to be used as catchment to provide rain water to a storage system. Hence, the rain water harvesting structure was installed at the campus of the Shri Shri Govindajee Temple, Imphal with a ferro-cement water storage tank of 5000 liters.

The technical data used for fabrication of a ferro-cement tank of 5000 litres capacity are as follows.

Mild Steel (8 mm Bar)

$$B_1 = 1.66 + 0.15 + 0.15 = 1.96 \text{ m (4 Nos.)}$$

$$B_2 = 1.505 + 0.15 + 0.15 = 1.805 \text{ m (4 Nos.)}$$

$$B_3 = 1.2 + 0.15 + 0.15 = 1.5 \text{ m (4 Nos)}$$

$$6\text{mm bar } B = 1.735 + 2.2 + 2.2 = 6.135 \text{ (2 Nos.), VB} = 2.2 + 0.20 = 2.4 \text{ m (20 Nos.)}$$

$$\begin{aligned} \text{Ring L R1} &= 2.084 \text{ m (2 Nos.), L R2} = 3.196 \text{ m, L R}_2^1 &= 4.3 \text{ m} \\ \text{L R3} &= 5.538 \text{ m (2 Nos), L R4} = 5.648 \text{ m} && (10 \text{ Nos}) \end{aligned}$$

$$(\text{Lid}) \text{ L RF1} = 2.35 \text{ m, LRF2} = 2.30 \text{ m, LRF3} = 1.07 \text{ m}$$

$$\text{Radial RR} = 0.91 \text{ m (8 Nos.), RB1} = 0.87 \text{ m (2 Nos), RB2} = 0.54 \text{ m (4 Nos).}$$

iii) Rain Water Harvesting Structure for Bishnupur District

Moirang – a tourist spot about 45 kilometer from Imphal was a historical place. This was the place where Indian National Army (INA) was set up for the first time by the then Netaji Subhash Chandra Bose- a freedom fighter to fight against the British authority for India's Independence. The Thangjing Mandir in Moirang is a popular religious holy place for the Manipuri Hindu. Groups of people from different parts



Ferro-cement tank installed at Moirang in Bishnupur

of the state make visits to the Mandir every week for worship and food. The shortage of water was a common problem faced by the management committee of the Mandir. On their request, the Rain Water Harvesting Structure for a capacity of 5000 liters for Bishnupur District was constructed and installed at Moirang. Not only giving local support, the Thangjing Seva Mondal was very keen in taking care of the maintenance of the harvesting structure being installed at Moirang. The performance of the tank was tested and found satisfactory. The tank has been used for storage of rain water.

iv) **Fabrication and Construction works in Ukhrul district (hill district)**

The ferro-cement tank for a capacity of 5000 liters was constructed in the campus of the Little Angels' English High School at Tangrei, Ukhrul District (a hill district inhabited by tribal of Christian by religion) at an altitude of about 1800 m above mea sea level and 85 kilometers away from Imphal

About 2000 students (Class I to Class X standard) studied in the School. Being a hill station, the management committee of the School faced problem to provide water to the students. Besides, storage of water was also a problem as noticed by the school authority. Hence, the structure was installed in the campus in the interest of the students so that rain water collected from the roof the school building may be stored in the tank to provide to the students as and when required. The School Authority provided local support while fabrication and construction works of the ferro-cement tank were going on by providing a room for stay of the project team. The tank has been filled in with water and now in use. The Principal (lady in the photo picture) of the School took risk of the maintenance of the rain water harvesting structure after handing over to them.



Ferro cement tank for storage of rain water installed at Ukhrul district

v) **Rain Water Harvesting Construction works in Tamenglong district (hill district)**

Tamenglong district (which is a hill district dominated by Zeliangrong tribes of Christian by religion) about 135 km from Imphal, the Capital of Manipur receives an appreciable amount of rainfall through out the year. However, by virtue of its topography, after rainfall, water does not remain as it flows towards the hill slopes. Among the hill

districts, Tamenglong Head quarter is one where people had experience of facing problem of scarcity of water for use.

The District Hospital of the Tamenglong stands for health care of the people of the district. As requested by the Chief Medical Officer (CMO) of the District and also advised by the then Commissioner (S&T) who also looked after the Department of Health Services, Govt. of Manipur, the project team led by the project PI visited District hospital campus. The problem identified when the project team visited the campus was the shortage of water supply for use by the patients' party. The hospital building did not have water storage facility. Hence, a

rain water harvesting structure with a ferro-cement water storage tank of 5000 liter was fabricated and installed in the campus of the District Hospital, Tamenglong. The water from the tank would be very useful to the patient and its parties in addition to hospital staff. The Nursing Superintendent of the concerned hospital took the responsibility for maintenance of the rain water harvesting structure.

vi) Structure installed at Wangkhei, Imphal East District

Jointly with Central Glass and Ceramic Research Institute (CGCRI), a premier R&D establishment of CSIR, this Council implemented a project on Iron removal plant. The water available in the valley of Manipur has been reported to have excess iron. The main objective of the joint programme was to provide purified water free of iron to the people. The machineries including installation, technical training etc. required for the plant was to be provided by CGCRI, Kolkata and this Council



Ferro cement water storage tank at District Hospital Campus, Tamenglong



Ferro-cement Water Storage tank at Wangkhei, Imphal East Dist

had to provide a 5000 liter capacity tank to store rain water or ground water. Hence, a ferro-cement tank of the capacity of 5000 lit. was fabricated and installed. The storage tank is used without any complaint.

vii) Rain Water Harvesting Structure at Langol Community Hall

There has been space problems mostly in the urban areas that most of the houses have very small or no court yard to accommodate even unavoidable societal or religious functions.

Hence, in each community or locality, it has been encouraged to have a common community hall where religious functions, development meetings, marriage ceremonies etc. may be organized.

Langol community hall is such a hall where most of the community development related programmes are held. The hall did not have its own rain water collecting system. Besides, it lies at a slightly higher foot hill zone. Being foot hill slope, no water remains after having continuous rainfall as it flows

down the hill slope. The CGI roof of the hall was quite big enough to be used as catchment area to provide water to the tank. Hence, one rain water harvesting structure has been installed in the campus of Meetei Community hall.. The Committee provided local support by providing a room for stay of the project workers during the construction period. Maintenance of the structure has also been taken care of by the committee of the above mentioned organization.



Ferro-cement tank at Langol

viii) Rain Water Harvesting Structure at Langjing Achouba village near N.H.No. 39



Ferro cement water storage tank at Langjing Achouba village, N.C. Road



Plastering bottom floor of the tank (inside)

The development committee of the Western Star Club (Youth Centre) at Langjing Achouba Village at the side of National Highway No. 39 , a registered body under Societies registration Act was keen to have a rain water harvesting structure attached to their newly constructed club building (Youth Centre). They approached this Council for the same. Hence, a ferro-cement tank of about 5000 liters capacity was fabricated and installed in the club premises with a system that the water to be collected from the CGI sheet roof of the building be stored in the tank for use of the office bearers of the developmental centre and surrounding villagers. The performance test was quite satisfactory without any leakages. The members of the local club is taking care of the maintenance of the structure.

ix) Rain Water Harvesting Structure for Chandel District (Hill district)

Moreh is a border town in Chandel District in Manipur near Myanmar border. This is about 110 kilometer away from the State Capital Imphal of Manipur. The town is inhabited by groups of communities such as Manipuri Hindu, Meities, Tribal both Naga and Kuki, Tamils, Muslims, Nepalies etc. The people living in and around Moreh in Chandel District utilized Community hall for arranging religious social events like marriage ceremony, social gatherings, public meetings etc. One of the problems faced in organizing such events is the problem of water either due to lack of water storage device or unavailability of water - supply facility. The Goura Sampradai Development Committee - a religious committee of the Moreh town submitted application requested MASTEC to consider for installation of a rain water harvesting structure at their community hall. Considering the needs, the roof top rain water harvesting structure for Chandel District was fabricated and installed at Moreh in Manipur near Myanmar/ Burma border. The structure was installed at the Goura Sampradai Mandop. The Goura Sampradai Committee had taken the responsibilities for maintenance of the structure. The ferro-cement tank has been tested and found quite satisfactory and now used as storage device of water. MASTEC received local support as well as good appreciation from the people living in the border town

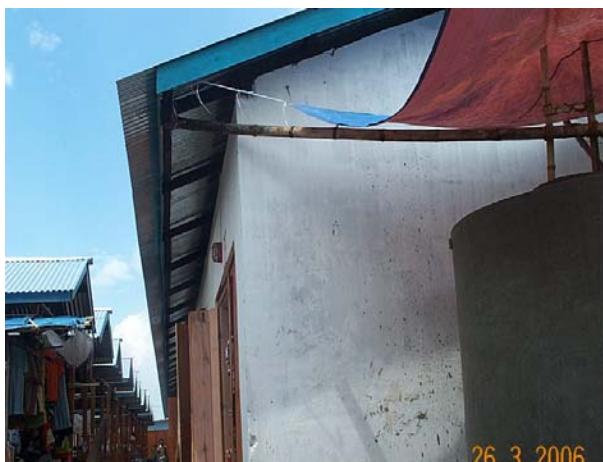


*Ferro cement water storage tank
at Moreh, bordering Myanmar*

while construction was going on. The maintenance part of the structure has been taken care by the committee.

x) Rain Water Harvesting Structure in Thoubal District

A New market shed was established at Wangjing – Lamding by the Municipal Council of Wangjing Thoubal District, Manipur. The problem faced by the women vendors in the market was to find water for use as and when required. Women vendors occupying their plots in the market had to bring water from far distance for use A survey in the area has



Ferro-cement water storage tank for Thoubal district under curing period

noticed that there was no water storage device in the market. Besides, the roofed CGI sheets of the market shed was found appropriate to be a catchment area for feeding rain water to the water tank. Considering the above facts, it was decided to install rain water harvesting structure in the new market area with an aim at providing rain water to the hundreds of women vendors and visitors who come daily to the market and also popularize rain water harvesting in the region. Hence, the roof top rain water harvesting structure for a capacity of 5000 liters was fabricated and installed at Wangjing – Lamding Bazar in Thoubal district, Manipur.

xi) Rain Water Harvesting Structure for Sangaiporou Tribal (Kabui) community.

Sangaiporou village is inhabited by a community of tribes called Kabui tribe. The village is situated south west of Imphal at a distance of about 7 km. from Imphal. The village, though it is not far from the capital city, preserves its own traditional costume with a Chief of the village (Khullakpa) who is involved at all stages of the development activities. Weekly or monthly organized meetings are held with the Village Chief in the chair in their community hall. The village authority had approached this office by submitting an

application for installation of a rain water harvesting structure in their village. Hence, considering the needs of the people of the village, a harvesting structure for a capacity of 5000 liters capacity has been installed. The village authority provided local support by providing accommodation to the project team (engineer and masons) during the construction period. The maintenance of the structure has been taken care by the Development Committee of the tribal village.



Structure at Kabui village

xii) Rain Water Harvesting Structure for Senapati District (ST)

The Secretary of the Motbung Youth Club (Regd. No.289/2/12/1963), Senapati District (ST) approached this Council to fabricate and install a rain water harvesting structure in their Church Complex. The project team led by the Principal Investigator visited the site and had a discussion with the Chief of the village and Chairman, Village authority and members of the Youth Club. The Chairman of the village made a briefing that they had community developmental meetings every week in the church complex. When any meeting are held to discuss developmental activities, their worry is to bring water from a long distance

to the meeting venue. He further said that being hill, no water is stored after rainfall. They had to go down the hill slope to find river or stream from where they could get water for any purpose. The discussion came to the resolution that the Village authority would take the responsibility for further maintenance of the structure.



Structure at Motbung

Hence, a rain water harvesting structure was fabricated and installed in the Church Complex at Motbung, Sadar Hills in Senapati District (Schedule Tribe inhabited area) in Manipur. The local support such as lodging was provided by the Motbung Youth Club for stay of the project working team during the construction period.

xiii) Rain Water Harvesting Structure at Evangelical Baptist Church (Convention) Complex, Churachandpur District (ST)

The Management Committee of the Evangelical Baptist Convention (EBC) took interest in the installation of a rain water harvesting structure in their EBC complex. They also assured for further maintenance of the structure by themselves. Hence, the rain water harvesting structure for the Churachanpur District (Kuki tribe inhabited hill district) was

successfully installed at the Evangelical Baptist Church complex at Elemveng, Churachandpur District head quarter, about 65 km south of Imphal. The Church Committee took the responsibility for maintenance of the structure in the future.

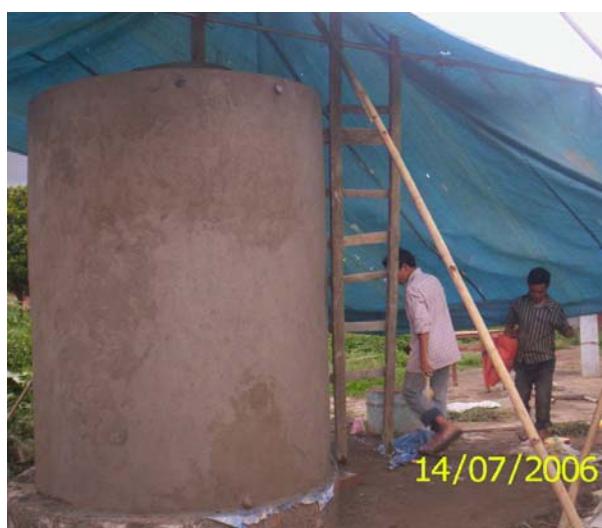


*Evangelical Baptist Church (EBC)
before structure was installed*



*E. Baptist Church with roof top rain
water harvesting structure. Elemveng.*

xiv) Rain Water Harvesting Structure installed at Don Bosco School campus.



Ferro-cement water storage tank installed at Don Bosco High School



The Principal of the Don Bosco High School, one of the best Schools in the state where about 1000 students from Nursery to Class X were reading, had approached this Council to install a rain water harvesting structure in their campus. They had been facing problems last few years due to lack of water storage device. They had been using water from the water supply stored in one small tank which was not sufficient to meet the requirements of the students. Hence, after site visit by the project engineer, the fabrication and installation

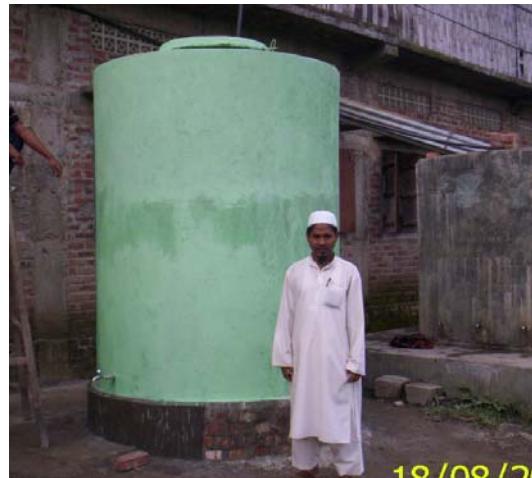
of the rain water harvesting structure was done near the newly constructed CGI roofed building which was used by the school authority as their canteen. The rain water collected by the roof of the canteen building was stored in the ferro-cement tank and now used by the students and school authority. The school authority has taken the responsibility for maintenance of the structure. The father of the Don Bosco school had expressed that he would try his best to make aware of the students about the importance of the rain water harvesting with the help of the structure installed at the campus.

xv) Rain Water Harvesting Structure installed for Orphanage at Lilong.

There are a few orphan homes in the state. The Markaz Darul Yatama is an orphanage established by Muslim minorities at Atoukhong village in Lilong, Thoubal District about 22 km. from Imphal and it is run by a committee consisting of the Muslim members. The Muslim orphan boys were given shelter, food and also education free of cost at the above



*Orphanage for Muslim boys
- Markaz Durul Yatama, Atoukhong*



*Rain water harvesting structure
installed at Orphanage home*

mentioned home. Highlighting the problems faced by them in the management of water for the maintenance of the orphanage, the Principal of the above Orphanage has requested MASTEC to install a rain water harvesting structure in the orphanage home. Hence, considering difficulties submitted by the Orphanage and also in the interest of the orphan boys living there, a rain water harvesting structure with a ferro-cement tank of 5000 liters capacity was installed. The Orphanage management committee provided lodging facility to the project team (masons, engineer) during the period of the fabrication and installation. After curing time was over, it has been given to them with maintenance by themselves.

9.3 Trainings held in the first year of the project.

A 6 day long training (awareness programme) on Rain Water Harvesting was organised during **February 2-7, 2005** at Takyelpat, Imphal West as partial fulfilment of implementation of the ongoing project . Thirty participants including civil engineers and masons participated in the training. The main objective of the training was to popularise rain water harvesting techniques and also impart training about construction of ferro-cement tanks for storage of water. Altogether 24 participants participated in the training.

Shri S. Madhu Sudan Singh, Director, S&T, Govt. of Manipur inaugurated the training. Shri L.

Swamikanta Singh, Executive Engineer, PHED, Govt. of Manipur was the Guest of Honour and Shri Th. Surendranath Singh, Executive Director, MASTEC presided over the inaugural function held on 2nd February , 2005 . Dr. L. Minaketan Singh, Scientific Officer (P.I). highlighted the objectives of the training.

Shri N. Gitkumar Singh, Member Secretary, Manipur Building construction centre, Imphal, Shri Ng. Dilip Singh, Engineer, Planning and Development Authority (PDA), Imphal and Shri L. Swamikanta Singh, Executive Engineer, PHED imparted in-depth training and interacted with the participants.

Shri L. Swamikanta Singh delivered lectures on the topics 1. Fundamentals of Rain Water Harvesting and its applications and 2. Need for popularisation of rain water harvesting in the state. Shri N. Gitkumar Singh delivered lectures on the topics 1. Materials required for construction of ferro-cement tanks and 2. Selection of appropriate design / shape of the tank for storage of water.



Inaugural function of training on rain water harvesting



A section of the participants

Ng. Dilip Singh delivered lectures on the topics 1. Types of Ferro-cement tanks and its construction techniques and 2. Ferro-cement tanks and its advantages over other water storage structures.

During the course of the training, as part of the hands on experiment, the participants could successfully fabricate and construct two types of tanks of the capacities of 1000 litres and 500 litres respectively. The practical was conducted under the guidance of Mr. Ningchuimi Singnaisui, Project Engineer.

While arranging a feed back session, most of the trainees were of the opinion that the training duration was short that they could not construct various types of tanks due to time constraints. They further commented to MASTEC to arrange similar training for a longer duration not less than ten days with more time on practical.

The training ended on February 7, 2005 with a function with Shri Th. Surendranath Singh, Executive Director as the Chief Guest. Certificates were distributed to the participants at the closing function.

Training held in the second year of the project.

An awareness training programme on Rain water harvesting was organised during **August 25-29**, 2006 at Imphal. The main objective of the training were to impart training about the fabrication of the ferro-cement water storage tanks and also popularise roof top rain water harvesting in the region. The training was inaugurated by Shri Th. Surendranath Singh, Executive Director, MASTEC as the Chief Guest.

The target participants were masons, civil engineers, interested representatives of NGOs etc. Altogether 22 participants including two ladies attended the training. The resource persons included Shri L. Somokanta Singh, Executive Engineer, State PHED, Er. L. Gopal Singh, Asst. Engineer, PHED and Er. Ch. Sarat Singh, (M.Tech), MASTEC. The trained workers such as Shri L. Robindro Singh, L. Hemanta Singh and Th. Bikram Singh were used as the demonstrator cum tutor during the practical sessions. Er. L. Somokanta Singh spoke on the topic **Need**



Participants at the training course

for popularization of Rain Water Harvesting in the region. Er. L. Gopal Singh delivered lecture on the topic **Various techniques for collection of rain water from roof top of buildings** and also interacted with the participants. Er. Ch. Sarat Singh delivered lecture on Construction of various types of ferro-cement water storage tanks. He further highlighted about the fabrication of structures with the help of slides which were installed at 15 select places in different districts in the state. During the course of the training specially during practical sessions, two tanks of ferro-cement for a capacity of 1000 liters each was constructed. The central room of the MASTEC at Takyelpat was the venue of the training.

9.4 Quality of water

Whether a given water is suitable for a particular purpose depends on the criteria or standards of acceptable quality for that use. The physical as well as chemical quality of water is important to decide its suitability for drinking purpose. Various standards are formulated by National and International agencies such as WHO, ICMR, PHE Committee and all the standards are recommendatory and provide guidelines for deciding the requirements. Rain water samples were collected from project sites during the rainy season and analysed. The parameter analysed included ph, conductivity, total dissolved solid, total hardness, calcium, magnesium, chloride,, sodium etc. The analysis was carried out to know range of the parameters contained in rain water and compare with the standards recommended by various agencies. The data generated by analysis of water samples are shown below.

Data on analysis of water samples

Sl. No.	Parameters	Spot No. 1	Spot No.2	Spot No.3	Spot No.4	Spot No.5	Spot No.6	Spot No.7	Drinking water standard recommended by		
									WHO	ICMR	PHE Committee Govt. of India
1	P ^h	7.4	7.3	6.8	7.02	7.32	7.50	7.41	7 to 8.5	7 to 8.5	7 to 8.5
2	Conductivity (Micromhos / cm)	636	833	781	482	60	60	50			
3	TDS (mg/l)	144	206	202	107	---	---	---	500	500	500
4	Hardness as CaCO ₃ (mg/l)	32	30	10	90	16	32	28	100	300	300
5	Calcium (mg/l)	17	16	6	46	2.41	6.42	6.42	75	75	75
6	Magnesium (mg/l)	15	14	4	44	2.44	3.9	2.92	30	50	50
7	Chloride (mg/l)	4.26	4.26	2.84	852	17.04	17.04	15.62	200	250	200
8	Sodium (mg/l)	1	1	1	10	--	--	--			

10 Technical Back-Up Support & Linkages with nearby institutions

- i) Regional Research Laboratory (RRL), CSIR, Jorhat, Assam provides technical guidance and related literature from time to time as and when required.
- ii) The Manipur Building Centre, Imphal provides full co-operation and also shared expertise.

11 SCIENCE AND TECHNOLOGY COMPONENT

- i) Introduction and fabrication of ferro cement water tank at 15 select sites
- ii) Giving training to the interested masons and engineers about techniques of fabrication and construction of ferro-cement water storage tanks.
- iii) Giving awareness to the public that ferro-cement tanks are cost effective, durable and easy maintenance comparative to other water storage devices.

12. PEOPLES PARTICIPATION :

The Council received good response from various communities in implementing the programme. Interested local masons and engineers living nearby the construction site sometimes visited the sites to see and learn the techniques of making ferro-cement tanks. Where ever the project team goes for work, the local clubs/community centres /developmental organizations at local level / Village authorities/ people of the surrounding area provided local support by providing available rooms free of cost for stay of the project staffs (engineer, masons and helpers) during the construction period.

13. PROGRESS INDICATORS

i) No. of rain water harvesting structures constructed and installed.

(Altogether 15 structures have been fabricated and installed in select places covering all the districts of the state)

ii) Trainings organized

(Two awareness programmes / trainings on rain water harvesting were organized in two years and altogether 46 persons have been benefited from the training)

14. WORKS TO BE DONE .

The activities proposed in the original proposal have been successfully performed and objectives proposed in the original proposal have been fulfilled. Hence no work is left.

15. SPECIAL FEATURES / HIGHLIGHTS

Since the project was first of its kind so far implemented by this Council in this region, encouragement was received from various state organizations including technical departments like Manipur Building Centers, PDA etc. Perhaps, the introduction of ferro-cement tanks of 5000 liters capacity for storage of rain water seem quite impressive to the people. Interested individuals as well as NGOs visited the fabrication sites when work was in progress and inquired of the cost effectiveness, durability and maintenance cost etc. as compared to other water storage structures. Sometimes it so happened that local brick masons and engineering students came to the site and helped the project team by curiosity of learning the construction techniques. Interaction with the people living specially in the hills has revealed that in order to solve the problems faced by them due to

water scarcity for domestic use in the hills, rain water harvesting would be the only alternative to be taken up as house hold programme. They further suggested to MASTEC to further implement a house to house rain water harvesting programme by selecting a tribal village as a model village so that the concept of it may spread to the neighboring villages.

During the course of implementation of the project, visitors had shown interest to construct ferro cement tanks for private people with the cost of expenditure to be borne by the interested individuals. However, as it was beyond the purview of the objectives, it was not done. Instead, they have been suggested to engage those masons who had already undergone training organized by this Council.

16. EQUIPMENTS PROCURRED: Drinking Water Testing Kit

17. STAFF SANCTIONED (and filled in): Staff Position

i)	Project Engineer	One
ii)	Field Assistant	One
iii)	Skilled Masons	Two
iv)	Helper	One

18. **Conclusions / Summary**

The following conclusions have been observed from implementing the **Pilot Project on Rain Water Harvesting** in Manipur supported by DST, GoI., New Delhi.

- i) The region received adequate amount of rainfall. There is need to introduce rain water harvesting programmes as an alternative to provide a solution to scarcity of water for domestic and drinking purposes in the region.
- ii) Fifteen number of rain water harvesting structures have been fabricated and installed at various select places (Temples/church/community halls/ Schools/Youth Centre (Club)/ Hospitals) covering all the districts including hills in the State. This has fulfilled the objectives of introduction of ferro cement tanks for storage of rain water and installation at different places as proposed in the original project proposal.
- iii) Week long Training programmes for the target participants of engineers, masons, representatives of NGOs, interested individuals etc. on Rain Water Harvesting with emphasis on construction of ferro-cement tanks for storage of rain

water have been organized two times as partial fulfillment of popularization of rain water harvesting in the region. Altogether 46 participants have been trained. The participants were really benefited that they could fabricate various types of ferro cement tanks of different capacities during the hands on practical of the training.

- iv) Analysis of rain water samples collected from different places has shown that the quality of the water is within the permissible standard as compared to the standards given by WHO, ICMR.
- v) The hill tribal get water for drinking from available springs or streams in the hills. However, interaction with them has come across that they find it difficult to get water for drinking during lean season when the springs are dry. They go a long distance down the slopes to get some water from streams or rivers. The hill districts are required to have more number of structures of rain water harvesting.
- vi) Research on identification of appropriate technologies of rain water harvesting is suggested to be taken up for further adoption in the hill districts.
- vii) It was suggested by some sections of the community that MASTEC should implement a rain water harvesting programme particularly in a selected tribal village in the hill and installing structures in all the suitable houses as a model rain water harvesting village so that the concept of it will be spread to other neighboring areas and interested persons might adopt it.
- viii) Considering the experience gained from implementing the two years project on Rain water harvesting and also interaction with peoples at various levels, it was observed that bigger schemes on rain water harvesting should be implemented in the region. Further, it is suggested that the State should have a state policy that all the new houses / buildings under Govt. or private should have a provision for roof top rain water harvesting.
- ix) While survey was conducted at various places for identification of feasible sites for installation of structures, it has been observed that villagers and hill tribes are ignorant of health and sanitation importance. Hence, it is suggested to organise

awareness programmes in all the districts on drinking water for better health care for the people living in the rural areas and hills.

- x) As part of project monitoring activities, the PI has visited all the sites where the rain water harvesting structures have been installed for monitoring the performance of the structures and it was found that the ferro –cement water storage tanks were in good health and showed satisfactory result. However, some hairline cracks were found developed on the outside wall surface of the tanks which invited minor repairing. But it did not create any problems such as leakages of water etc. The ferro cement tanks may be encouraged in the region of Manipur for storage of rain water as it is cost effective comparative to other water storage devices.

(Signature of the P I)

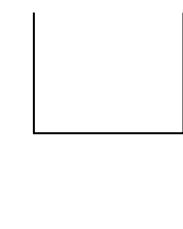
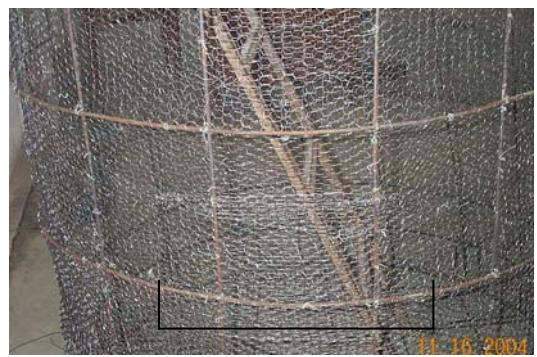
Technical details for construction of 5000 litres

Mild Steel (8 mm Bar)

$$B_1 = 1.66 + 0.15 + 0.15 = 1.96 \text{ m} \quad (4 \text{ Nos.})$$

$$\begin{aligned} B_2 &= 1.505 + 0.15 + 0.15 = 1.805 \text{ m} \quad (4 \text{ Nos.}) \\ B_3 &= 1.2 + 0.15 + 0.15 = 1.5 \text{ m} \quad (4 \text{ Nos.}) \end{aligned}$$

$$\begin{aligned} 6\text{mm bar} \quad B &= 1.735 + 2.2 + 2.2 = 6.135 \quad (2 \text{ Nos.}) \\ VB &= 2.2 + 0.20 = 2.4 \text{ m} \quad (20 \text{ Nos.}) \end{aligned}$$



Ring

L R1 = 2.084 m (2 Nos.)
L R2 = 3.196 m
 $L R^1_2$ = 4.3 m
L R3 = 5.538 m (2 Nos)
L R4 = 5.648 m (10 Nos)

(Lid)

L RF1 = 2.35 m
LRF2 = 2.30 m
LRF3 = 1.07 m

Radial

RR = 0.91 m (8 Nos.)
RB1 = 0.87 m (2 Nos)
RB2 = 0.54 m (4 Nos)

—

