2007-08

Field Training Report

Report submitted to-

Superintending Engineer,

Ghatghar Hydropower Project,
Kalwa, Dist: Thane
(17/03/2008-21/03/2008)

Chapter 1 Introduction

Ghatghar Hydroelectric Project

Water Resources Department, Government of Maharashtra (India)

1.1 About Project

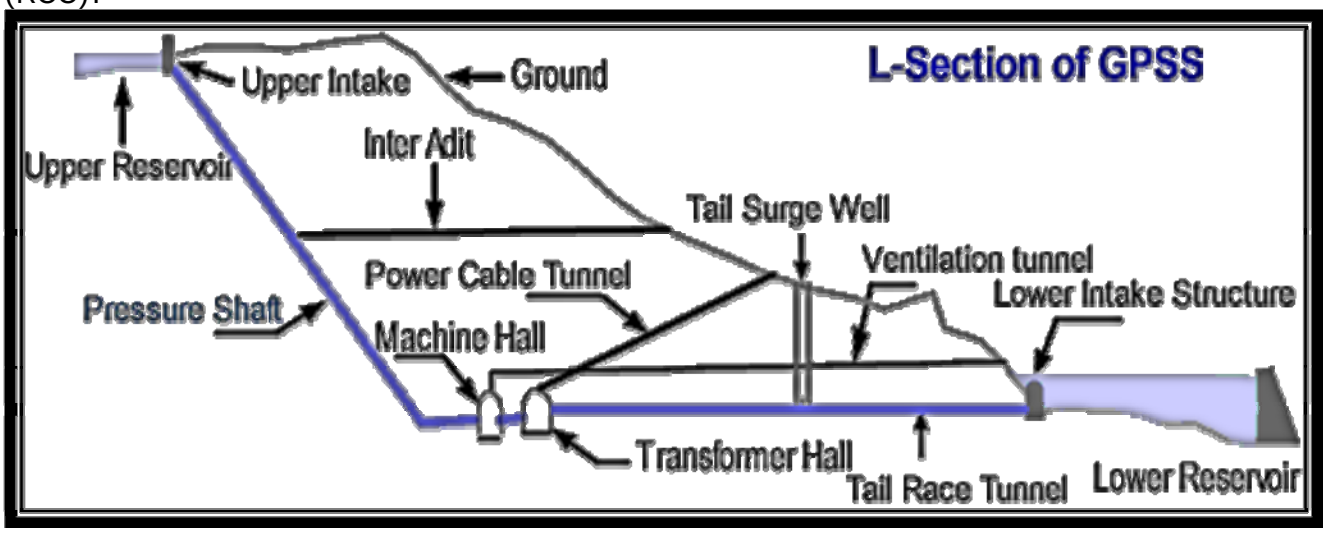
The scheme involves recycling of water between the Upper reservoir & lower reservoir and is the first major dam construction in India to use fly ash as a major constituent. It is the largest pumped storage scheme in the state. The scheme envisages 1.5 MUs of daily power generation during peak hours of demand & pumping of water from lower reservior to upper reservoir during off-peak hours.

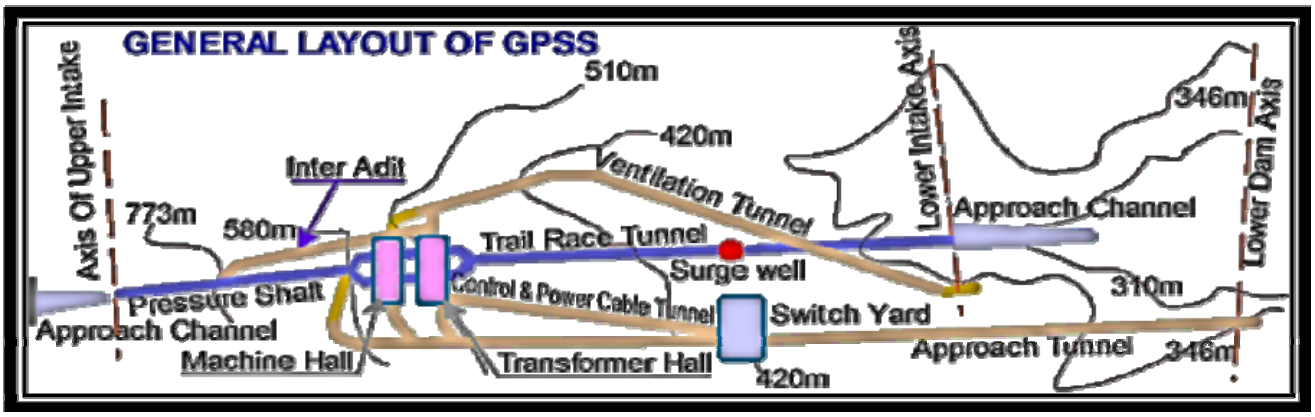
Ghatghar Hydroelectric Project is located on river Pravara on the boundary of Thane and Ahemadnagar districts in Maharashtra state (India). Increased demand for electricity due to industrial growth & population in Maharashtra has led to an increase in hydro power projects. Installation capacity of Ghatghar Hydroelectric Project is 250 MW. This Pumped Storage scheme comprises construction of two reservoirs i.e. Upper reservoir near village Ghatghar, Taluka Akole, District Ahmednagar and Lower reservoir near village Chonde Taluka Shahapur, District Thane. The water conductor system with underground Power House is located near Lower Dam Site i.e. near village Chondhe. Two units of reversible pump turbines, each of 125 MW capacity, are installed in an underground Power House. The scheme envisages annual generation of 497 Mus.

The scheme involves recycling of water between the Upper reservoir & lower reservoir with a head of 400 m. The scheme is intended to be operated on weekly cycle with generation for six hours daily during peak hours of demand except Sunday & Pumping for seven hours during off-peak hours from Monday to Saturday & balance on Sunday.

1.2 L-Section of GPSS

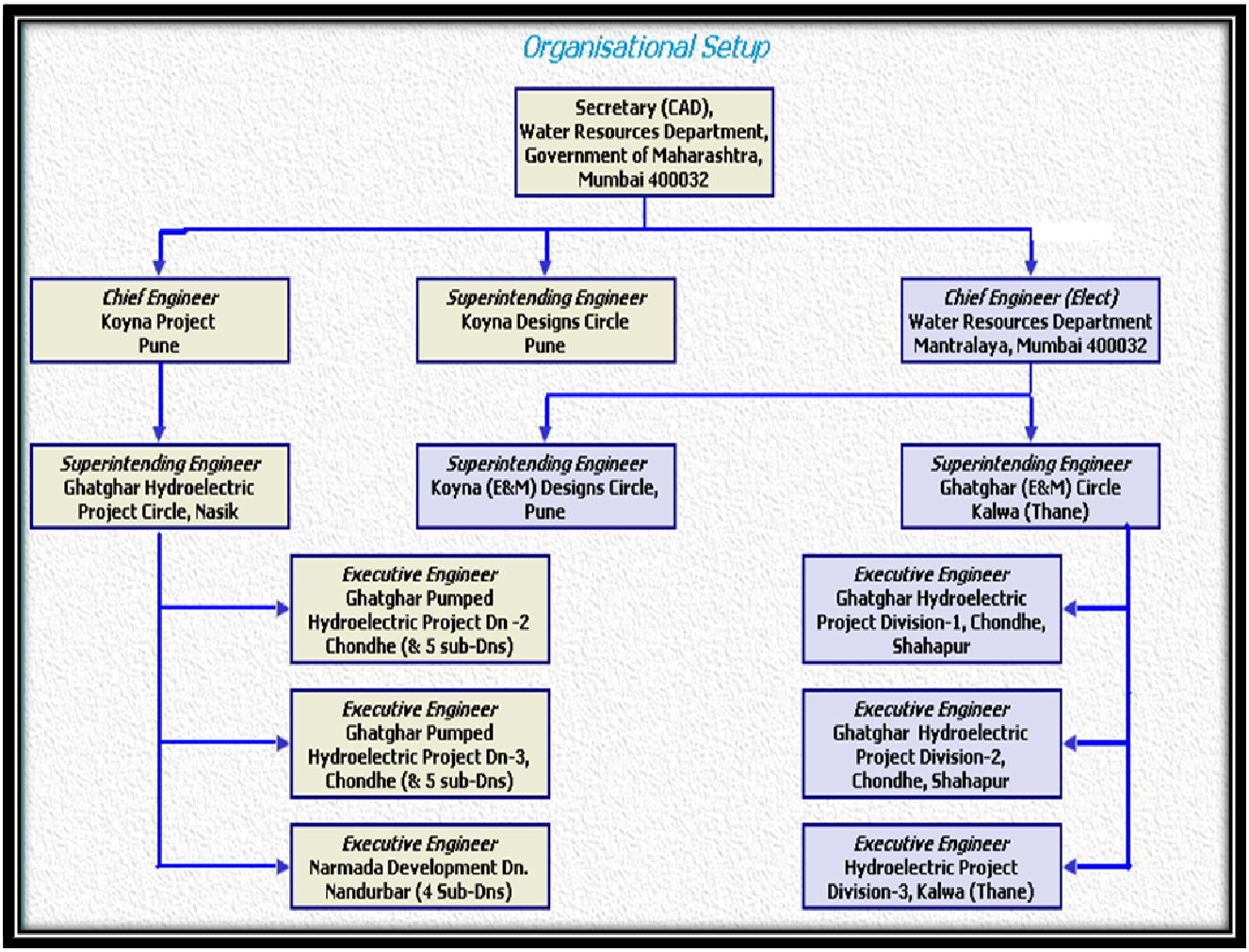
The new technique viz. Roller Compacted Concrete is used first time for large dam construction in India. Both the dams are constructed using Roller Compacted Concrete (RCC).





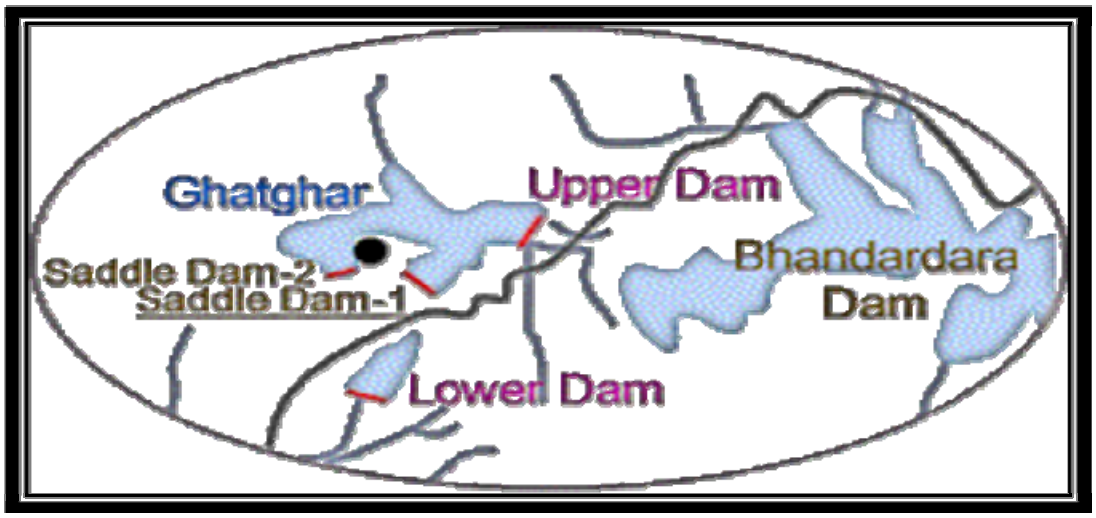
1.3 Organization Chart

The organization chart of the Ghatghar Hydroelectric project is presented below-



1.4 Location of GHP

Power House & Lower Dam of Ghatghar Pumped Storage Scheme is situated near village Chondhe Taluka Shahapur, District Thane. Upper Dam is situated near village Ghatghar Taluka Akole, Dictrict Ahmednagar.

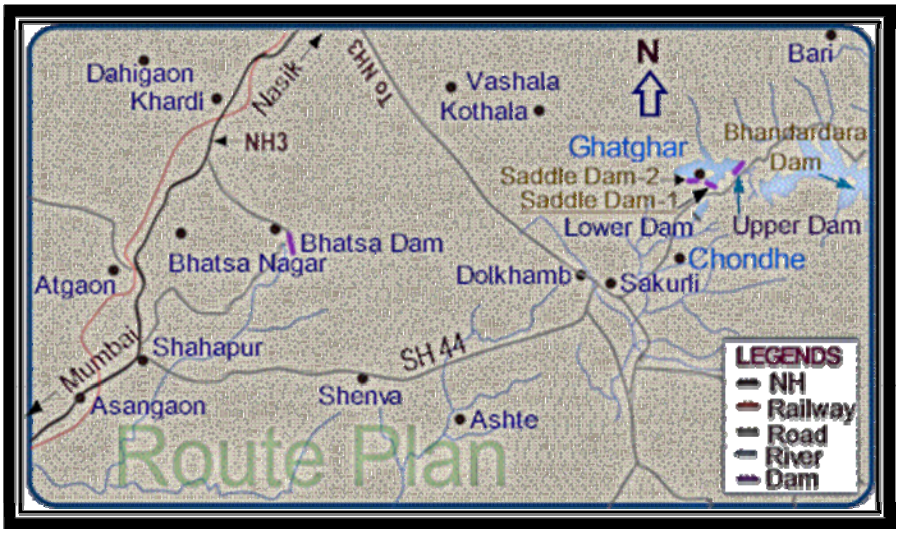


1.5 Lower Dam &Project Site:

Lower Dam is located on Shai nalla near Chondhe village of Shahapur Tahasil in Thane District. Constructed in RCC (Roller Compacted Concrete). Maximum Height of the dam above deepest foundation level is 86.14 m and length of the dam is 446.80 m. Storage capacity of the dam is 3.21 MCum. Stepped spillway having designed discharge 192.38 m3/sec & length 89m.

Distance from :

- Shahapur : 42 Km
- Mumbai : 80 Km
- Nearest Railhead : Asangaon
- Nearest Airport : Mumbai (126 Km)
- Nearest Seaport : Mumbai (80 Km)
- Approach Road : SH No. 44.



1.6 Upper Dam

Upper Dam is located on River Pravara near village Ghatghar of Akola Tahsil in Ahemadnagar District. The gross storage capacity of the dam is 5.82 MCum. Maximum height of the dam above deepest foundation level is 15.165 m and length is 503 m. Constructed in RCC (Roller Compacted Concrete). Ogee type Spillway having designed discharge of 837 m3/sec & length of 70.80 m.

1.7 Highlights

1. The Administrative Approval to the project was accorded by the Government of Maharashtra for the estimated cost of Rs.179.61 Crores in June-1988 at the price level (87-88). Second Revised Administrative Approval has been accorded for Rs.1184.60 Crores at 2001-2002 price level. Third Revised Estimate is submitted to the Govt.
2. The loan assistance of 11414 JY Million (Rs.442 Crores) from JBIC, Japan (Earlier called as OECF) was available upto Jan-2003. The loan has been fully utilised upto Jan-2003. The loan of Rs.400 Crores for balance was sanctioned by Power Finance Corporation (PFC), New Delhi in March-2004. Loan agreement was upto 31-3-2007. Reimbursement of Rs.375.51 Crores has been received from PFC upto March-2007.
3. M/s EPDC, Japan has been appointed as consultant for RCC dams. The agreement with EPDC was signed by GOMID on 12-6-1998. Also Dr. Malcolm Dunstan, RCC consultant(UK) was appointed to give expert guidance during the construction of RCC dam. Accordingly, under his valuable guidance, the works of all 3 RCC Dams are completed.
4. Contract amounting to Rs.63.89 Crores for Power House Complex, Pressure Shaft, Upper Intake and Cable Tunnel was awarded to Patel Engineering Ltd. Mumbai. Joint venture with PES in May-2000 with contract period of 48 months. The work is completed.
5. The contract amounting to Rs.200 Crores, for three RCC dams viz. Saddle Dam No.1, Upper Dam & Lower Dam has been awarded to Patel Engineering Ltd., Mumbai in Nov-2001 and work is completed.
6. The construction of 86 m. high Roller Compacted Concrete (RCC) Lower Dam using Fly-ash with cementitious material is the main feature of the project. And this type of construction is first time in India. The works of Saddle Dam, Upper Dam and Lower Dam are completed. Work of conventional concrete of Spillway concrete, bridge, railing etc are also completed.
7. High Power Committee (H.P.C) is constituted by the Govt. for timely completion of OECF, Japan (Now JBIC) assisted project.In this year one meeting of H.P.C. was held on 21-8-2006. Panel of Experts (PoE) is constituted to give advice in respect of preparation of detailed tender papers, technical specifications and bidding drawings and to conduct periodical independent reviews during construction of the project and also in order to assess whether there is a need for changes in the design or in the construction and quality control methods or procedures.
8. The part of the village Ghatghar is affected due to the construction of Upper Dam. 22 houses are submerged and 154 houses surrounded by reservoir. The rehabilitation is completed.
9. GOMWRD has specially accorded approval to the appointment of PAPs who are rendered landless and lost the means of livelihood on daily rated establishment on project work. Thus 67 Project affected persons (PAPs) on daily wages and 47 PAPs on regular temporary establishment are appointed on project.
10. Third Revised Estimate amounting Rs.1564.01 Crores is submitted to GoM vide Chief Engineer (E), Hydro Project, WRD, Mumbai's letter No.1004 dt.21-4-2007 for Administrative approval.

1.8 Clearance Details

The status of various clearances is as under.

1. **Environmental Clearance :**
   Ministry of Environment and Forests, Govt. of India, New Delhi has cleared the project in June-1985 vide their letter No.J-11015/1/04/KNU.5 dtd.1-6-1985.
2. **Forest Clearance :**
   Ministry of Environment and Forests, Government of India, New Delhi has cleared the project in May-1992 vide their letter No./8-47/ 90.F.C. dt.7th May-1992.
3. **Clearance from Planning Commission :**

First Clearance: In Dec-1997 by Central Electricity Authority and in Aug- 1992 by Planning Commission Govt. of India.

Second Clearance: In Nov-1993 by CEA and in August-1994 by Planning Commission Government of India.

4. **Clearance under Wild Life (Protection) Act. 1972 Amendment 1991 :**
   The Project area of upper portion has been cleared from the Kalsubai Harishchandragad wild life sanctuary on 17th April 1997.
5. **Application of provisions of Rehabilitation Act :**
   The provisions of the Maharashtra Project Affected Persons Rehabilitation Act 1986 were applied in Dec-1994 by Government of Maharashtra, Water Resources Department.

1.9 Administrative Approval (A/A) :

Sr. No.	Particulars	Estimated Cost as per A/A (Rs. Crores)	Price level	Reference (Govt. letter No.)
1	Original A/A	179.61	1986-1987	HEP-1087/(93/87) HP Dtd.21-6-1988
2	Revised A/A	554.26	1991-1992	GTR-1092 (364/92) Dtd.18-2-1994
3	2nd Revised A/A	1184.60	1999-2000	GTR No. Ghatghar 198/SA55/(35/98)/MP-1 Dtd.19-03-2002.
4	3rd Revised (Estimate Submitted)	1564.01	2006-2007	Submitted to GOM, WRD vide C.E.(E), Hydro Project, Mumbai's letter No.1004 dtd.21-4-2007

Chapter 2 Main Components of the Project :

2.1 Main Components of the Project :

The Main Civil Components of the Scheme are-

- Upper Dam,
- Saddle Dam-I,
- Upper Intake Approach Channel,
- Upper Intake Structure,
- Pressure Shaft,
- Underground Power House Complex,
- Tail Race Tunnel,
- Tail Surge Well,
- Lower Intake Structure,
- Lower Intake Approach Channel,
- Lower Reservoir

2.2 Dam

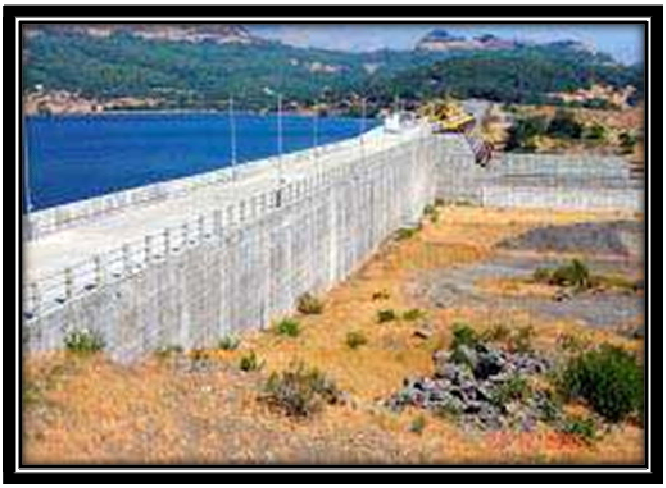
Two reservoirs are spaced apart approximately by 1.5 Km and separated in levation by 400m. For the speedy construction, the Upper Dam and Lower Dam are constructed with new technology called Roller Compacted Concrete (RCC). Also work of Saddle Dame No.1 is done in RCC. The main features of Upper and Lower Dam are as given below.

Dam	Height (m)	Length (m)	RCC Qty.(m^3)
Saddle Dam-	11.5	286	14500
Upper Dam	15.16	503	40000
Lower Dam	86.14	446.80	643000

2.3 Upper Reservoir

The work of Saddle Dam-1 & 2 and Upper Dam is already completed in May 2003 and June 2005 respectively.

Saddle Dam No. 1



Upper Dam

2.4 Upper Intake Structure

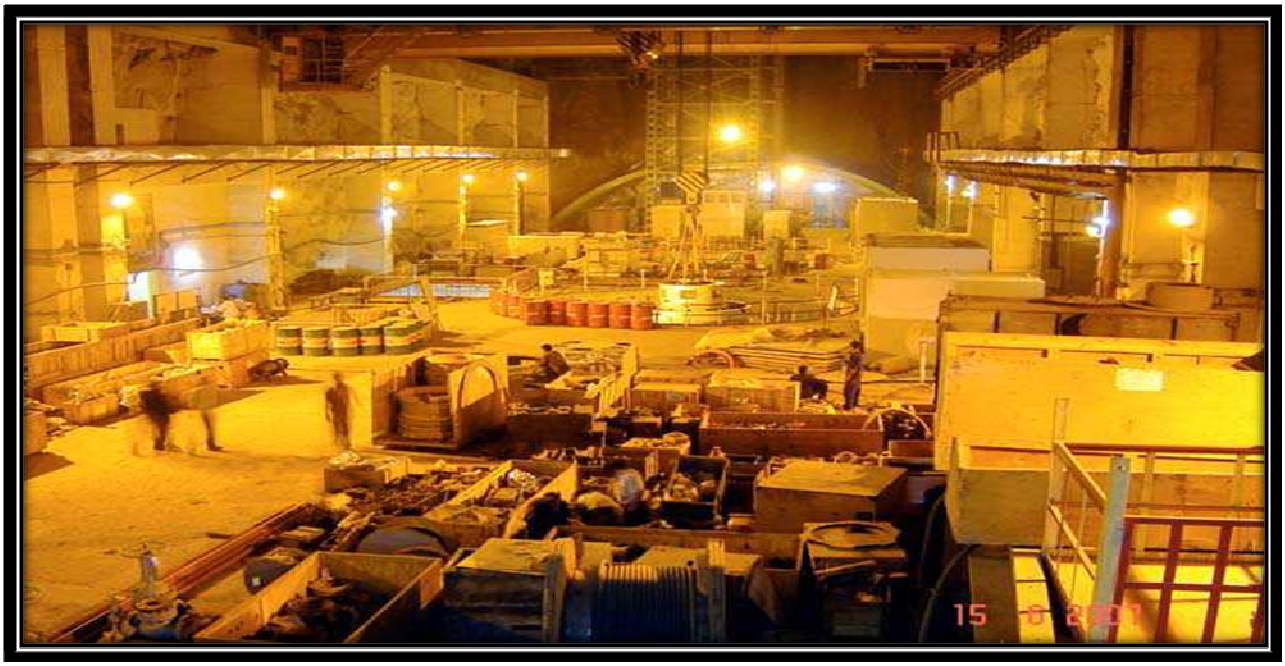
Work includes lowering of emergency gate trash racks, with hoisting structure. The works are completed in all respect (May-2005) except bulk head removal.

2.5 Power House Complex :

The power house complex of this project comprises two caverns to accommodate two turbine generator units and two three phase transformers respectively. The machine hall is 123.40 mVlong, 23.4 m wide & 47 m high cavern housing two 125 MW turbine - generator units i.e.Vreversible turbines. While the transformer hall cavern is 81.35 m long, 20 m wide & 30 mVhigh having two 220 KVA transformers. Both the caverns are parallel to each other & separated by a 40 m wide rock pillar.1 11.5 286 14500 Upper Dam 15.16 503 40000 Lower Dam 86.14 446.80 643000

2.6 Machine Hall

(Length = 82, Width = 23.40, Height = 23.40)

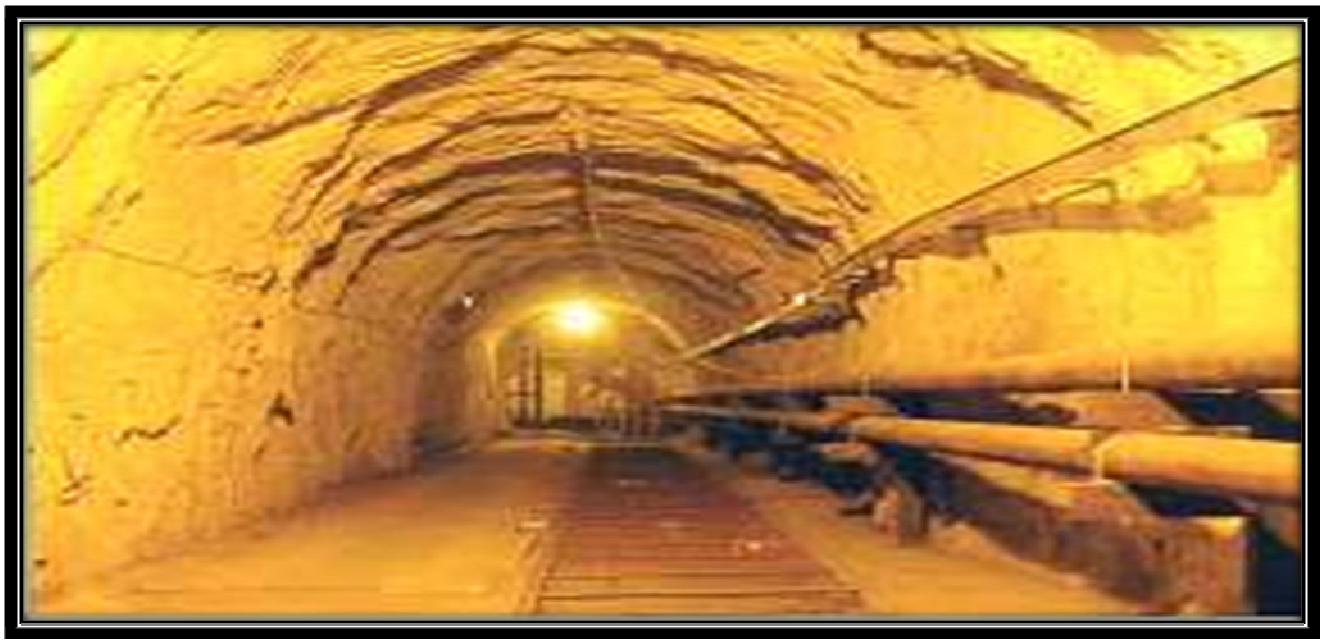


2.7 Auxiliary Blocks

Power House Complex is having two auxiliary blocks on either ends of machine hall.The auxiliary block No.1 is located on service bay side having size 29 x 22.20 x 23.80 m. The auxiliary block No.2 is located on V.T. side of size 19.475 x 23.40 x 24.80 m. excluding sump pit.

2.8 Other Passages

The Power House Complex is having various passages such as cable passage, bus duct 1 & 2, emergency passage joining transformer hall and machine hall. All the Civil activities are completed in respect of connecting Tunnels @ EL 273.80m.



2.9 Transformer Hall

The Transformer Hall is having length of 81.35 m and width 20m. The height of transformer hall is 26 m from service bay level. All Civil works are completed. E & M has proposed installation of air handling unit to Transformer Hall, Service bay and the work is completed on 25-3-2007.

2.10 Tail Race Tunnel

The length of Tail Race Tunnel is 590 m, & having diameter 6.00 m in circular shape and is concrete lined. Works of TRT including lining, construction of 2 concrete plugs at the Junction of Link Tunnels and Tail Surge Well is completed (June-2006). UCR masonary plug removal & cleaning of TRT is completed.

2.11 Tail Surge Well : (Depth - 137 m, Dia - 11.0 m)

Work is completed. The work of RCC frame of Hoist Structure is completed and 20 T capacity EOT crane is erected over surge well.

2.12 Lower Intake Structure

All the works including lower intake approach bridge, lowering of trash rack, lowering of emergency gate, construction of RCC hoist structure for Lower Intake Gate and erection of hoist are completed. (June-2005) Lower Intake Approach Bridge including lowering of emergency gate, lowering of trash racks are completed.

2.13 Cable Tunnel

The cable tunnel of the power house complex is single 4m dia, 384.50 m long tunnel starting from transformer hall and emerging out in over ground Switch yard. The Civil works of Cable Tunnel are completed. (Nov-2004)

2.14 Switch Yard

The work of Plot development, Colgrout Masonry retaining wall & Civil work pertaining to GIS Room, Control Room & D.G. set buildings development of area in switchyard premises are completed.

2.15 Lower Dam

The work of RCC placement of Lower Dam is completed on 8-6-2006. Balance work of overflow portion of dam above RL 336.30 m is completed.

Water Conductor System :

Water Conductor System :The water conductor system consist of Upper Intake Structure, a steel lined pressure shaft of 696 m in length and dia 4.25 to 3.5 m, Tail Race Tunnel 590 m in length, and Lower Intake Structure at the end of Tail Race Tunnel. Tail surge well of 11 m. dia. and 137 m depth is provided on TRT.

Emergency gates are provided at upper as well as Lower Intake Structure. The emergency gate at Lower Intake is of size 5.27 x 9.25 m & weighting 110 T, provided with electrically operated hoist, totally fabricated & erected by the Mechanical wing of Water Resources Dept, Govt. of Maharashtra.

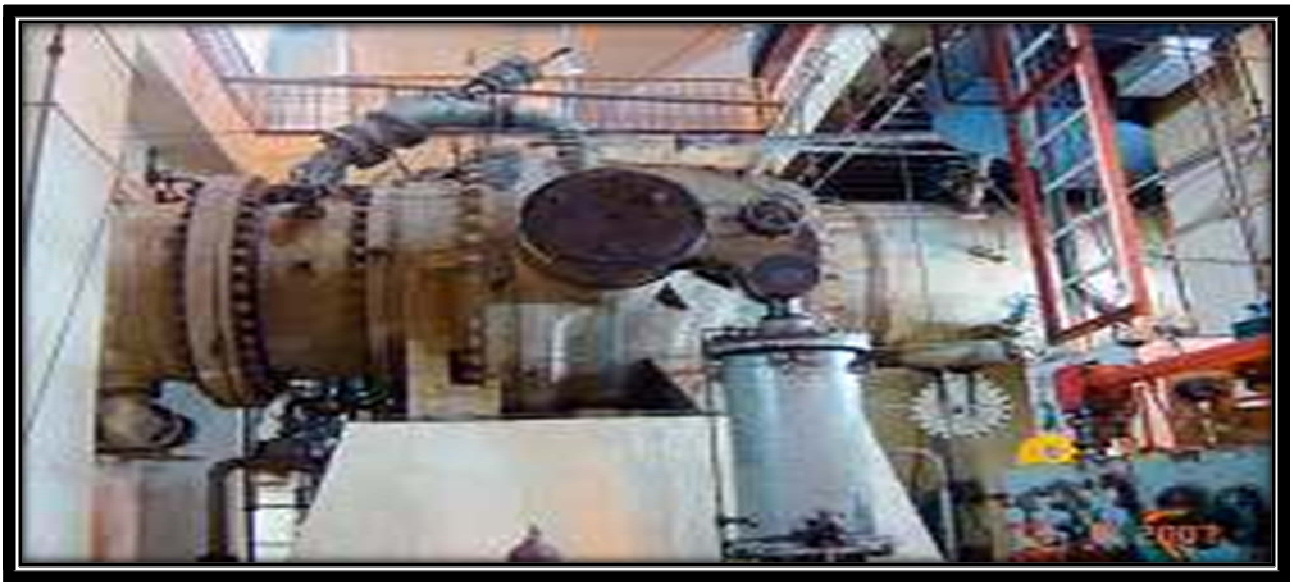
Turbine Unit

Installation of guide vanes, guide vane operating mechanism, G.V. servomotors, turbine guide bearing & Turbine shaft, runner shaft seal assembly is completed. Oil piping & instrumentation work is in progress. Pre-commissioning testing of governor oil system is completed.

Butterfly Valve:- The T.R.T. draining work and installation of BFV OPU unit (power pack) is completed. B.F.V. servomotor installation work is completed. Work of operational checks of B F V is completed.

Main Inlet Valve:- Installation of MIV servomotor OPU and its connection with MIV is completed. Installation of MIV control panel and oil piping is completed. Operational checks of MIV are completed.

Motor Control Panels (MCC):- Installations of MCC's of air compressor system, Head cover drainage pump, cooling water booster pump, cooling water strainers, drain pump, cooling water system, sand separator. Shaft seal and governor control panel is completed.



Generator Unit

a. Installation of lower bracket, stator and upper bracket, upper thrust & guide bearing, Air coolers; rotor lower guide bearing, brake jacks, brake dust collector, space heaters, slip ring brush gear assembly & shaft current CT is completed.
b. Combined alignment of Turbine- Generator shaft coupling is completed.
c. Installation of oil cooler and it's piping work for lower guide bearing & upper guide bearing is in progress. Installation of H.P. lubricating pump and its piping work is completed.

d. Installation of Motor control panels of lubricating oil system, NG cubicle, AVR, PRS is completed.
e. Laying of control & power cables from local control panels to unit control room & from unit control room to control room in switchyard is completed. Cable termination work is almost completed. Cable connection checking/testing by Fuji supervisor is in progress. Erection of Bus duct & IPB cubicles is in progress.
f. Installation of unit compressor & dry test are completed.

Auxiliaries :

a. Dismantling and overhauling of all D & D pumps completed. D & D control panel installed and two D & D pump is commissioned. Commissioning of other D & D pumps is in progress.

Machine Hall D & D Pumps

Machine Hall ACLT Floor

b. 400 Volts ACLT new panels installed and internal wiring is completed. SA-I & SA-II panels are charged.
c. Station Auxiliary supply transformers (2 Nos.), Unit Auxiliary supply transformers (2 Nos.) are installed, Testing and commissioning of one S.A.T. is completed. SAT-I & SAT-II are charged.
d. Installation of 110 Volts D.C. batteries and battery charger 3 Nos. are completed. 110 V D.C. supply made available at switchyard from the charger.

Power and Control Cable :

Installation of cable racks, trays is completed in machine hall, transformer hall, and cable tunnel & cable trenches. Installation of power & control cables is almost completed cable termination work at various equipment is in progress.

Chapter 3 Salient Features

3.1 Location

State	Maharashtra	
Region	Western Maharashtra	
	Upper Dam	***Lower Dam***
Village	Ghatghar	Chondhe
Tahsil	Akola	Shahapur
District	Ahmednagar	Thane
River	Pravara	Shai Nalla

3.2 Water Utilization

1	**Daily water utilization for power generation**	**1.607 mm^3**
2	Design discharge	74.80 m^3/sec
3	Water required for weekly generation	2.346 mm^3

3.3 Reservoir Data

		Upper Storage	***Lower Storage***
1.	Catchment area (Km^2)	18.43	2.5
2.	***Storage (mm^3)***		
	i. Dead Storage	0.68	0.48
	ii. Live Storage	5.14	2.73
	iii. Gross Storage	5.82	3.21

3.4 Dam And Appurtenant Works

	Upper Dam	***Lower Dam***
Type	Roller Compacted Concrete (RCC)	
Free board above MWL	1.25 m	1.00 m
Maximum height of the dam	15.165m	86.14 m
Length of Dam	503.00 m	446.80 m

3.5 Spillway

1. Type	**Ogee**	**Stepped (Ungated)**
2. Design discharge	837 m^3/Sec.	192.38 m^3/Sec.
3. Length	70.80 m	89.00 m.

3.6 Upper Intake

i.	**Type**	**Open R.C.C. Structure**
ii.	Trash Rack	10 Nos. (5 / Bay)
iii.	Service Gate	3.90 m x 7.27 m

3.7. Lower Intake

i.	**Type**	**Open R.C.C. Structure**
Ii	Trash Rack	10 Nos.(5/Bay)
iii.	Service Gate	5.27 m x 9.25 m

3.8. Upper Intake Approach Channel

i.	**Design Discharge**	**80 m^3/Sec.**
ii.	Bed Width	11.00 m
iii.	F.S.D.	2.05 m
iv.	Length	705 m

3.9 Pressure Shaft

i.	**Properties**	**Single, steel lined, Bifurcated in two limbs**
ii.	Length	696 m.
iii.	Diameter	4.25 m at the intake and tapering to 2.00 m,
iv.	Inter Adit	'D; Shaped 7m wide, 409 m long.

3.10 Power House

i.	**Type**	**Underground**
ii.	Installation proposed	250 MW (2 x 125 MW)
iii.	Machine Hall (Auxiliary Block)	123.00 m x 23.40 m x 46.80 m
iv.	Transformer Hall	81.35 m x 20.00 m x 26.00 m

3.11 Tail Race Tunnel

i.	**Length**	**590 m**
ii.	Shape	Circular, Lined
iii.	Diameter	6.00 m

3.12 Approach Tunnel

I	**Shape**	**'D' shaped**
Ii	Size	7.00 m x 7.00 m
Iii	Length	1295 m

3.13 Ventilation Tunnel

i.	**Length**	**728 m**
ii.	Width	6.0 m
ii.	Shape	D

3.14. Electrical And Mechanical Equipment

1.0 Pump Turbine :		
Type	Vertical shaft single runner single stage Francis type	
Number of Units	Two	
Elevation of pump-turbine center	260.00 m	
Design Head (Turbine Mode)	410 m	
Design discharge (Turbine Mode)	37.40 m^3/Sec	
Design Head (Pump Mode)	430 m	
Design discharge (Pump Mode)	30.40 m^3/Sec	
Rated Speed	500 rpm	
Direction of rotation	Clockwise (Turbine Mode)	
Spiral case	Welded steel construction	
Design pressure	68 Kgf/cm^2	
Inlet diameter	1800 mm	
Inlet center line offset	3670 mm	
Runner	Francis type	
No. of runner vane	7	
Inlet diameter	3468 mm	
Outlet diameter	1730 mm	
2.0 Generator-Motor :	Generator	Motor
Output	147 MVA	150 MW
Voltage	13.8 KV	13.8 KV
Current	6150 A	6380 A
Frequency	50 Hz	50 Hz
Power factor	0.9	1.0
Speed	500 rpm	500 rpm
Direction of rotation	Clockwise	Counter clockwise
Daily hours generation	6 Hours (Except Sunday)	
Daily pumping hours	7 Hours (balance on Sunday)	
Energy generated	9.57 MUs/ week (497.43 MUS / year)	
Energy required for pumping	12.41 MUs / weekly (645.37 MUs / year)	

Chapter 4 Special Features

4.1 DESIGN

Having started in 1994, the Ghatagr Dams Project, due for completion in 2005, is the first major dam construction in India to use fly ash as a major constituent.

Funded by the Overseas Economic Cooperation Fund (OECF) of Japan, the £40 million Ghatghar Pumped Storage Scheme is also the first of its kind in the Maharashtra State being undertaken by the State Government's Irrigation Department.

The scheme involves the construction of two reservoirs. Both upper and lower reservoirs are constructed in Roller Compacted Concrete (RCC). This is the first time this method has been used in India. The water transmission system consists of an approach channel, intake structure and a pressure shaft that will take the water to the underground turbine house to feed two reversible units. The tailrace discharge from the turbine house is taken through the common tailrace tunnel to the lower pond

4.2 CONSTRUCTION

- The principal contractor for the overall programme is Japan's Nissho Iwai Corp, with Japanese engineering company, J-Power, providing project management throughout. J-Power also provided consultancy in 1994 prior to the construction phase, which started in 1995.
- The main contractor for the roller compacted concrete dam work is Patel Engineering Ltd of Jogeshwari, Bombay. The use of fly ash is being regarded as an innovative approach to the roller compacted concrete method of construction.
- Dirk India Ltd is supplying more than 80,000t of Pozzocrete to the project. As part of the agreement with Dirk India, civil engineers, Patel Engineering has agreed to use Pozzocrete on any other relevant projects for a five-year period until 2007.
- A downstream vertical shaft of 130m with an 11m diameter had to be excavated near the lower reservoir. Initially it was decided to sink the shaft with conventional blasting methods but due to the time this was taking and the risk to personnel it was decided to excavate a pilot shaft so as to accomplish the final widening by slashing.
- The Central Mining Research Institute (CMRI) in Nagpur designed the blasting method for the excavation of the 122m-deep pilot shaft, which was carried out by contractor R.J. Shah and Co from Bombay. The excavation was carried out by long hole raise blasting. The drilling was carried out using a Wagon drill. Long hole raise blasting is considered one of the most economic vertical shaft methods. It is safe and does not involve cumbersome procedures. It does, however, require a meticulous drilling and blasting strategy. In the Ghataghar vertical shaft, the final 85m was blasted in only 20 days.
- Fuji Electric is supplying two 125MW vertical Francis pump-turbines along with a generator-motor and control equipment to the high head, large capacity pumped storage scheme. The two reversible pump turbine and generator motor units will be located in the underground powerhouse complex.
- Hyderabad-based Bharat Heavy Electricals Limited (BHEL) has tied up with Nissho Iwai Corporation and Fuji Electric to carry out the installation of the hydro power generating equipment.
- The Maharashtra Engineering Research Institue in Nashik carried out both physical and chemical tests on the Fly ash being used in the RCC Dams.
- A software package called CMRI_ROCK supplied by India's Central Mining Research Institute is being used to carry out strata control investigations.

4.3 Key Data

- ✓ Client : Government of Maharashtra Irrigation Department
- ✓ Main contractor : Nissho Iwai Corporation
- ✓ Project management : J-Power
- ✓ Dam contractor : Patel Engineering Ltd
- ✓ Pump-turbine supplier : Fuji Electric
- ✓ Generator-motor and control equipment supplier : Fuji Electric
- ✓ Penstock supplier : Indian Hume Pipe Co.
- ✓ Pumping station contractor : Bharat Heavy Electricals Limited
- ✓ Blasting consultant : Central Mining Research Institute
- ✓ Excavation contractor : R.J. Shah and Co
- ✓ Concrete supplier : Dirk India
- ✓ Strata control consultants : Central Mining Research Institute
- ✓ Strata control software : CMRI_Rock
- ✓ Fly ash composition testing : Maharashtra Engineering Research Institue
- ✓ Completion date : 2005
- ✓ Estimated cost : £40 million
- ✓ Dam type : RCC
- ✓ Overall capacity : 250MW
- ✓ Concrete type : Pozzocrete
- ✓ Concrete used : 80,000t
- ✓ Upper reservoir – catchment area : 18.43km²
- ✓ Upper reservoir –gross storage capacity : 5,870,000m³
- ✓ Upper reservoir – live storage area : 5,210,000m³
- ✓ Lower reservoir – catchment area : 2.5km²
- ✓ Lower reservoir –gross storage capacity : 3,800,000m³
- ✓ Lower reservoir – live storage area : 3,460,000m³
- ✓ Upper dam – type : RCC
- ✓ Upper dam - height : 14.5m
- ✓ Upper dam - crest length : 478m
- ✓ Lower dam - type : RCC
- ✓ Lower dam - height : 78m
- ✓ Lower dam - crest length : 390m
- ✓ Upper spillway - type : Ogee
- ✓ Upper spillway - capacity : 837m³/s
- ✓ Lower spillway - type : Ogee
- ✓ Lower spillway - capacity : 101m³/s
- ✓ Penstock type : Underground
- ✓ Penstock length : 700m
- ✓ Penstock diameter : 4.29m
- ✓ Powerhouse type : Underground
- ✓ Turbine type : Vertical reversible Francis pump turbine
- ✓ No of units : 2
- ✓ Turbine output : 125MW
- ✓ Turbine rated head : 430m
- ✓ Generator type : Vertical synchronous motor generator
- ✓ No of units : 2
- ✓ Generator output : 147MW

4.4 Use of FLY ASH

World over more than 100 dams have been constructed using RCC technology. In India too recently Fly Ash Utilisation Programme (FAUP) in association with Maharashtra Irrigation Department has successfully demonstrated the use of RCC technology for construction of upper and saddle dams at Ghatghar Pumped

Storage Scheme, Bhandardara, near Nasik. With the experience gained from these projects, many other dam projects are being now undertaken with RCC technology using high doses of fly ash in the country, including lower dam of about 90 Meters height at Ghatghar which is under construction

India is in growing need of Power & Water Resources with anticipated huge investment in this sector. In the current scenario Hydro power sector has assumed great significance. The hydroelectric capacity currently under operation in the country is about 26,000 MW and additional 16,083 MW is under various stages of development. 56 sites have been identified for pumped storage schemes with an anticipated aggregate installed capacity of 94,000 MW. In addition, a potential of 15,000 MW installed capacity is estimated for small, mini and micro hydel schemes. Similarly, in the Water Resources sector & Irrigation too several projects are in progress.

Fly ash is emerging as one of the most promising construction material in the Hydro power / water resources sector. Fly ash based Roller Compacted Concrete (RCC) has now gained world wide acceptance as an alternative to conventional concrete in dams. Fly ash can also be used gainfully in all concrete/mortar for construction of spillways, galleries, river training works, water conducting systems, tunnel linings, canal linings and the auxiliary structures (offices/housing complexes) of hydro power / water resource sector projects and also as a part replacement of cement for rehabilitation of hydraulic structures.

4.5 Quantity of Fly Ash used

- Study of suitability: MERI, Nasik.
- Source: NTPS Eklahare (Nasik)
- Grdae Size: 40 Grade.
- Source distance 104 Km for upper dam.
- Source distance 155 km for Lower Dam.

Quantity of Fly Ash used					
	Saddle Dam	Upper Dam	Lower Dam	Other Concrete	Total
RCC Qty. (cum)	14510	35776	637512	12,716	7,00,514
Fly Ash used (MT)	2150	5280	1,11,526	923	1,19,879

4.6 Milestones in RCC Dams Construction

- **Study in MERI regarding suitability of fly ash for RCC dam:**
- 1998 : Stage I : Trial mix programme at MERI ,Nasik
- Feb 2001 : Stage II : Trial mix programme at MERI ,Nasik
- Mar 2002 : Test section- 1, based on MERI mix
  - Purpose: Understanding methodology , sequence of operation and training the staff, gevr new procedure decided.
- Oct 2002 : Test section- 2, Mix used as field Laboratory.
- Dec 2002 : Stage - IIA
  - Trial mix worked out in consultation with RCC Consultant Malcom Dunston & Associates.Mix found suitable and decided to be adopted for saddle dam as full scale trial.
- Dec 2002 : Full scale trial.
  - For layers 1,2,3 with mix suggested by M D & A for saddle dam.
  - Objective of full scale trial was to investigate all construction procedure in particular joint treatment between the layer & training

of personnel who were supposed to execute work of Upper & Lower Dam.

- Mar 2003 : First trial (14200 cum for RCC saddle Dam)
  - Gave good learning curve to all supervisor personnel of Department Contractor & designer.
- Jun 2004 : Construction of RCC Upper Dam completed.
- Jun 2006 : Construction of RCC Lower Dam completed.

4.7 Important features & Facts regarding RCC Lower Dam Construction

- G.I Plates at contraction Joints : 15 m c/c
- PVC Water stop : 15m c/c
- Concrete plant capacity : 400 m3/hr
- Transportation rate of concrete : 400 m3/hr
- Cement Use : 52727 MT
- Cement storage silos : 1475 T
- Fly ash storage silos : 1280 T
- Fine aggregate manufacture : 175 T/hr
- Aggregate crushing : 350 T/hr
- Fly Ash Use : 111526 MT

4.8 Construction Period of RCC Dams

Season	Period	Days		RCC Placement In Cum		
		Calendar	Working	Total	Daily average	% over total qty
SADDLE DAM						
1	02/12/2002-09/05/2003	113	34	14510	427	100%
UPPER DAM						
1	19/05/2003-10/06/2003	23	16	6257	391	17.49%
2	26/11/2003-16/01/2004	52	38	29519	777	82.51%
1 + 2		75	54	35776	663	100%
LOWER DAM						
1	14/12/2004-31/05/2006	169	126	2,35,577	1870	36.95%
2	14/11/2005-08/06/2006	207	164	4,01,935	2451	63.05%
1 + 2		376	290	6,37,512	2198	100%

4.9 RCC Placement Rate for Lower Dam:

Season	Daily placement (Cum)		No of days for which RCC placement		
	Average	Maximum	> 3000 Cum	> 4000 Cum	> 5000 Cum
1	1865	3014	1	--	--
2	2488	5323	44	12	1

Chapter 5 Resettlement & Rehabilitation

5.1 Land Acquired:

Status of the Land acquired for the Project is as follows :

Location			Land Acquired (Ha)			Land Acquired for
Village	Tahsil	District	Private	Forest	Total	
Ghatghar	Akole	Ahmednagar	177.86	12.09	189.95	Upper Dam Saddle Dam Approach Channel, Road Quarry Gaothan etc
Chondhe	Shahapur	Thane	80.146	50.00	130.146	Lower Dam Roads Quarry Colony etc
Total			258.006	62.09	320.096	

5.2 Rehabilitation:

Due to construction of upper dam one gaonthan and two wadies namely Ghatghar village, Barkewadi and Kandalwadi are affected. There are 176 houses in Ghatghar village. Out of which 22 Houses are directly affected by the submergence of upper dam. In addition to this 154 houses are situated on the edge of waterbody and are surrounded by water from three sides.

5.3 Resettlement of PAPs in New gaothan:

New gaothan is established in Gut No.160, 161 & 162 (area 10.32 Ha.) of same village Ghatghar & situated at higher elevation. Revised layout plan is approved by Town Planning Department and accordingly the PAPs has been allotted plots and 54 PAPs have built their houses in Gaothan. Following civic amenities are also provided in new gaothan and handed over to Grampanchayat for maintenance.

1. Water Supply scheme for drinking water
2. School with play ground
3. Samaj Mandir (Chavadi)
4. Electrical Supply
5. Cremation Ground – (burial Ground)
6. Internal Roads & C.D.works
7. Public Latrine
8. Land of cattle shed
9. Land for pick up shed (bus stop)
10. Land for threshing floor (Khalwadi)
11. Land for market

5.4 Employment to PAP's:

The PAP's who are rendered landless and lost the means of livelihood have been provided with employment on project work. (GOM has specially accorded approval to the appointment of PAP's on daily rated establishment.) Out of 238 PAP's 67 persons have been appointed on daily wages and 47 persons are appointed on regular temporary establishment.

Conclusion