2007-08

Field Training Report

Report submitted to-

Executive Engineer,
Gosikhurd Dam Division,
Wahi, Pauni, Dist: Bhandara
(29/10/2007-03/11/2007)

कार्यकारी अभियंता,
गोसीखुर्द धरण विभाग, वाही, पवनी
Executive Engineer,
Gosikhurd Dam Division, Wahi, Pawani

सरळ सेवा भरतीने नियुक्ती दिलेल्या सहाय्यक कार्यकारी अभियंता/सहाय्यक अभियंता श्रेणी–१ अधिकाऱ्यांसाठी प्रतिष्ठापन प्रशिक्षण कार्यक्रम, (भाग १), जलसंपदा विभाग

Induction Training (Part I) for Direct Recruits (Assistant Executive Engineer and Assistant Engineer (Grade 1)) of Water Resource Department.

कालावधी: १ आठवडा (२९ ऑक्टोंबर–०३ नोव्हेंबर २००७)

Duration: 1 week (29 October -03 November 2007)

"क्षेत्रीय प्रशिक्षण अहवाल"

"FIELD TRAINING REPORT"

सादरकर्ता–

Submitted by-

प्रविण कोल्हे, बी.ई.(सिव्हिल), एम.टेक.

(सहाय्यक कार्यकारी अभियंता)

Pravin Kolhe BE(Civil), MTech.

(Assistant Executive Engineer)

Vidarbha Irrigation Development Corporation, Nagpur

Executive Summary

Maharashtra Engineering Training Academy (META), Nashik organized training program for direct recruits - Assistant Executive Engineer and Assistant Engineer (Grade 1) of Water Resource Department (WRD), in accordance with Maharashtra Engineering Service Examination-2004.

As per schedule of training program, first group of Assistant Executive Engineer's was directed to undergo field training under the guidance of Superintending Engineer, Gosikhurd Project Circle, Nagpur to observe & learn about dam, canals and rehabilitation work. After spending two week at Gosikhurd Rehabilitation Division, Nagpur and Ambadi and one week at Gosikhurd Right Bank Canal Division, Bramhapuri, we joined Gosikhurd Dam Division, Wahi. The Gosikhurd Dam Division consists of five subdivisions headed by Executive Engineer - Shri. G.M. Shaikh. This report includes the abstract of the interaction with the officers and staff of this division as well as observations/study performed by us.

Gosikhurd project is one of the ambitious project in Vidarbha region. As per plan, it includes construction of main dam at Gosikhurd village, left and right bank canal, 4 Lift Irrigation Scheme (LIS) on reservoir, 2 LIS on left bank canal, renewation of Asolamendha project etc. Gosikhurd village is located in Pauni Tahsil of Bhandara district on Wainganga River. We visited Gosikhurd dam which is created by constructing a composite dam 11.35 km long across River Wainganga. i.e. earthen dam both the right and left ban flanks of central masonry gated Ogee spillway 773 m long in the river gorge and 14 m above foundation level. It have battery of 33 radial gates of 18.3x16.5 m (used first time in Maharashtra) to discharge a design flood of 67,300 m^3/sec.

During our site visit at dam site, on 31st October, there was '***Chul Jalawo'*** stir organized by '*Gosikhurd Prakalpgrasta Sagarsh Samitee'.* The situation at dam site was critical and at that time, the government officers, including Shri. G.M. Shaikh (Executive Engineer, Gosikhurd Dam Division) handled that situation carefully. It was memorable moment in my life to be witness of that occasion and we realized the future challenges during the career in Water Resource Department. I am pleased to see well organized, efficient and helping nature of all the officers and staff of this division. Definitely, their contribution in the success of the entire project is uncountable. I am sure that completion of the project will bring green revolution in Vidarbha region.

कार्य सारांश

महाराष्ट्र लोकसेवा आयोगामार्फ़त घेण्यात आलेल्या 'महाराष्ट्र अभियांत्रिकी सेवा परिक्षा–२००४' च्या निकालाच्या अनुसंघाने 'सहाय्यक कार्यकारी अभियंता' आणि 'सहाय्यक अभियंता श्रेणी–१' या पदावर नियुक्ती दिलेल्या अधिकाऱ्यांसाठी 'महाराष्ट्र अभियांत्रिकी प्रशिक्षण प्रबोधिनी', नाशिक या संस्थेद्वारे एका वर्षाच्या प्रशिक्षण कार्यक्रमाचे आयोजन करण्यात आले. या प्रशिक्षण कार्यक्रमांर्तगत, पहिल्या तुकडीतील सहाय्यक कार्यकारी अभियंत्यांचा पहिला गट क्षेत्रीय प्रशिक्षणासाठी अधीक्षक अभियंता, गोसीखुर्द प्रकल्प मंडळ, नागपूर यांच्याकडे दि. ०८ आँक्टोंबर २००७ रोजी चार आठवड्याच्या प्रशिक्षणासाठी रुजु झाला. बांधकाम प्रकल्पाचे सर्वेक्षण, अन्वेषण व प्रकल्प अहवाल तयार करणे, चालू प्रकल्पांचे प्रत्यक्ष मुख्यधरण, कालवा व वितरीकाचे कामाचे नियोजन करणे व चालू बांधकामावर प्रत्यक्ष देखरेख करणे असा या प्रशिक्षणाचा पोटविषय होता.

प्रशिक्षणाच्या चौथ्या आठवड्यांमध्ये (२९ आँक्टोंबर– ३ नोव्हेंबर २००७) आम्हाला जी. मो. शेख कार्यकारी अभियंता, गोसीखुर्द धरण विभाग, वाही यांचे बहुमोल मार्गदर्शन लाभले. या विभागाचे पाच उपविभाग असुन, श्री. र. गो. शर्मा, श्री. द. तु. चौधरी, श्री. लो. दा. हवेलीकर, श्री. सु. गो. ढवळे, आणि श्री. दि. स. जावळे हे या उपविभागाचे उपविभागीय अभियंता/अधिकारी आहेत. प्रस्तुत अहवालात या अधिकाऱ्यांबरोबर झालेल्या सुसंवादाचा सारांश आणि आम्ही केलेले निरिक्षण नोंदवले आहे.

गोसीखुर्द प्रकल्प हा विदर्भातील एक मोठा महत्वाकांक्षी प्रकल्प आहे. या प्रकल्पांतर्गत गोसीखुर्द गावाजवळ मुख्य धरण, डावा कालवा व उजवा कालवा, जलाशयावरील ४ उपसा सिंचन योजना, डाव्या कालव्यावरील २ उपसा सिंचन योजना, असोलामेंढा प्रकल्पाचे नुतनीकरन इत्यादी प्रमुख घट्कांचा समावेश आहे. मुख्य धरणाचे बांधकाम भंडारा जिल्ह्यातील पवनी तालुक्यातील गोसीखुर्द गावाजवळ सुरु आहे. वैनगंगा नदीवरील मुख्य मातीधरणाची एकुण लांबी ११.३५ कि.मी. असुन यात संधानकातील उत्सारीत भाग ७७३ मी. व अनुत्सारीत भाग १३० मी. यांचा समावेश आहे. उत्सारीत सांडव्यावर १८.३x१६.५ मी. आकाराचे ३३ वक्रद्वारे बसवले आहेत. या आकराच्या वक्रद्वारांची उभारनी महाराष्ट्रात प्रथमच होत आहे. मुख्य धरणाचे सा.क्र. ८२० मी. व सा. क्र. ७८७५ मी. वर अनुक्रमे डावा व उजवा तीर विमोचके बांधण्यात आलेली आहेत व याद्वारे सिंचन व विज निर्मिती (३ मे.वॅ) प्रस्तावीत आहे. तसेच धरणाचे पायथ्याशी २५ मे.वॅ विज निर्मीतीची योजना प्रस्तावीत आहे.

सदर विभागाचे काम पाहून धरणाच्या आव्हानात्मक कामाची मला जाणीव झाली. या विभागाचे कार्यकारी अभियंता – जी. मो. शेख यांच्या मार्गदर्शनाद्वारे सर्व अधिकाऱ्यांच्या व कर्मचाऱ्यांच्या संघटनात्मक, कार्यक्षम आणि सदैव मदतीसाठी तत्पर असण्याच्या स्वभावामध्येच या विभागातील यशाचे गमक सामावले आहे. या प्रकल्पाच्या यशामध्ये त्यांचा वाटा निश्चितच मोलाचा आहे व त्यातुनच या भागामध्ये हरितक्रान्ती होवून या भागाचा विकास होईल असे मला वाटते.

Acknowledgement

This report will be incomplete without a proper acknowledgment of the debt to many persons, who made it possible. It is my great pleasure to acknowledge those whose active help and support make this report possible in the present form. First of all I express my sincere gratitude to Shri. S.R. Suryavanshi- Chief Engineer and Shri. S.L. Kholapurkar-Superintending Engineer, for their guidance during field training.

It is the endless guidance and constant encouragement of Executive Engineer- Shri. G.M.Shaikh, who is directed us towards the challenges during the career in Water Resource Department. Engineer has to consider social aspects along with the technical knowledge while working in the department. The experience during '*Chul Jalao*' stir was a lifetime experience since we were witness of that event.

Deputy engineers-Shri. R.G. Sharma, Shri, D,T. Chaudhari, Shri. L.D. Havelikar, Shri. S.G.Dhawale and Shri. D.S. Jawale and I would like to express my heartfelt gratitude to them. Special thanks to Shri. Choure for providing technical information's during site visit.

I am deeply indebted to all technical and non-technical staff of division and sub-division for insisting in me the drive to work hard and for inculcating in me the discipline to think clearly. Definitely the knowledge, I received during this training session was a lifetime experience and it will serve as a foundation for my career.

I am thankful to my colleagues who make the stay at Wahi Rest House enjoyable. Last, but not least, I wish to express my gratitude towards my parents- Shivaji and Rohini, my grandparents- Rangnath and Sitabai, my uncle Raosaheb and aunty Radhika who sacrificed a lot to give me a good education.

-Pravin Kolhe
(Assistant Executive Engineer)

Chapter 1. Gosikhurd Project

1.1 Introduction

The major part of Vidarbha region lies in Pranhita sub-basin of Godavari region. The tributaries finally contributing to form Pranhita river are Penganga, Wardha and Wainganga.

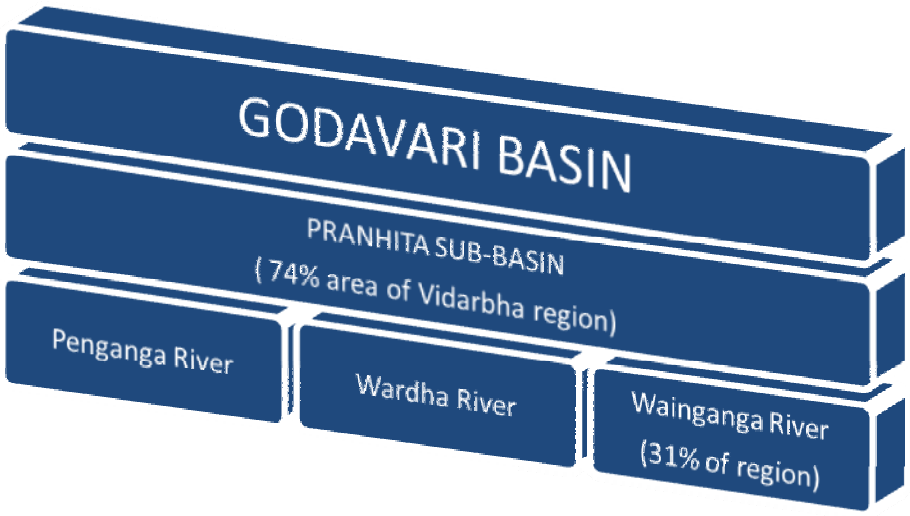

Fig. 1.1.1 Details of contribution of rivers in Vidarbha region

Wainganga originates near the village Pratapgarh at an elevation of 640 m RL in Seoni district of Madhya Pradesh and traverses almost North-South through Bhandara and Chandrapur district of Maharashtra state. Total length of Wainganga from its origin up to confluence with Wardha river is about 717 km. The total catchment area drained up to the proposed dam site of Gosikhurd project is 34,860 km^2, out of which 24,261 km^2 lies in Madhya Pradesh and 10,627 km^2 in Maharashtra state. Wainganga river has following tributaries-

Table 1.1.1 Tributaries of Wainganga river

Left bank tributaries	Right Bank tributaries
1. Thel River (MP) joins at 71 km	1. Hirri River in MP joins at 183 km
2. Bagh River (MS) joins at 257 km	2. Mawanthadi River (MS) joins at 300km
3. Chulband River (MS) joins at 415 km	3. Kanhan River (MS) joins at358 km
4. Khobragadi River (MS) joins at 450 km	4. Mayur River (MS) joins at 386 km
5. Kathani River (MS) joins at 470 km	5. Andheri River (MS) joins at 555 km
6. Dina River (MS) joins at 600 km	

Gosikhurd village is located in Pauni Tahsil of Bhandara district on Wainganga River. As per planning, Gosikhurd reservoir will be created by constructing a composite dam 11.35 km long with earth embankment across River Wainganga. i.e. earthen dam both the right and left ban flanks of central masonry gated Ogee spillway 773 m long in the river gorge and 14 m above foundation level. It

will have battery of 33 radial gates of 18.3x16.5 m size to discharge a design flood of 67,300 m^3/sec. The maximum height of the dam will be 27 m above river bed. The barrage will submerge about 18,960 ha land of which 12,600 ha in Nagpur and Bhandara district (68 villages fully and 75 villages partially)

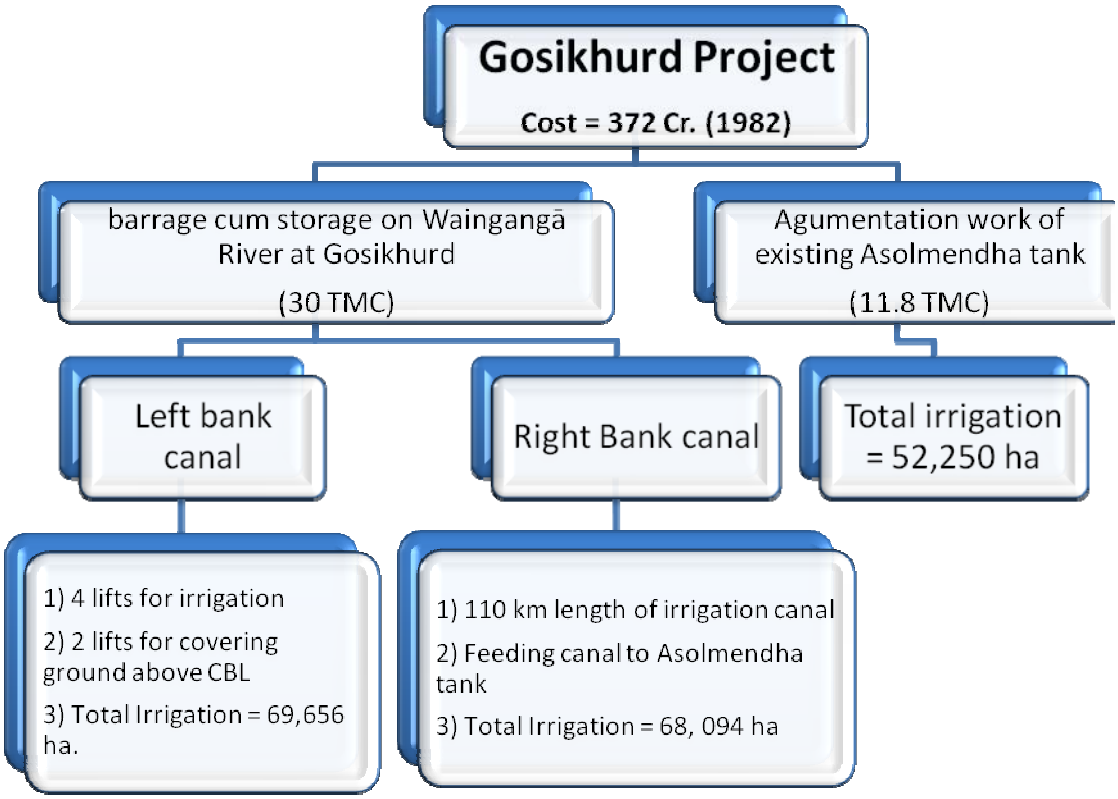

Fig. 1.1.2 Details of Gosikhurd project

The year wise percentage of development of irrigation potential –

Table 1.1.2 Year wise percentage of development of irrigation potential-

5th year of construction	20 %
6th year of construction	29 %
7th year of construction	31 %
8th year of construction	20 %

1.2 Salient features of Gosikhurd Project

a) Cost of Gosikhurd project : 316.57 Cr. (1982)
b) Cost of Asolmendha Tank : 55.62 Cr. (1982)
c) Total cost of project : 372.22 C. (1982)
d) Total irrigation :2,50,800 ha
e) Location of dam :

Table 1.2.1 Details of dam location

State	Maharashtra
District	Bhandara
Tahsil	Pauni
Village	Gosikhurd
Toposheet No.	55 P/9
Latitude	20° 52′ 15″ N
Longitude	79° 37′ 0″ E

f) Name of river : Wainganga (Tributary of Pranhita)
g) Name of basin : Godavari
h) Catchment area :

	Madhya Pradesh	Maharashtra	Total
Gross	24,261 km^2	10,627 km^2	34,888 km^2
Free			5,902 km^2

i) Availability of water

75 % dependable mansoon yield	501.33 TMC
Past mansoon flow (4.7 %)	23.56 TMC
Total annual yield	524.89MC

1.3 Utilization

a) Irrigation utilization :

With flow canal on LBC	4.418 TMC
On lift canal	3.537 TMC
LB foreshore lift	5.610 TMC
Right bank flow canal	11.85 TMC
RC foreshore lift	6.75 TMC

b) Water supply to ordnance factory, Bhandara : 0.837 TMC
c) Feeding to Asolamendha tank : 13.766 TMC
d) Annual evaporation loss : 7.107 TMC
e) Total utilization : 53.88 TMC
f) Balance spill over : 58.704 TMC

1.4 Dams and spillway details

Table 1.4.1 Details of dam and spillway

Dam	
Type of dam	Rolled filled earthen dam
Length of dam	11.35 km
Maximum height of dam	22 m
Free board	
Over MWL	3m
Over FRL	4.5 m
Spillway	
Type of spillway	Central gated Ogee shaped masonry spillway
Length of spillway	774 m
Maximum height	10.3 m
Crest level	232 m
Design flood	67,300 m^3/sec
No. of gates	33
Size of gates	18.3x16.5m

1.5 Prominent features of irrigation by canal

Table 1.5.1 Prominent features of irrigation by canal

Sr. No	Canal	Capacity (m^3/sec)	Length (km)	CCA (ha)	ICA (ha)	Lift head
1	Right Bank Canal	95	108	53,405	50,735	--
2	Left Bank Canal	40.50	27.5	35,860	34,067	--
3	Left bank fore shore lift- Paghora	21.11	45	21,284	20,223	35 m
4	Left bank fore shore lift- Jakh	4.47	4	4,000	3,800	35 m
5	Right bank fore shore lift- Mokhabardi	24.02	53	21,350	20,280	35 m
6	Right bank fore shore lift- Ambhora	10.24	9.10	9,100	8,645	18 m

Chapter 2. Gosikhurd Dam

2.1 Introduction

As the part of training program, we spend one week on the various activities of dam construction. We studied several reports and design notes related to the dam at division office, and then visited dam site on 1st October 2007 to know about masonry dam and 2nd October 2007 to gather information about earthen embankment. Construction of dam is highly precious and important work, since it involves greater care to convert all drawings related to dam alignment and cross-section in to reality. It is vey important to keep the designed bed level and cross-section as per specified, otherwise canal wont give its designed returns. The alignment of dam runs trough soft as well as hard rock, sometimes in cutting, in banking, partial cutting and banking.

2.2 General layout of Gosikhurd Project

Gosikhurd project consists of construction of a barrage-cum-storage on Waingangā river at Gosikhurd, in Pauni Tahsil of Bhandara district, Augmentation work of existing Asolamendha tank in Chandrapur district and remolding the entire canal system of Asolamendha irrigation tank. The proposed reservoir at Gosikhurd has been named as Indira Sagar. The total irrigation potential covered in this project is of the order of 2, 50,800 ha.

There are left and right bank canals and four foreshore LIS[1] at Tekepar, Mokhabardi, Ambhora and Paghora proposed on main reservoir at Gosikhurd. The right and left bank canals are 107km and 28 km in length respectively. The right bank canal is to carry surplus monsoon water at Gosikhurd to augment the Asolamendha tank project in 100th km of canal, in addition to irrigation in its own command.

The river Waingangā is a major tributary of Godavari basin. The total catchment area intercepted at Gosikhurd dam site is 34,863 km^2, out of which, 24,243 km^2 lies in Madhya Pradesh and 10,619 km^2 lies in Maharashtra.

The gross storage capacities of the reservoir viz. Gosikhurd and Asolamendha tank will be 1,146.075 Mm^3 and 334.14 Mm^3 respectively. The live storage capacity of the reservoir at Gosikhurd at 50 years silt planning will be 740.168 Mm^3

The final proposal of general layout is –

Earthen embankment on left flank	**RD -3150 to 5905m**
Left side NOF[2] masonry portion	RD 5905 to 5970m
Central OF[3] spillway portion with 33 No. of radial gates of size 18.3x16.5	RD 5970 to 6767.2m
Right side NOF masonry portion	RD 6767.2 to 6832.2m
Earthen embankment on right flank	RD 6832.2 to 8056m
Envelope type junction for left and right NOF portion of masonry dam	
Left bank irrigation outlet	RD 820m
Right bank irrigation outlet	RD 7905m
Left bank irrigation **cum power** outlet	RD 780m
Right bank irrigation **cum power** outlet	RD 7911m

[1] Lift Irrigation Scheme
[2] Non Over Flow
[3] Over Flow

2.3 Geology at dam site

The geological investigation of the dam site has been carried out by Department of Geological Survey of India. In and around the project area, Archeean group of rocks represented by schist, phyllites and quartzite of Sakoli series are exposed. The basement rocks if arranges in increasing order of crushing strength fall in the manner of alluvium, schist, phyllites and amphibolites.

Molonitic characteristic of phyllite together with sliken slides, shearing and pyritisation etc. indirectly indicate that phyllite has suffered shearing and faulting. The water intake test results have brought the picture of underlying rock as leaky, necessitating the need of grouting for seepage arresting and for formation of monolithic nature.

2.4 Site selection and alignment of dam

The selection of site for irrigation project is governed by consideration of optimum utilization of yield available and availability of foundation bed rock at higher elevations for economizing the cost of headwork's.

Two sites near Bhandara town are investigated for this project; viz. Sawargaon and Gosikhurd. The site located near Gosikhurd is finally selected being quite suitable and feasible. It is about 45 km south of Bhandara town and 10 km upstream of Pauni, a Tahsil place. The dam site is immediately downstream of confluence of river Marur with river Wainganga. There are hillock on right and left flank of the rivers and the alignment follows a well defined ridge and passes through a pair of hillocks on left flank.

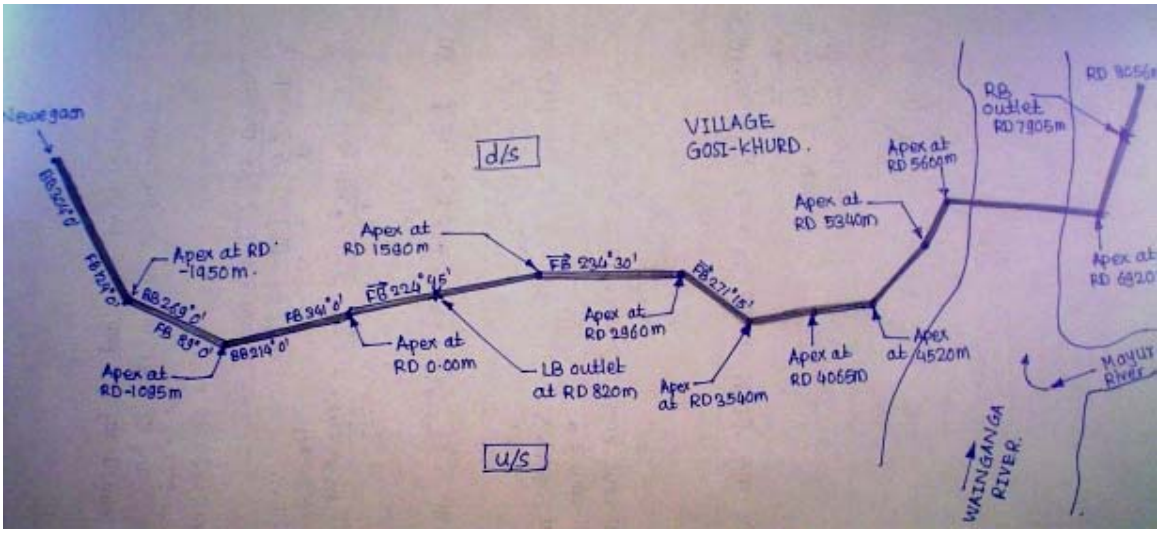

Figure: General layout of Gosikhurd dam

2.5 Layout of spillway

Relevant salient features of the project-

TBL	**250.05m**
MWL	245.70m
FRL	245.50m
Length of spillway	763.90m
No. and size of gates	33 No. (18.3x16.5)m

Occasional submergence of radial gate trunnion is allowed; provided that suitable precautions should be taken to avoid corrosion. IS 4623:1984 recommend 1.5m clear water profile. PoE suggested following precautions-

1. Provision of self lubricating bearing (LUBHTE or DEVA)
2. Provision of covers on both sides of bearing with spring actuated seals to avoid possibility of entry of silt, in the bearing.

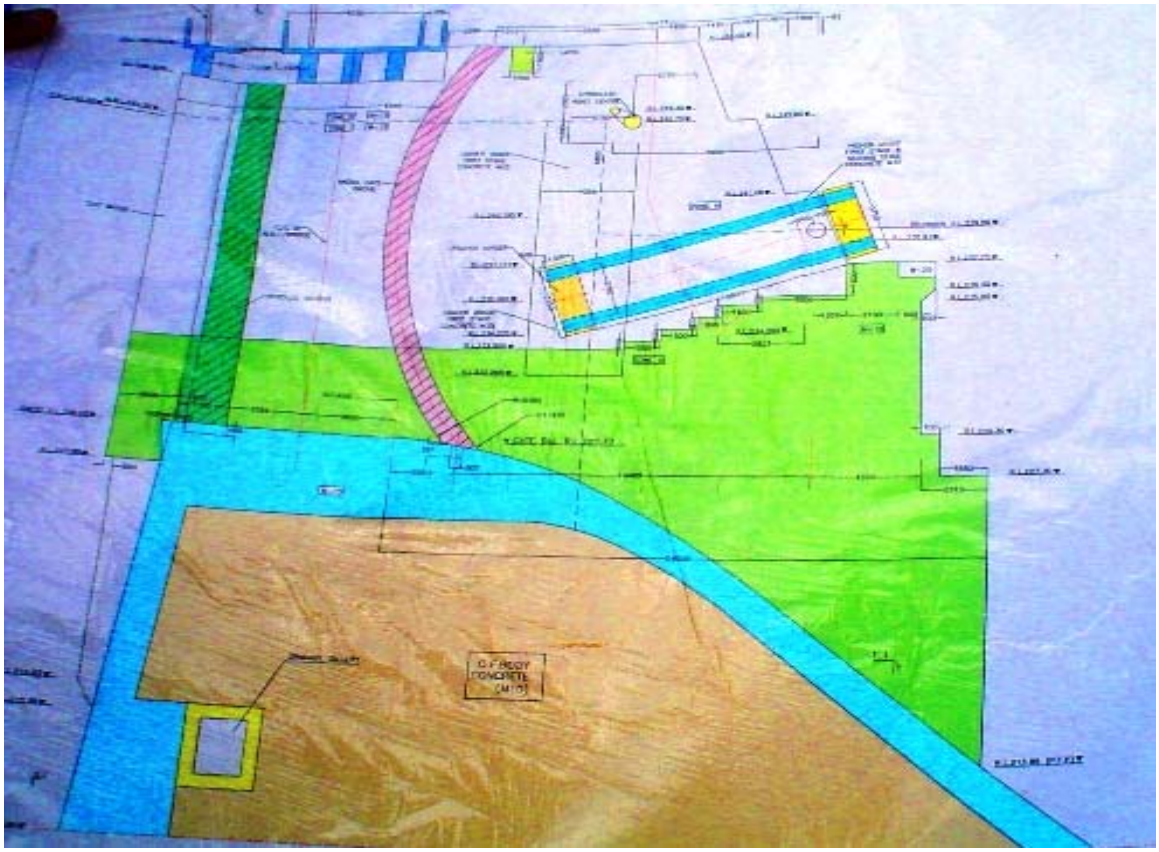

Figure: Cross section of spillway

2.6 Design flood

The original project report provided for a maximum peak flood of 52,000 cumecs based on study of 15 years observed flood data at Pauni. This flood corresponds to return period of 10,000 years. As per comments of CWC[4], the storage at Gosikhurd being more than 61 Mm^3, the dam should be designed for probable maximum flood. The CWC has also suggested revising storm value and reviewing the unit Hydrograph studies on better data base. The efforts of above changes were evaluated by water planning unit of CDO[5] and it was estimated that the design flood value will increase by 30% on ad-hoc basis. The peak value of probable maximum flood was then worked out to be 67,300 cumecs.

[4] Central Water Commission, New Delhi, Government of India.
[5] Central Design Organization, Nashik, Government of Maharashtra.

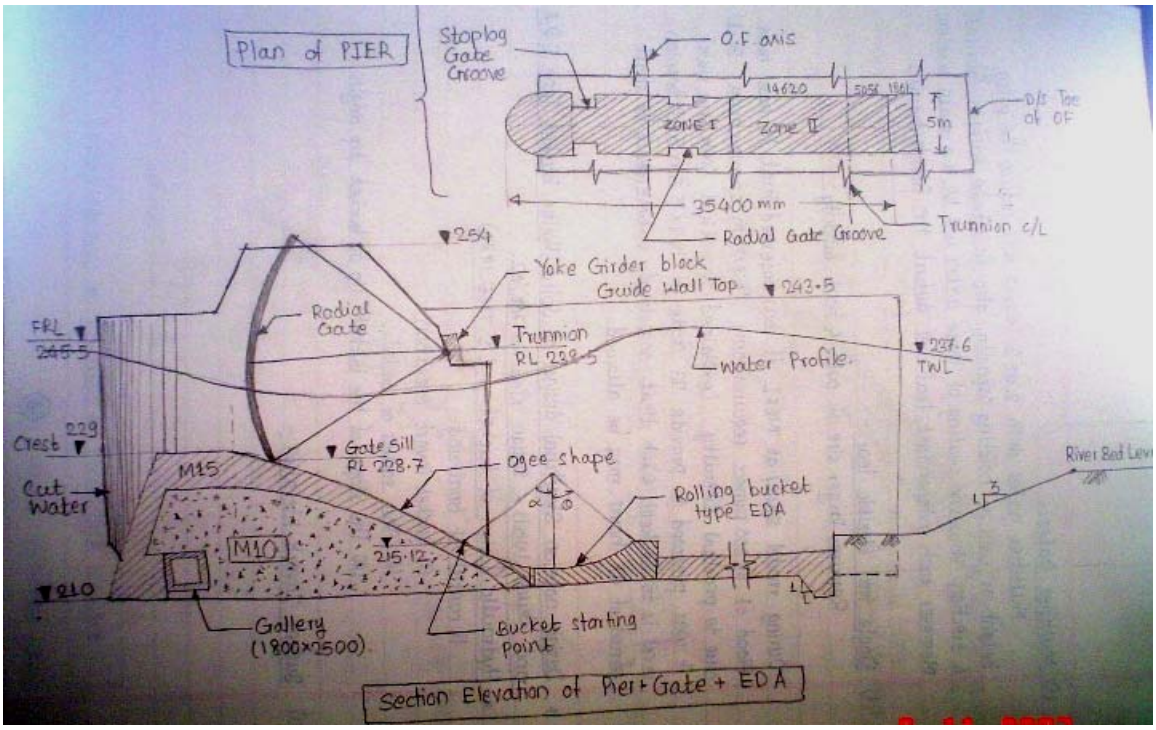

Figure: Spillway details

2.7 Selection of gate size

Flood routing has done considering the design flood hydrograph with a peak of 67,000 cumecs with following two alternative gate sizes.

Size of gate (WxH) m	No. of gates	Crest RL of spillway	Bed RL of approach channel	MWL (RL)
18.3x16.76	30	228.74	228.70	246.128
18.3x16.76	31	228.74	228.70	245.688
18.3x16.76	28	228.74	228.70	246.871
15x12	62	233.50	233.40	245.652
15x12	56	233.50	233.40	246.578

It is proposed to provide 33 number of radial gates (including 10 % standby) of size 18.2x16.5 (MWL=245.70m) to reduce the probability of upward revision.

The proposed size of gates is the largest in Maharashtra.

View of Gosikhurd dam

2.8 Energy Dissipater Arrangement

Certain hydraulic parameters have been specified in IS 12527:1985 for selection of suitable type of EDA i.e. - Bucket type and stilling basin type etc. In Gosikhurd project case, parameters are not suitable either for stilling basin or bucket type EDA. Due to large difference in River Bed Level (RBL) (224.00m) and foundation level (210.00m) model performance was studied by MERI[6]. 2D model studies of project was completed except for items of calibration and gate operation schedule. These schedules indicated that solid roller bucket type EDA is more appropriate instead of originally proposed stilling basin type. The final recommendations of 2D model study areas under-

Type of EDA	**Solid roller bucket type**
Radius of bucket	12 m
Invert level	212.00m
Lip level	216.52m

2.9 Flow Divide Walls

Flow divide walls are proposed when there is large difference in foundation level of OF/EDA. The length of spillway is very large (764m). Hence PoE[7] suggested to divide EDA in 3 equal bays in front of 11 openings each (i.e. about 252m length of each bay) so that gate operation during low flood can be managed and it will also facilitate maintenance and repair of stilling basin by dewatering bays one by one.

Flow divide walls	**2 No.**
	1st at RD 6252.10 m
	2nd at RD 6531.70m
Foundation level for reach No. 1	Varying (on bucket portion)
Foundation level for reach No. 2 and 3	211.50m
Foundation level for reach No. 4	211.5/215.00m
Type of walls	224.50m
Wall thickness	Reach No. 1 = 5m
	Reach No. 2 = Varying from 5 to 3 m
	Reach No. 3 = 3m
	Reach No. 4 = Varying from 3 to 1.5 m

Structural aspect of flow divide wall: Plane C.C. or masonry gravity wall, requiring larger base width is out of consideration, hence RCC M-15 wall is proposed. As the wall starts form the downstream face of the pier (i.e. 5m) the foundation level of wall varies in bucket portion and it is uniform in apron portion.

[6] Maharashtra Engineering Research Institute, Nashik, Government of Maharashtra.
[7] Panel of Experts

2.10 Piers

a. **Thickness of Pier:** As per IS 13551:1992, the thickness of 4.75m is required for radial gates of size 18.5x16.75m, which is matching with the size of 18.3x16.5m of Gosikhurd radial gates. So even size of 5m thick is proposed for all piers including abutment piers.
b. **Cut water and ease water:** Semi circular cut water of 5.0 m diameter equal to pier thickness is provided as per normal practice. Ease water is not proposed on downstream side
c. **Length and top level of pier:** Initially length of pier on downstream side as measured from axis of overflow was assumed as 24.0m as per original layout. An offset of 1.86m from downstream face was proposed at RL 227.3m during first revision of the layout which resulted in considerable economy. Another offset of 750mm was introduced at RL 229.30m as per final layout (2nd revision). This further reduced the pier concrete. The top level of pier is at RL 250.50m.
d. **Stop logs:** MDDL[8] of the project is 241.29m (i.e. more than 12 m above the crest RL 229m). Hence provision of stop log gate is absolutely essential and made accordingly.
e. **Trunnion level:** Trunnion level at RL 239.50m is proposed to ensure 1500mm clearance above nappe profile (Ref: IS 4623:1983) for restricted outflow of 34,000 cumecs.

2.11 Design considerations of Piers

Following considerations are taken into account while designing the spillway pier-

1. The pier has to provide adequate support for Spillway Bridge at top.
2. The pier has to take the thrust of water from spillway gate and transfer the same to the concrete below by means of anchor girder and yoke girder.
3. Pier has to ensure smooth flow of water over the spillway crest with serious end contraction.

Scope of design:

1. The intermediate piers resting on OF section and both end piers are resting on NOF section. The pier concrete and reinforcement will be taken below the ogee surface to a depth of 5m, which is equivalent to one thickness of the pier.
2. The structural design of pier is done according to the design procedure laid down in IS 13551:1992.

Forces considered:

1. Dead load
    a. Self weight of pier
    b. Weight of spillway bridge
    c. Weight of hoist
    d. Weight of radial gates, acting through vertical anchors of the hydraulic hoist girder.
2. Live load: Single lane class AA loading of IRC code acting at centre line of Spillway Bridge.
3. Water pressure

[8] Maximum Draw Down Level

   a. Horizontal water pressure on the portion the pier u/s of the gate sill
   b. Water pressure on radial gates leaf transmitted to the pier through the horizontal and vertical anchors of the anchor girder.
4. Uplift pressure
5. Wind loads
6. Seismic forces for zone II
7. Frictional force
8. Braking force
9. Radial gate weight and forces

2.12 Design considerations of Spillway crest

While analyzing the structural stability of spillway crest, the mass of concrete up to the plane of checking is only stabilizing force. The total disturbing force comprises of-

1. Trapezoidal hydrostatic pressure on crest thickness
2. Uplift pressure

These two forces are higher than stabilizing force.
To avoid tension on u/s side of pie section, RCC is provided in the spillway crest portion of overflow dam.

2.13 Structural details of drainage gallery

A foundation cum drainage gallery is proposed for following purpose-

1. Tapping, collection and disposal of water seeping through body of dam.
2. For drilling drainage holes for release of uplift pressure at dam foundation.
3. For drilling and providing grout curtain to control under seepage.
4. Providing access and space for instrumentation and monitoring dam behavior.
5. Facilitating inspection of dam.

Details of drainage gallery	
Clear opening size of gallery	1.8x2.5m (WxH)
Gutter size	0.3x0.3m
RCC lining in M20at top and bottom to take care of tensile stresses	750mm thick

Ventilation shafts are proposed through alternate piers. 450 mm diameter NP3 class RCC hume pipe are proposed as ventilation shaft.

2.14 Ring COT[9] and bund for reducing possible water seepage through Mendha Hillock and Rajiv Hillock

There are two hillocks on centre line of the dam from Rd 4200 o 4520m (Mendha hillock) and from RD 5227 to 5440 (Rajiv hillock) where GL[10] is above TBL[11] of earth dam. So no special attention was given during earth dam design. After detailed study, it was noticed that the rock present in the hillock is pervious. The result of permeability test at these regions shown the permeability through the mica schist strata is from 0 lugeon to 166 lugeon from both the hillocks. Though both the

[9] Cut Off Trench
[10] Ground Level
[11] Top Bund Level

hillocks are steady and stable from the stability point of view, to reduce seepage, continuity of COT along with impervious blanket is found necessary.

To reduce possibility of leakage through existing Mendha Hillock and Rajiv Hillock, the gap between the earth dam due to hillock should be treated so as to stop leakage through hillock-

To reduce the same, the design has to cover-

a. **Under seepage control Measures:** To reduce probable seepage through the foundation of dam, i.e. hillock, the best suitable provision is open COT. The location of the centre line of COT is proposed at near about contour of MDDL. Bottom of COT is 5m, but hard strata is available at 6m, therefore bottom of COT is proposed at lease 0.6m in hard strata.
b. **Provision of bunds to cover the top of COT**: To reduce possible seepage through hillock, the excavated top of COT should be covered with the same impervious material which is used for COT filling and minimum required cover of casing should be provided. Hearting and casing zones are provided for the construction of bunds.

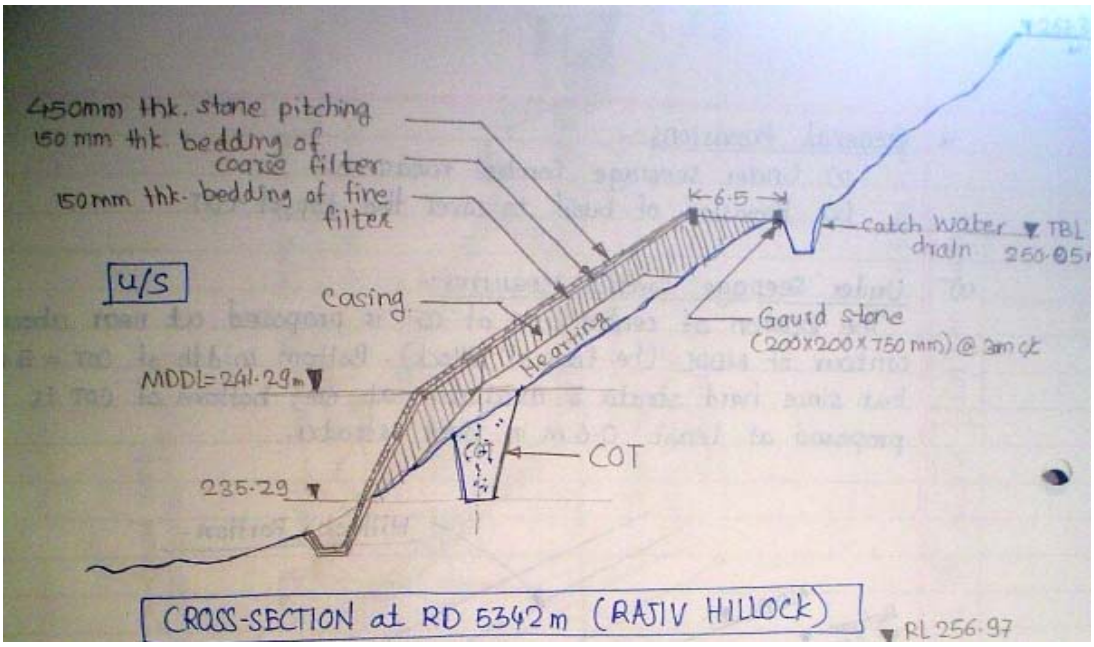

Figure: Under Seepage Control Measures at Rajiv Hillock

2.15 Fixing of Outlet sill levels

The new zero sill elevation for 100 years and 50 years are at RL 241.29m and 235.88m respectively. Outlet sill levels of the left and right bank outlets are proposed at RL 238.5m and 235.5m respectively. CBL[12] of left and right bank canals are at RL 238m and 235m respectively. Thus left and right bank outlets are about 2.79m and 5.79 m lower than 100 years zero sill elevation respectively. It is, therefore reposed to construct a well type structure around outlets with its top @ RL 241.79m.

[12] Canal Bed Level

The CBL of GRBC at start (0km)	235m
Head loss in bed gradient	10m
Head loss for all CD work	2.77m
Head loss per aqueduct	0.122m
Head loss per siphon	0.15m

2.16 Spillway Junction studies

Junction between OF section of spillway and earthen embankment are done both for the divide wall type junction and envelope type junction for left and right banks. The divide wall section was considered with a top width of 1.5m waterside vertical and back batter as follows-

Height	Back batter
30-40m	1:1.5
20-30m	1:1.25
Up to 20m	1:1

Envelope type junction is economical, since quantities of masonry requires is less hence same are proposed for left ad right junctions of spillway.

NOF masonry with an envelope type junction will be between RD 5905 to 5970 on the left side and between RD 6767.2 to 6832.2m on right side of spillway.

2.17 Dam instrumentation

Provision of instruments- IS 7436 (Part II):1976 has recommended two types of measurements-

a. Obligatory measurements

i. Measurement of uplift
   1. Uplift pressure at base of dam
   2. Uplift pressure at different horizontal planes inside the dam body

ii. Seepage measurement: V-notch and weirs

iii. Temperature measurement: (Resistance type and vibrating wire type thermometers)

iv. Displacement measurement
   1. Conventional plumb line
   2. Inverted plumb line
   3. Joint meters

b. Optional measurements

v. Stress-strain measuring instruments
   1. Stress meter
   2. Strain meter
   3. No-stress-strain meter

vi. Tilt measuring instruments (Tilt meter/clino meter)

vii. Seismic instruments
   1. Structural response recorder
   2. Accelorograph
   3. Strong motion accelorograph
   4. Peak accelerograph
   5. Acceleration column

Conclusion

During our training session, we visited most of the important sites of the dam. It was great experience for me, since I could see the structures and various components which were studied in books. I gained the valuable experience of important components like pier, spillways, gate, earth embankment, outlets, and social effect- i.e. *'Chul Jalao stir'*

The Gosikhurd project is one of the ambitious project and since it is spread over thousands of hectare of land, it created social and environmental impacts. The dam construction involves greater art of earthwork and as the profile and nature of ground is highly unpredictable, there were many challenges including seepage and one of the technical features of dam-i.e. buried channel. Most of the technical difficulties arise during the construction were solved satisfactory with economy.

At the end of one week, I felt that the one week period of training is not sufficient to get complete knowledge of the dam and its components, and the subject is very vast. Still, I tried my best to gather maximum knowledge through observation and discussion with the officers and staff, and it will be helpful throughout my career.

We are thankful to Executive Engineer- Shri. G.M. Shaikh, and all the officers and staff of division and subdivision for their guidance and co-operation during this training session. After going through details of the project, I am sure that the completion of the project will bring green revolution in Vidarbha region.

-Pravin Kolhe
(Assistant Executive Engineer)