2007-08

Field Training Report

Report submitted to-

Superintending Engineer,
Earthen Dam Circle,
Central Design Organization , Nashik
(16/06/2008-18/06/2008)

अधिक्षक अभियंता,
मातीचे धरण मंडळ, नाशिक

Superintending Engineer,
Earth Dam Circle, CDO, Nashik

कार्यकारी अभियंता, जल नियोजन विभाग

Executive Engineer,
Water Planning Division

सरळ सेवा भरतीने नियुक्ती दिलेल्या सहाय्यक कार्यकारी अभियंता श्रेणी–१ अधिकाऱ्यांसाठी क्षेत्रीय प्रशिक्षण कार्यक्रम, जलसंपदा विभाग

Field Training for Direct Recruits - Assistant Executive Engineer (Grade 1) of Water Resource Department.

कालावधी: १६ ते १८ जुन २००८

Duration:16 to 18 June 2008

"क्षेत्रीय प्रशिक्षण अहवाल"

"FIELD TRAINING REPORT"

सादरकर्ता–

प्रविण कोल्हे, बी.ई.(सिव्हिल), एम.टेक. (आय. आय. टी.– कानपूर)

(सहाय्यक कार्यकारी अभियंता)

Submitted by-

Pravin Kolhe, BE (Civil), MTech (IIT-Kanpur)

(Assistant Executive Engineer)

Executive Summary

Maharashtra Engineering Training Academy (META), Nashik organized training program for direct recruits - Assistant Executive Engineer & Assistant Engineer (Class I) of Water Resource Department (WRD), in accordance with Maharashtra Engineering Service Examination-2004. As per schedule of training program, we were directed to undergo training under the guidance of Superintending Engineer- **Shri. M.S. Bendre Saheb**, Earth Dam Circle, Central Design Organization, Nashik.

The training program was scheduled for six working days, started on 16th June 2008 and we were directed to study about Flood Estimation under the guidance ot Executive Engineer- **Miss. Sunanda Jagtap madam**. We undertaken a case study to estimate flood and we completed it successfully.

This report includes the day-to-day details of training program at Earth Dam Circle, Central Design Organization, Nashik. It also contains the study and observations performed by me. I learned valuable information regarding water availability, flood study, flood estimation reports published by Central Water Commission. I had also collected reference materials and Technical Notes from the office.

Acknowledgement

I take this opportunity to express my gratitude to those whose active help and support make this report possible in the present form.

First of all, I express my sincere gratitude to **Shri. M.S. Bendre Saheb, Superintending Engineer,** Earth Dam Circle, Central Design Organization, Nashik for insisting in me the drive to work hard and for inculcating in me the discipline to think clearly.

It is the endless guidance and constant encouragement of Er. **Sunanda Jagtap,** Executive Engineer (Water Planning) and I would like to express my heartfelt gratitude to her and her staff for providing me necessary technical information which was needed time to time.. She shared her valuable experiences with us and it was the most enjoyable part of training.

My special thanks to **Shri. Kulkarni** Saheb, for his active help and valuable guidance during Flood Estimation Exercise. All the reports and reference materials were available for my study purpose.

Definitely the knowledge, I received during this training session was a lifetime experience and it will serve as a foundation for my career.

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 BE (Civil), MTech (IITK)
(Assistant Executive Engineer)

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Chapter 1. About Central Design Organization, Nashik

WATER RESOURCES DEPARTMENT GOVERNMENT OF MAHARASHTRA, INDIA

CENTRAL DESIGNS ORGANISATION, NASHIK

1.1 Establishment of Central Design Organization, Nashik

Development programme to harness the available irrigation potential and also to increase the power resources were undertaken by the state of Maharashtra, India on a larger scale after independence by construction of dams and hydro power projects. To cope up with the need of providing designs of earth and gravity dams. Central Designs Organization (C.D.O) was established in 1957 by the Government of Maharashtra.

The CDO at that time had to start from scratch, but because of continuing efforts of the Engineers working in the CDO, the Organization is now recognized nationwide as a pioneer Design Organization in the field of Dam Design. Organization was strengthened for undertaking design of Hydro Electric Projects. It has now established its own design practices from the experience gained from the designs prepared and executed for last 51 years which has stood the test of the time and which are commensurate with the relevant BIS Code and USBR provisions.

CDO is located at Nashik a central place connected with rail and road. It has its own building and residential quarters for the staff. The pioneer research institute of the state, Maharashtra Engineering Research Institute (MERI) is located in the same premises, which is complementary for the Design.

1.2 Activities of CDO

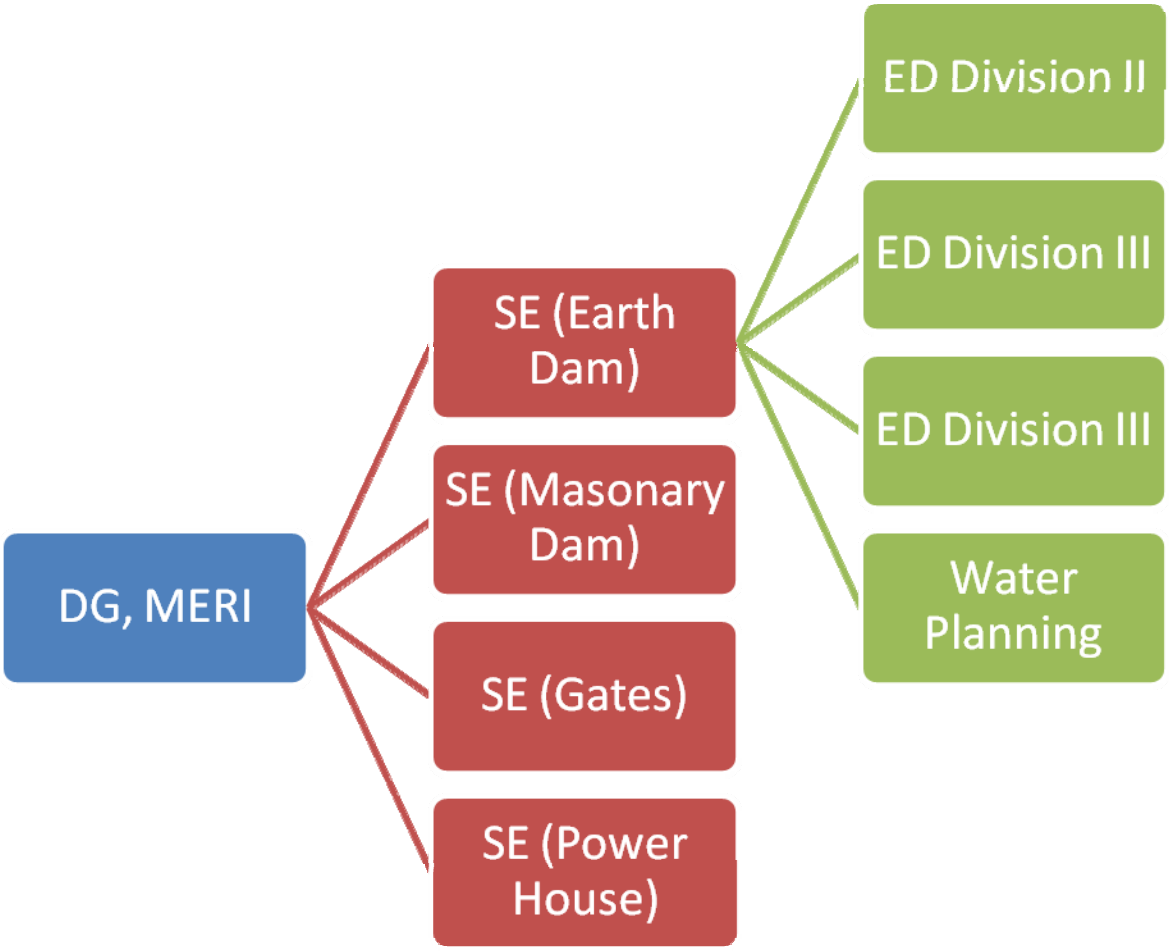
- Design of irrigation project /Design of Hydro Electric Project / Design of Lift Irrigation Scheme.
- Hydrology, Yield, Flood, Simulation studies and Flood routing.
- Detailed design of Earth dam, Gravity dam and its junctions.
- Design of different types of spillways / Energy dissipation arrangements.
- Instrumentation.
- Design of various types of Outlets.
- Design of all types of Gates.
- Design of various types of Major Canal Structures.
- Design of Hydro Electric Projects.
- Design of lift Irrigation Schemes.
- Review of old dams and suggesting remedial measures, if required.
- Scrutiny of Project Report for C.W.C. Clearance.
- Working on different Committees of BIS for preparation of various standards.
- Consultancy services for Semi Government / Private Sectors.

1.3 Organizational Structure

Maharashtra State is one of the developed states in India in agriculture sector. The policy makers have given due importance for the creation of irrigation potential for which construction of Major, Medium and Minor projects is taken up on a large scale. There are 1427 large completed dams in the state and many more are coming up. Central Designs Organization (CDO) is the state owned Organization under the Irrigation Department of the state entrusted with the activity of designing dams and other allied structures.

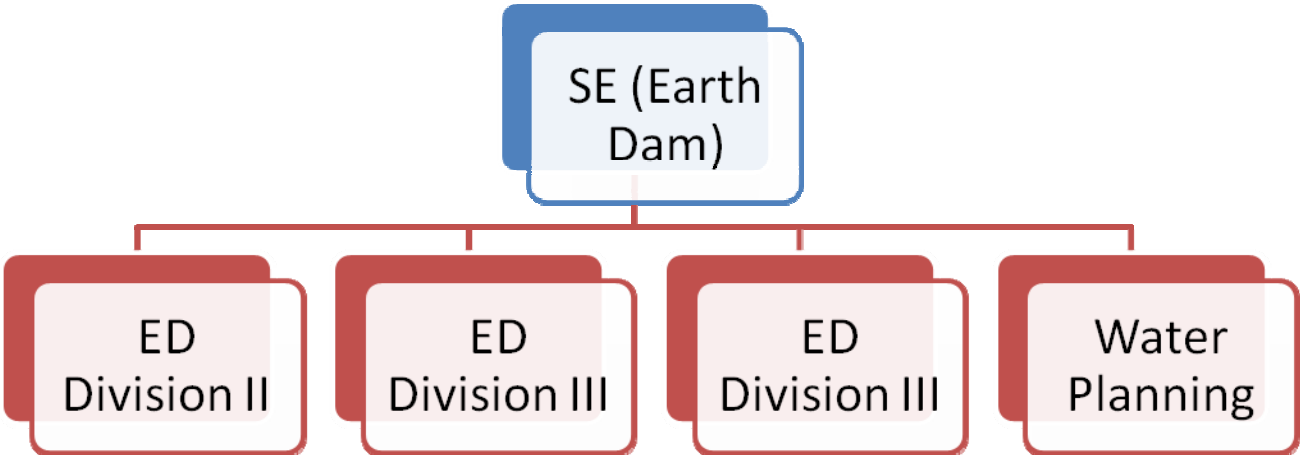
CDO was formed in the year 1957. It has four design circles headed by Superintending Engineer. Design units in each circle are headed by Executive Engineers which are assisted by Deputy Engineers and Assistant Engineers.

- Masonry dam circle - 4 Design units and one geological unit headed by senior geologist.
- Earthen dam circle - 3 Design units and a Water planning unit.
- Gates circle - 4 Design units.
- Power House circle - 4 Design units.
- All the staff is quite experienced and attained certain degree of expertise.
- All the key software's are indigenously developed to suit the needs of the design.
- Nearly 200 trained Engineers are working in this organization.
- It has its own building.
- The reputed Maharashtra Engineering Research Institute (MERI) is also located in the same premises. The model studies and other material testing work are carried out in the Institute which timely corroborates/supplements design needs.
- The organization has enormous amount of collection of various technical literature and fulfills needs of the time by adding on the latest.
- The organization has published number of papers in various1 national and international seminars.



Chapter 2 Earth Dam Circle

2.1 Organizational Setup of Earth Dam Circle



2.2 Role of Earth Dam Circle

1) Preparation of General Layouts of main dam of Major/Medium Irrigation projects (Marathwada & Konkan region)
    a. Selection of type of dam
    b. Fixing the control levels.
    c. Finalization of spillway location
    d. Layout of tail & approach channel.
2) Design of Under Seepage Control Measures.
3) Design of Earth/Rock fill Dam for Major, Medium & Minor Irrigation Project. The stability of earth dam is checked for the following conditions.
    a. Upstream slope reservoir full with earthquake condition.
    b. Upstream slope for sudden drawn-down condition.
    c. Downstream slope for steady seepage with earthquake condition.
    d. Downstream slope for steady seepage without earthquake condition.
    e. Downstream slope for sustained rainfall condition.
4) For design of earth dam section, computer program is developed by this circle. This program is built in `Fortran Language' which covers maximum trials to give accurate results.
5) Design of junction between Masonry & Earth dam.
6) Provision of various types of instrumentation in earth dam.
7) Review Of Old Dams

8) Review of old dams. For taking review of old dams, Government of Maharashtra has prescribed a checklist. Accordingly the required data for the project is collected from field officers and study all the aspects, which are required for review & suggest the remedial measures if required. For review of project Hydrological study & structural stability is mainly checked.

9) To increase the existing capacity of the reservoir, the height of earth dam has to raise. The design for such raised earth dam section is also done by this circle.
10) Suggestions to the problems raised during construction/ after construction on field.
11) Hydrology studies (Water Planning
    a. Water availability (yield) studies.
    b. Flood study of major & medium projects for finalization of spillway capacity as well as C.W.C clearance.
    c. Simulation studies to check the performance of the project.
12) Design of canal structures: As per the government norms the design canals structures costing more than 2.5 crores is done by this circle.
13) Checking of the project report posed to Central Water Commission for clearance from Konkan & Nagpur Region.
14) Consultancy services for semi government/Private sectors for construction/ designs of earth dams.

15) Vetting of the designs & drawings for Irrigation Projects prepared by private consultant.

Since 1959, the work of design of earth dam is being done by this circle. Vast experience from last 49 years is available. Based on the practical experience gained C.D.O Code of practice for design of Earth dam is prepared. This circle have design more than 500 numbers of earthen dam in all regions of Maharashtra. This includes longest dams as well as high dams. Prominent among these are Warna dam in Kolhapur district having height 78m and Tillari in Ratnagiri district having height 75m are designed by this circle.

2.3 Data Required for Design of Earth Dam

For design of earth dam Foundation investigation and Borrow area investigation is necessary.

[1.] For Foundation investigation following data is required:

i) Bore hole data and open trial pits marked on 'L' Section showing detailed stratification.
ii) Undisturbed samples collected from the foundation at every 1.5m depth or change of strata.

[2.] For Borrow area investigation following data is required:

i) Borrow area Plan.
ii) For major and medium projects one sample per 30,000 m3 and for minor irrigation projects one sample 15,000 m3 of estimated quantity of earth work and at least 5 samples from each quarry shall be tested for each zone of the embankment.
iii) 20% samples should be tested exclusive from MERI , Nashik for confirmatory test.
iv) Annual rainfall for checking stability of dam for rainfall condition.
v) Location of stone quarries and filter material along with availability.

2.4 Data Required for Flood Studies

1) Catchment area plan up to the site in question for which flood studies are to be done to a scale of 1:50,000 or 1:2,50,000 depending on the size.
2) Hourly gauge data for 8 to 10 severe flood events for the flood period prefixing & suffixing 48 hours, for the river gauge site or dam site located near the point for which flood studies are to be done.
3) Stage Vs. Discharge data for the years for which severe flood events as stated (2) above are selected.

4) The hourly rainfall data of all the Self Recording Rain Gauge[1] stations located in the Catchment area in question, for the flood period as stated in point (2) above.
5) 5. Daily rainfall data of all ordinary rain gauge stations located in the Catchment area in question, for the period as stated in point (1) above .
6) Plan showing the locations of river gauge stations/ Tank and S.R.R.G. & O.R.G stations.
7) If medium or major projects are located in its Catchment area upstream, their salient features. In case, this upstream project contributes to a large extent to the downstream flood at the point in question, moreover moderate to the flood to a great extent, then data as mentioned in 1 to 6 above would be required for this upstream project. In addition Area-Capacity table & spillway details such as number and size of gates etc. would also be required for this upstream project.

2.5 Data Required for Yield Studies

1) Catchment area plan showing the location of the site for which yield studies are to be done.
2) Monthly runoff data observed at dam site or site maintained by either state or CWC[2] from the commencement of the station to this date.
3) Monthly rainfall data of all the stations located in the catchment area for 40 continuous years. This 40 years includes the years for which run off data is available.
4) Plan showing the locations of rain gauge stations & River gauge stations.
5) Monthly upstream utilization data of existing projects located in its Catchment area.

2.6 Data Required for Simulation Study

1. 40 years monthly runoff series at the site at which the simulation studies are to be done. The data required for yield studies are separately given.
2. Monthly evaporation depth at the project site.
3. Demands expected from the project
    a. Domestic water supply requirement
    b. Industrial water supply requirement
    c. Crop water requirement as per Modified Penman's method
4. Monthly upstream utilization data planned in its catchment area
5. Silt rate observed at the gauging site in vicinity
6. Original area-capacity table showing survey contours

[1] SRRG: Self Regulating Rain Gauge
[2] Central Water Commission

Chapter 3 Flood Estimation Report[1] of CWC

3.1 Introduction

Estimation of flood of various return periods for design of waterways and foundations of bridges and culverts having small and medium catchments, where hydro-metrological data are inadequate or totally absent, is extremely difficult. In such a situation, regional methods based on hydro-meteorological approach involving use of Synthetic Unit Hydrograph and design storm of specific return period has been adopted. For this purpose, the country has been divided into 26 hydro-metro logically homogenous subzones and 21 flood estimation reports covering Hydro-meteorological studies for 24 subzones have been published by CWC.

Whenever extra data is become available, periodic revision of sub zonal report is undertaken by CWC. These reports are a joint venture of following organizations-

1. Central Water Commission (CWC)
2. Indian Meteorological Department (IMD)
3. Research Design and Standard Organization (RSDO) of Ministry of Railways.

3.2 Necessity of FER

Design engineers essentially need the design flood of specific return period for fixing the waterways vis-à-vis the design HFL and foundation depths of bridges, culverts and CD structures depending on their life and importance to ensure safety as well as economy. A casual approach may lead to underestimation or overestimation of structure or uneconomical structure with problematic situation.

The use of empirical flood formulae like Dickens, Rxves, Inglis etc. has no such frequency concept, though has the simplicity in relating the maximum flood discharge to the power of catchment area with constants. These formulae do not take into account the basic meteorological factor of storm rainfall component and other physiographic and hydrological factors varying from catchment to catchment. Proper selection of constants in these empirical formulae is left to the discretion of the design engineer, involving subjectivity.

Recognizing the need to evolve a method for estimation of design flood peak of desired frequency, the committee of engineers headed by Dr. A.K. Khosla had recommended, in their report that the design discharge should be maximum flood on record for a period not less than 50 years. Where adequate

[1] FER: Flood Estimation Report, published by CWC.

records are available extending over a period of not much less than 50 years, the design flood discharge should be 50 years flood determined form probability curve on the basis of recorded flood during the period. In case, where the requisite data as above is not available, the design flood should be decided on the ground and meteorological characteristics obtained on the basis of design storm necessitating the systematic and sustained collection of hydro-meteorological data at selected catchments in different climatic zones of India.

Economic constraints do not justify detailed hydrological and meteorological investigations at every new site on a large scale and on a long term basis for the estimation of design flood with desired return period. Regional Flood Estimation studies thus become necessary for the hydro-meteorological regions of the country.

3.4 Regional Approaches

Broadly two main regional approaches are open for adoption depending on the availability of storm rainfall and flood observations for the representative catchments for subjecting to statistical analysis to develop a regional flood-frequency model, which are as follows-

The other approach need concurrent storm rainfall and runoff data of the representative catchment over a period of 5 to 10 years to develop representative Unit Hydrograph (UH) of the catchment located in the region, so that Synthetic UH may be obtained for the region (subzones) and long term rainfall records at a large number of stations to develop design storm values. This approach has been adopted in the preparation of FER under short term and long term plan.

3.5 Short Term Plan

Under short term plan, the report on estimation of design flood peak utilizing hydromet data available for 60 bridge catchments, spread throughout the country, was brought out in 1973, wherein the method has been recommended for estimating the design flood peak for catchments areas ranging from **25 to 500 Sq. km** in the country.

3.6 Long Term Plan

Under long term plan, country has been divided into 26 hydro-meteorological homogeneous subzones. For preparing the FER for these subzones, systematic and sustained collection of hydro-meteorological data at the representative catchment s, numbering 10 to 30, for a period of 5 to 10 years in different subzones has been carried out in a phased manner by different zonal railways since 1965 under the supervision and guidance of Bridge and Flood Wing of RSDO. Similarly, the Ministry of Transport had undertaken the collection of data for 45 catchments through CWC since 1979.

3.7 Flood Estimation For Un-gauged Catchment

Regional Hydrology Studies Directorate, CWC carries out analysis of selected concurrent rainfall and flood data for the gauges catchments to derive UH of mostly one hour duration on the basis of rainfall data, gauge and discharge data collected during the mansoon season. Representative UH is obtained for each of the gauged catchments. The characteristic of the catchment and their UH, prepared for several catchments in subzone are correlated by regression analysis ad the equation for Synthetic UH for subzone are derived for estimating design flood for un-gauged catchment. Studies are also carried out by CWC to arrive at suitable recommendations for estimating loss rate and base flow for un-gauged catchments.

IMD conducts Depth-Duration frequency analysis of rainfall for each subzone to provide hydro-meteorological input for estimation of design flood.

The sub zonal reports incorporating studies carried out by CWC and IMD are prepared and published by CWC on approval of Flood Estimation Planning and Coordination Committee (FEPCC)

Flood Estimation Reports for subzones

So far, following 21 FER's covering 24 subzones have been published-

Sr. No.	FER	Year
1	Lower Ganga Plains Subzone 1(g)	1978
2	Lower Godavari Subzone 3(f)	1981
3	Lower Narmada and Tapi Subzone 3(b)	1982
4	Mahanadi Subzone 3(d)	1982
5	Upper Narmad and Tapi Subzone 3(c)	1983
6	Krishna and Pennar Subzone 3(h)	1983
7	South Bramhaputa Subzone 2(b)	1984
8	Upper Indo-Ganga Plains subzone 1(e)	1984
9	Middle Ganga Plains Subzone 3(f)	1985

10	Kaveri Basin Subzone 3(i)	1986
11	Upper Godavari Subzone 3(e)	1986
12	Mahi and Sabarmati Subzone 3(a)	1987
13	East Coast Subzone 4(a), (b) and (c)	1987
14	Sone Subzone 1(d)	1988
15	Chambal Subzone 1(b)	1989
16	Betwa Subzone 1(c)	1989
17	North Brahmaputra Subzone 2(a)	1991
18	West Coast Region Subzone 5(a) & (b)	1992
19	Luni Subzone 1(a)	1993
20	Indravati Subzone 3(g)	1993
21	Western Himalaya Zone 7	1994

Chapter 4. Synthetic Unit Hydrograph

4.1 Synthetic Unit Hydrograph (SUG))

Hydro-meteorological approach has been adopted for developing a regional method for estimating design flood for small and medium catchment in various hydro-meteorological homogeneous subzones. In this approach the design storm after converting it into effective rainfall (input) is applied to the UH (transfer function) to obtain a design flood (basin response). It is possible to develop UH if the site specific concurrent rainfall-runoff data is available for 3-4 years. Collection of adequate concurrent rainfall-runoff data for every site is however neither practicable nor economically feasible. In such a situation, the regional method for developing SUG is resorted to.

4.2 Data Required

For conducting the UH studies for development of equations for derivation of SUG, following concurrent rainfall and runoff data for a number of catchments of small and medium size, representatively located in a subzone are required for a period of 5 to 8 years during the mansoon season:

1. Hourly rain gauge data at the gauging site
2. Gauge and Discharge data observes 2 to 3 times a day at a gauging site.
3. Hourly rainfall data of rain gauge stations in the catchment.

Following catchment details are also required-

4. Catchment area plans showing the river network, location of rain gauge stations and gauge and discharge sites, contours, roadways and railways network nature and man made storages, habitations, forests, agricultural and irrigated areas, soils etc.
5. Cross-section of the river at gauge site, upstream and down-stream of the bridge site.
6. Longitudinal section of the river upstream and downstream of the gauging site.

4.3 Derivation of Synthetic Unit Hydrograph

Procedure to obtain physiographic parameters and UH parameters o the catchments and establishing relationship between these parameters to derive SUG is described in following paragraphs-

Physiographic Parameters

- Catchmnet Area (A)
- Length of Main Stream (L)
- Length of main strema from a point near the CG of catchment to the gauge site (Lc)
- Equivalent Stream Slope
  - By Graphical Method
  - By Analytical Method

Unit Hydrograph Parameters

- Scrutiny of data and finalization of Gauge-Discharge rating curve
- Selection of floods and corresponding storm events
- Computation of hourly catchment rainfall
- Computation of the hourly direct runoff depth
- Computation of Infilteratio loss and 1-hour effective rainfall units
- Derivation of 1-hour unitgraph
- Drawing of representative unitgraphs and measuring their parameters

4.4 Establishing relationship between Physiographic an dUH parameters

Linear and non-linear equations were tried for establishing the relationship between UG parameters and physiographic parameters of the catchments and non-linear equation as described below was found to be the best fit.

$$Y = C * X^P$$

Where,

Y = Dependent Variable
X = Independent Variable
C = Constant
P = Exponent

4.5 Derivation of 1-hour SUG for an un-gauged catchment

Considering hydro-meteorological homogeneity of subzone the relations established between physiographic and UH parameters are applicable for derivation of 1-hour SUG for an un-gauged catchment in the subzone.

The steps for the derivation of 1-hour UH are-

1. Physiographic parameters of un-gauged catchment viz A, L, Lc and Ls are determined form the catchment area plan.
2. Obtain tp, QP,W50, W75, WR50,WR75 and TB substituting appropriate basin/UH parameters.

3. Plot the parameters of 1-hr Unitgraph viz Tm, TB, Qp, w50, W75, WR50 and WR75 on a graph paper and sketch the Unitgraph through these points.

Sum of discharge ordinates of tr-hr Unitgraph is obtained and compared with the value found by using the following equation-

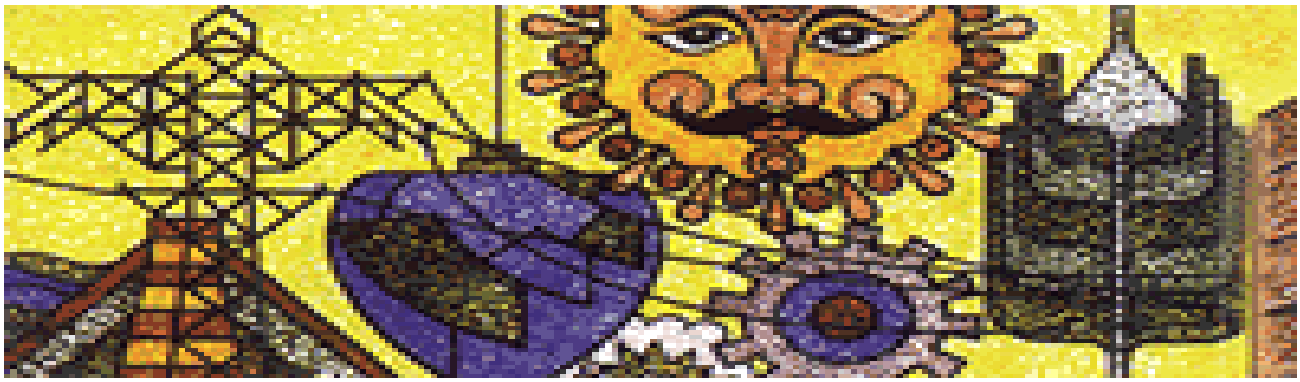
$$Qi = 2.78\ A / tr$$

Where,

Qi = Discharge ordinates at 1-hour interval (cumecs)
A = Catchment Area (sq. km)
tr = Unit durations in Hour.

4.6 Design Loss Rate

Direct surface runoff is the end producer of storm rainfall after Infilteration into surface soils, subsurface and ground besides abstractions like evaporation, soil moisture and filling up of surface depressions. It is different, rather impossible, to record these various parameters at various representative locations in the catchment except by the analysis of observed storm rainfall and flood events. Conversion of gross storm rainfall units into effective rainfall units for application to Unitgraph is normally done by subtraction of constant loss rate for the catchment, even though the loss rates in the catchments, complex phenomena, vary due to soil conditions, soil cover and topography along with temporal and spatial variations of storm rainfall.



Chapter 5. Design Flood Estimation

5.1 Criteria & Standard

Criteria and Standards followed fir design flood for bridges, CD structures and small dams are given below-

5.1.1 Indian Railway Standard Bridges Substructure

It was revised in 1985 stipulate that all bridges shall be designed with adequate waterway for design discharge. This shall normally be the computed flood with probable recurrence interval of 50 years. However, at discretion of Chief Engineer/Chief Bridge Engineer, if a bridge is likely to have severe consequences, it may be designed for floods with a probable recurrence interval of more than 50 years, while bridges on less important lines or sidings may be deigned for floods with a probable recurrence interval of less than 50 years.

5.1.2 Indian Road Congress

IRC 5-1985, Clause 103 of section I "General Features of Design" Specifies that the Water way of a bridge is to be designed for a maximum flood safety, the foundation and protection works should be designed for larger discharge specified in Clause 103 is same as suggested by the Committee of Engineers.

5.1.3 IS:7784 (Part I)-1975 "Practice for Design of CD Works"

It recommends that the waterway for CD works should be designed for a 25 year return period flood. To provide adequate margin of designed for larger discharges. The percentage increase over the design discharge recommended in the code is same as suggested by the Committee of Engineers.

5.1.4 CWC Criteria

CWC Criteria of 1968 specifies that the diversion dams and weirs should be designed for floods of frequency of 50-100 years

5.1.5 IS:11223-1985 "Fixing Spillway Capacity of Dams"

It recommends 100 year return period flood as inflow design flood for small dams having either gross storage of the dam between 0.5 and 10 Mcum or hydraulic head between 7.5 to 12 m.

5.2 Estimation of Design Flood: A Case Study

To study the procedure of calculating the design flood for any irrigation project the concerned officer of water planning divison undergo through FER. As per instructions our batch studied the report of 'Review of Design Flood for Gharni Medium Project of Tal. Shirur Anantpal, Dist: Latur.

The date required and the procedure of flood studies is explained briefly as under-

5.2.1 Data Required

1. Location	**Tal: Shirur Anantoal, Dist: Latur**
2. Geodetic Location	Toposheet No. 56B/15
3.	Latitude: 18^{o} 22' 30''
4.	Longitude : 76^{o} 49' 15''
5. Catchment Area	243.46 Sq.km (94 sq.km)
6. Submergence Area	9.49 Sq.km
7. Controlling Levels	TBL: 598.20m
8.	FRL: 594.04m
9.	MDDL: 589.93m
10.	RBL: 582.90m

5.2.2 Design Criteria

As per IS 11223:1985, the design criteria regarding design flood for deciding spillway capacity of the dam is as under-

Sr. No.	Gross Storage (MCM)	Hydraulic Head (m)	Type of Design Flood
1	➢ 60	➢ 30	PMF
2	➢ 10 <60	➢ >12 < 30	SPF
3	➢ > 0.5 < 10	➢ 7.5 < 12	100 years return period

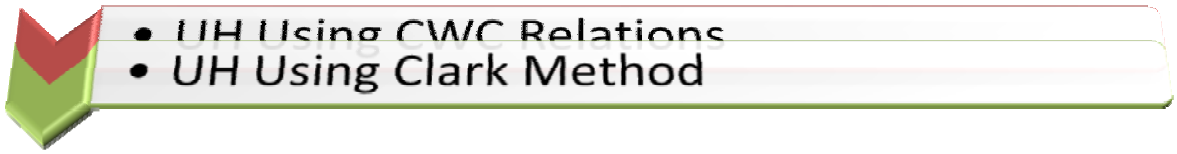
The gross storage of the Gharni M.I. project is 25.08 MCM and hydraulic head is less than 50m. Hence spillway capacity of existing project is required to be sufficient to pass standard project flood safely.

5.2.3 Methodology for Computing Standard Project Flood

For Gharni M.I. Project hydro-meteorological approach is adopted for computing standard project flood. In this method the representative UH for catchment proper is required to be derived and appropriate standard project storm is to be applied to UH ordinate to compute SPF

5.2.4 Derivation of UH

Following two methods are generally used for derivation of UH-



Detailed procedure for calculating UH using CWC Relations-
In absence of actual observed hydrological data the SUG can be derived by using relations of FER for various subzones. The project considered for the present case study lies in Upper Godavari Subzone 3(e).
The various steps necessary to estimate the design flood peak/design flood hydrograph are as under-

1. Preparation of catchment area plan of the un-gauges catchment.
2. Determination of physiographic parameters viz. the catchment Area (A). the length of the longest stream (L) and equivalent Stream Slope (S).
3. Determination of 1-hour unigraph parameters i.e. peak discharges per sq.km (qp), the peak discharge (Qp), the basin lag (tp), the peak time of UG ™, width of Unitgraph of 50% and 75% of Qp (W50 & W75) widths of the rising limbs of UG at 50% and 75% of Qp (WP50 & WP75) and time base of Unitgraph (TB)
4. Drawing a Synthetic Unigraph.
5. Estimation of Design Storm Duration (TD)
6. Estimation of point rainfall and areal rainfall for design storm duration (TD)
7. Distribution of areal rainfall during deign storm duration (TD) to obtain rainfall increments for unit duration intervals
8. Estimation of rainfall excess units after subtraction of prescribed design loss rate from rainfall increase.
9. Estimation of base flow.
10. Computation of design flood peak.
11. Computation of design flood hydrograph.

As peer the above mentioned procedure the UH for Gharni M.I Project was derived as under-
Physiographic parameters are calculated from C.A. plan-

- Catchment Area = 243.46 sq.km
- Length of longest stream = 21.60 km
- Equivalent Slope = 2.603 m/km.

Using the physiographic parameters and relations in FER-(e), SUG for virgin condition is derived.
The Salient features of UH are as under-

- 1 cm – 1 hour UH
- Unit Duration – 1 hour
- Time to Peak – 4 hours

- Pak – 163.12 cu.m./sec.
- Base Period -14 hours

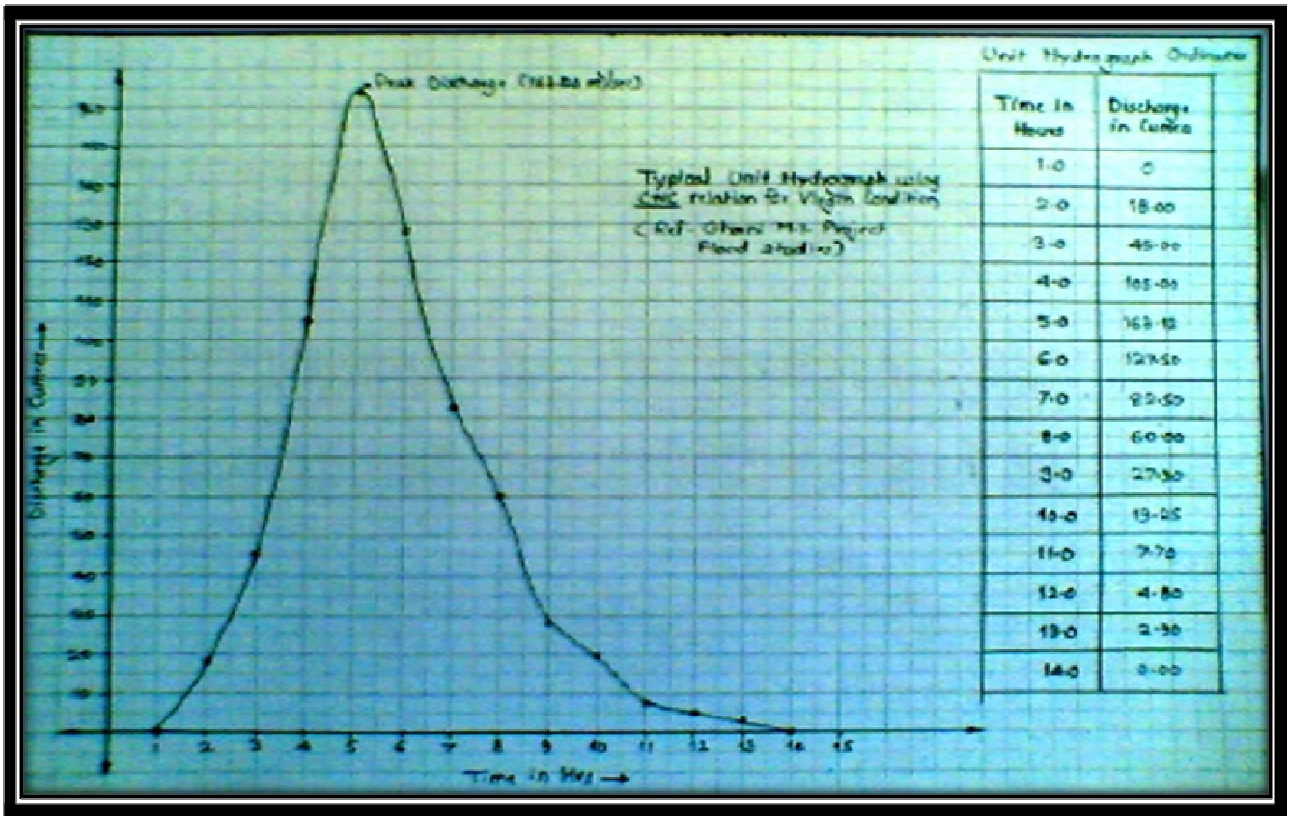
5.2.5 Design Storm

As per the design steps/criteria discussed earlier, it is necessary to compute standard project flood for which standard project storm details are required. These details can be obtained from IMD.
The design storm values data received from IMD is in the following form-
As per the available rainfall data, the 1-day SPS and PMP values are 40.1 cm and 50.1 cm respectively. These values may be increased by 15% to convert them into any 24-hour values.

Duration (hour)	**3**	**6**	**9**	**12**	**15**	**18**	**21**	**24**
% of Storm Rainfall	39	59	71	81	89	93	97	100

5.2.6 Computation of Standard Project Flood Hydrograph

Using he UH ordinates the standard project flood hydrograph are computed by convolution method. Base flow rate worked out by formulae given in FER 3(e). The base flow at this rate is added and SPF hydrograph thus computed.



Chapter 6. Conclusion

The training session at Water Planning Division of Earthen Dam Circle, Central Design Organization, Nashik, was the most enjoyable session for me. I joined Water Planning Division on 16th June 2008 under the guidance of Miss. Sunanda Jagtap Madam Executive Engineer, and interacted with her along with the staff of division. Training session ended on 18th June 2008 and this report includes the summary of the training.

I learned the procedure for estimation of flood and details of Flood Estimation Report prepared by Central Water Commission, New Delhi.

It was nice experience for me since I could realize the importance of Water Planning and Flood Estimation. The success of the project heavily depend on the flood estimation study.

At last, I am thankful to Superintending Engineer- **Shri. M.S. Bendre Saheb,** Executive Engineer- **Miss. Sunanda Jagtap madam** , SDE- **Shri. Kulkarni Saheb** and all the staff of division for providing me an opportunity to enjoy the thrill of design and providing all the necessary documents and related procedure.

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