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उत्तराखण्ड शासन

Annual Report 2014-15



Irrigation Research Institute
(An ISO 9001 : 2008 Certified Organisation)
Roorkee - 247 667

August 2015

Consultancy Areas

IRI undertakes Research and Development activities related to Irrigation and Hydro-electric Projects in the following major areas :

- Providing efficient and economical hydraulic design for various engineering works viz.
 - Canal works, Spillways, Power House, Intakes.
 - Diversion Works, Surge Tanks, Sediment Excluding and Ejecting Devices.
 - Siting of Bridges and Barrages.
 - River Training, Flood Protection and Anti-erosion measures.
- Geotechnical Investigations, Concrete Mix Design and Material Testing for all Civil Engineering Structures.
- Economical design of Concrete Mixes using Flyash and Superplasticizers; Roller Compacted concrete for Massive Structures.
- Ground Water Development
 - Conjunctive Use of Sub-surface and Surface Water, Water logging.
 - Suitability for Canal Linings, Seepage from Canals, Tubewell.
 - Stability due to Sub-surface flow, Water Suitability.
 - Studies for Regeneration/Seepage from Water Bodies.
 - Artificial Recharging.
- Sedimentation Studies
 - Capacity and Life of Reservoirs.
- Mathematical Modeling
 - Hydrological Events.
 - Sub-surface flow, Surface flow.
 - Hydraulic Structures etc. (Surge Tank, Water Hammer and Sedimentation Chamber).
- Basic & Fundamental Research in the field of Water Resources.

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Annual Report 2014-15



An ISO 9001:2008 Certified Organization

Irrigation Research Institute
Roorkee - 247 667(Uttarakhand)

August 2015



हरीश रावत



मुख्यमंत्री, उत्तराखण्ड

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सन्देश

मुझे यह जानकर हर्ष हो रहा है कि उत्तराखण्ड सिंचाई विभाग के अधीन शोध एवं विकास सम्बन्धी प्रतिष्ठान सिंचाई अनुसंधान संस्थान, रुड़की वर्ष 2014-15 में किये गये विभिन्न अनुसंधान एवं परीक्षण कार्यों की 85 वीं वार्षिक विवरणिका प्रकाशित करने जा रहा है। सिंचाई अनुसंधान संस्थान, रुड़की लगभग विगत 7 दशकों से जल संसाधन से सम्बन्धित शोध एवं विकास कार्यों के विभिन्न क्षेत्रों में महत्वपूर्ण योगदान दे रहा है।

सिंचाई अनुसंधान संस्थान, रुड़की द्वारा जलविज्ञान क्षेत्र में अनेकों महत्वपूर्ण उपलब्धियां अर्जित की गयी हैं। संस्थान द्वारा अनेक बाढ़ नियंत्रण एवं जलविद्युत गृह सम्बन्धी शोध अध्ययन संचालित किये जा रहे हैं। आज के युग में विभिन्न नदियों के जल से ऊर्जा, प्रकाश एवं अन्य उत्पादन प्रदेश एवं देश की प्रथम प्राथमिकता बन गयी है।

उत्तराखण्ड राज्य में विभिन्न नदियों, जल स्रोतों का अपूर्ण भण्डार है। इस प्राकृतिक अमूल्य जल संपदा का जन कल्याण हेतु उपयोग किये जाने में एवं बढ़ते हुए ऊर्जा एवं जल संकट का समाधान करने में सिंचाई अनुसंधान संस्थान, रुड़की महत्वपूर्ण भूमिका निभा रहा है।

विवरणिका में प्रकाशित वैज्ञानिक/अभियन्ताओं के शोध कार्य युवा वैज्ञानिकों के लिये लाभदायक एवं प्रेरणाप्रद होंगे, ऐसा मेरा विश्वास है।

विवरणिका वर्ष 2014-15 के सफल प्रकाशन हेतु शुभकामनायें।

(हरीश रावत)

यशपाल आर्य
सिंचाई मन्त्री



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सन्देश

मुझे यह जानकर अत्यन्त प्रसन्नता हो रही है कि सिंचाई अनुसंधान संस्थान, रुड़की वर्ष 2014-15 हेतु अपने शोध कार्यों की 85वीं स्मारिका प्रकाशित कर रहा है।

प्रकृति की अमूल्य धरोहर जल निधि के प्रबन्धन में यह संस्थान ब्रिटिश काल से ही अग्रणी रहा है। उत्तराखण्ड राज्य भारत वर्ष की दो प्रमुख नदियों गंगा एवं यमुना का उद्गम स्थल है। इन नदियों के साथ-साथ राज्य में उपस्थित अन्य नदियों के अपूर्व जल संपदा, जल विद्युत ऊर्जा, नदियों की सिंचाई क्षमता सदैव अभियंताओं एवं शोधार्थियों को लुभाते रहे हैं। सिंचाई अनुसंधान रुड़की जल विद्युत ऊर्जा परियोजना, बाढ़ नियंत्रण क्षेत्र तथा जल विद्युत ऊर्जा परियोजनाओं के प्रतिरूप अध्ययन में आज भी अग्रणी कार्य कर रहा है।

मुझे पूर्ण विश्वास है कि संस्थान के अधिकारी कर्मचारी देश व प्रदेश में जल संवर्धन एवं जल प्रदूषण की समस्याओं हेतु भी मंथन करेंगे साथ में इसके उपयोग, संरक्षण एवं प्रबंधन में पारस्परिक सौहार्दपूर्वक महत्वपूर्ण भूमिका निभायेंगे।

मेरी ओर से 85वीं पुस्तिका के सफल प्रकाशन हेतु सिंचाई अनुसंधान संस्थान, रुड़की के समस्त अधिकारियों/वैज्ञानिकों एवं कर्मचारियों को हार्दिक शुभकामनाएँ।

आपका

(यशपाल आर्य)

Anand Bardhan, IAS
Secretary



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Letter No. - 59 PS-SECY/2015

Dated : 16 June, 2015



Message

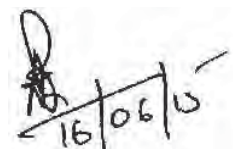
It is matter of great pleasure that Irrigation Research Institute, Roorkee is publishing 85th annual report highlighting its achievement during year 2014-2015.

Irrigation Research Institute, Roorkee is a premier Institute in the field of hydraulic modeling, geotechnical testing, ground water related studies, flood protection works, concrete technology and testing of materials for engineering use.

I am happy to learn that during the year 2014-2015, Irrigation Research Institute, Roorkee has undertaken hydraulic studies for various important hydroelectric projects like Tehri P.S.P (Uttarakhand), Ratle H.E.P.(J&K), Lata Tapovan H.E.P. (Uttarakhand), Kameng H.E.P. (Arunachal Pradesh), Naitwar Mori H.E.P. (Uttarakhand), Bogibill bridge (Assam), Seli H.E.P. (H.P.). I am happy to note that forty eight Research reports and seventy test reports were issued by the Institute which speak volume of its contribution in R&D activities.

I compliment engineers, scientists and staff of the entire Institute for their outstanding achievements and hard work.

I wish all the success for the publication of this report.


16/06/15
(Anand Bardhan)

V.K. Tamta

Former Chief Engineer & HOD
Irrigation Department, Uttarakhand
Dehradun



Message

It gives me great pleasure that Irrigation Research Institute, Roorkee is publishing its 85th Annual Report for the year 2014-2015. Irrigation Research Institute has played important role at national and international level in R & D activities related to water resources management especially in Planning, Design & Hydraulic Model studies for Hydro-Electric projects.

Irrigation Research Institute, Roorkee is very old and premier institute in the field of hydraulic modelling and testing of civil engineering construction materials. It was initially established as a small research unit in 1928 at Lucknow and then shifted its activities to Bahadrabad in 1946, situated on the left bank of Ganga canal in Hardwar district. The unit was upgraded to a full-fledged research institute at Roorkee in 1954.

During the year 2014-2015, the institute has taken up big leap in undertaking R & D activities of many projects like Seli HEP (Lahul & Spiti HP), Tehri PSP (Uttarakhand), Ratle HEP (Kishtwar, J&K), Kameng HEP (Arunachal Pradesh), Road Bridge over river Hindon (U.P.), Rapti Main Canal (U.P.), Naitwar-Mori HEP (Uttarakhand), Bogibil Bridge (Brahmaputra, Assam), Lata-Tapovan HEP (Chamoli, Uttarakhand). I am happy to mention that the institute has issued 48 Research Reports and 70 Test Reports.

To conclude, I take this opportunity to compliment the engineers, scientists and entire staff of IRI Roorkee, who even after the limited resources have helped in achieving the deserved goals. I hope that the publication of this annual report will help the end users and the same momentum will be maintained the year to come.

I wish all the success for publication of Annual Report 2014-2015.

(V.K. Tamta)

D.P. Jugran

Chief Engineer & HOD
Irrigation Department, Uttarakhand
Dehradun



Message

It gives me immense pleasure that Irrigation Research Institute, Roorkee is publishing its 85th Annual Report for the year 2014-2015. Irrigation Research Institute, Roorkee, which is one of the directorates of Uttarakhand Irrigation Department, is involved in carrying out R&D activities related to hydroelectric and Irrigation projects for different states of the country.

The institute has excellent facilities for carrying out hydraulics model studies in its Field Research Station, Bahadrabad. It is worth mentioning that model studies for major projects of international importance have been carried out at IRI only viz. Tehri Dam Project, Baglihar HEP (Joint venture of India & Pakistan), Nathpa Jhakri Project (J&K), Nyabarango Hydel Project, Rwanda (East Africa), Upper Marsyandi Hydel Project (Nepal), etc. Besides, the design of flood protection work for Yamuna river at Karnal District and preparation of DPR for artificial recharge of ground water in district Gurgaon and Mahdragarh of Haryana State have also been carried out in association with Irrigation Design Organisation (IDO), Roorkee which is a sister concern of the institute located just adjacent to IRI, Roorkee.

In addition, an ambitious joint project of Central and State Governments namely Hydrology Project (HP-1) was launched in 1995. The third phase of the project (HP-3) has been taken up in 2014 and renamed as National Hydrology Project (NHP). IRI and IDO, have been identified as an implementing agency for NHP in Uttarakhand. The main objectives of NHP are Meteorological Monitoring of different districts; Surface Water monitoring, including water use and Water Quality monitoring of different rivers flowing in Uttarakhand; assessment of sediment potential of different rivers as well as reservoirs, etc. Recently IRI, Roorkee has also taken lead in quality assurance works for Rural Road & Drainage Department and the construction work related to forthcoming Ardha-Kumbh fair- 2016 being organized at Haridwar.

To conclude, I take this opportunity to compliment the engineers, scientists and entire staff of I.R.I Roorkee, who even after the limited resources have helped in achieving the desired goals. I hope that the publication of this annual report will help the engineers and research personnels involved in R & D activities of similar nature.

I wish all the success for publication of Annual Report 2014-2015.

(D.P. Jugran)

Ajay Verma

Chief Engineer (Design) & Director
Irrigation Research Institute
Roorkee - 247 667 (Uttarakhand)



Message

It gives me immense pleasure in presenting the 85th annual general report of Irrigation Research Institute, Roorkee for the year 2014-15. This annual report contains details of R & D activities carried out by different research units of the institute. This institute is an excellent work station in the field of Hydraulic model studies, testing for civil engineering construction materials and studies related to Ground water etc. The hydraulic model studies for various irrigation, hydro projects and flood protection works of Uttarakhand and other states are being conducted at Hydraulic Research Station of Irrigation Research Institute, Roorkee located at Bahadrabad.

Important studies for different projects carried out by this institute during the year include Seli H.E.P (Lahul & Spiti, HP), Tehri Pump Storage Plant (Uttarakhand), Ratle H.E.P. (Kishtwer, J&K), Kameng H.E.P.(Arunachal Pradesh), Naitwar Mori H.E.P. (Uttarakhand), Bogibill bridge across river Brahmaputra (Assam), Road bridge over river Hindan (Ghaziabad, U.P.) Rapti main canal (U.P.), Lata Tapovan H.E.P. Chamoli (Uttarakhand), 3-D EHDA Model studies for various Syphon Aqueducts on Rapti Main Canal (U.P.) etc.

Some important activities of the institute during 2014-15 are mentioned below :-

1. During the year 48 research reports and 70 test reports were issued.
2. A proposal for establishing Highway Testing Laboratory was finalized for conducting tests related to various road works.
3. Initiative taken for World Bank aided Hydrology Project-3 for the state of Uttarakhand.
4. Initiative taken for joint collaborative research/sponsored studies with IIT Roorkee.
5. Linking of Irrigation Research Institute, Roorkee website (www.iriroorkee.res.in) to Uttarakhand government website (www.uk.gov.in) through NIC portal.

I appreciate the remarkable efforts adopted by the institute towards R & D actives related to present scenario of irrigation and hydro electric projects through applied and field oriented research. An institute report is an excellent medium to disseminate its scientific creativity and its finding to the engineering fraternity.

To sum up, I wish to record my gratitude to various sponsors all over country who have shown their faith by referring studies to this institute. I take this opportunity to thank research personnels, engineers and staff who have helped in achieving the desired goal and are ready to undertake future challenges.

Jai Hind


(Ajay Verma)



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SECTION - A GENERAL REPORT

(a) GENERAL

Irrigation Research Institute, Roorkee (Formerly U.P.I.R.I.) was initially established as a small research unit in the year 1928 at Lucknow, the Capital of North Central Province during British era. The purpose of this unit was to carry out research and development works related to Irrigation Canal projects being executed by the U.P. Irrigation Department. Mr. Gerald Lacey, the proponent of very popular regime theory for the design of irrigation canals in alluvial soils, was the founder of the above unit. The success of this research unit boosted up the confidence of practicing engineers and hence the research activities were further expanded when the aforesaid unit was shifted to a small town at Bahadrabad in 1946, which is located on the bank of Northern Ganga Canal near Haridwar on the national highway. Later on, it raised to a full-fledged research Institute in 1954 at Roorkee. The institute gradually developed as a pioneer research station of the country, which is providing facilities essentially for hydraulic model studies, testing of almost all types of civil engineering materials and basic / applied research related to hydroelectric projects, civil engineering


structures, flood protection, canal works etc. In addition, it also provides consultancy services on planning, design and constructions of canal and river valley projects to all the state governments, central government departments and private engineering organisations such as U.P.P.W.D., Public Health Engineering Deptt., Haryana, U.P. State Bridge Corporation Limited, National Hydro-electric Power Corporation (NHPC), Rail India Technical and Engineering Services (RITES), Tehri Hydro Development Corporation (THDC), Hindustan Construction Company (HCC) Ltd. Satluj Jal Vidut Nigam Ltd. (SJVN Ltd.), GVK Ltd. Secundrabad, Lanco Infrastructure, Dans Energy Ltd., Teesta Jal Urja Ltd. GMR Consultancy by Angelique International Pvt. Ltd, Hydrel / Irrigation Departments of Chatisgarh, Odisha, Uttar Pradesh, Haryana, Himachal Pradesh, J&K, Gujrat, Sikkim etc.

A list of important studies carried out for different projects of national and international importance is shown under the title 'Important projects/ R&D studies carried out in past by Irrigation Research Institute Roorkee.'



(b) Important Model Studies / R & D Activities Carried Out for Different Projects by IRI Roorkee in the Past:

- Tehri Dam Hydro-Electric Project (Uttarakhand).
- Hasan Dam (Republic of Yemen).
- Nyabarango Hydro-Electric Project, Rawanda,(East Africa).
- Upper Marsyandi Hydro-Electric Project, (Nepal).
- Baglihar Hydro-Electric Project J&K, (India / Pakistan).
- Vishnu Prayag Hydro-Electric Project (Uttarakhand).
- Maneri Bhali Project (Uttarakhand).
- Nathpa Jhakri Hydro-Electric Project (Himachal Pradesh).
- Ban Sagar Project Mirzapur (Uttar Pradesh).
- Karcham Wang too Hydro-Electric Project (Himachal Pradesh).
- Teesta Hydro-Electric Project (Sikkim).
- Tenga Dam Hydro-Electric Project (Arunachal Pradesh).
- Lahchura Dam, Mahoba (Uttar Pradesh).
- Vishnugad Pipalkoti Hydro-Electric Project (Uttarakhand).
- Rongni Chu Hydro-Electric Project (Sikkim).
- Rangit Hydro-Electric Project (Sikkim).
- Lower Rajghat Canal Lalitpur (Uttar Pradesh).
- Saurashtra Branch Canal Project (Gujrat).
- Koteswar Hydro-Electric Project (Uttarakhand).
- Baspa Barrage (Himachal Pradesh).
- Kameng Hydro-Electric Project (Uttarakhand).
- Srinagar Hydro-Electric Project (Uttarakhand).
- Hydraulic model studies of under sluice pocket and sediment excluder at Virbhadra Barrage (Uttarakhand).
- Polavaram Project (Andhra Pradesh).
- Design of Sharda Type fall for Canals (A Basic Research Study).
- Design of surge systems under transient conditions for different H-E Project (A Basic Research Study).
- Evolving criterion for design of energy dissipaters at low Froude Number.
- Revision and updating of Manual on Canal Lining (A Basic Research Study).
- Development of high performance concrete for Srinagar & Vishnu Prayag Hydro-Electric Projects (Uttarakhand).
- Impact Type Energy Dissipaters for Ranipur Super passage (A Basic Research Study).
- Design of roller compacted concrete for Jamrani Dam Project (Uttarakhand).
- Hydraulic model studies of Miyar H.E.Project (Distt. Lahaul & Spiti, Himachal Pradesh).

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- Yamuna H. E. Scheme Stage II, Throttled Surge Tank for Chhibro Power House - A Model Study.
 - Hydraulic model studies for diversion tunnel of Dibbin H.E. Project (Arunachal Pradesh).
 - Model studies for revised proposal of Jorethang Loop Hydro Electric Project (Sikkim).
 - Model studies for Bajoli Holi Hydro Electric Project (Himachal Pradesh).
 - Model studies for desilting chamber, reservoir flushing and hydraulic performance of power intake of Teesta-III Hydro Electric Project (Sikkim).
 - Model studies for Rongnichu Hydro Electric Project (Sikkim).
 - Model Studies for Desilting Chamber Rangit H.E Project (Sikkim).
 - Model studies of de-sander for Teesta H.E. Project Stage-VI (Sikkim).
 - Model Studies for Dam Spillway for Greater Shillong Water supply Scheme (Meghalaya).
 - Model Study for Tail Fall of Escape Channel of W.Y.C. H.E. Project Stage-II (Haryana).
 - Design of Spurs (A Basic Research Study).
 - Studies for hydraulic design of Excluder (A Basic Research Study).
 - Hydraulic design of stilling basin for Ghagra Barrage (Uttar Pradesh).
 - Sharda Sediment Ejector – A prototype study & Sharda type fall stilling basin design.
 - Siting barrage across Ram Ganga River at Hareoli.
 - Training river Yamuna above Tajewala for E.Y.C.
 - Study for siting barrage across river Yamuna near Tajewala (Uttar Pradesh).
 - Hydraulic design of Obra Dam spillway (Uttar Pradesh).
 - Training river Great Gandak in Nepal Territory.
 - Hydraulic Model Studies for Kalisindh dam project (Rajasthan).
 - Hydraulic Model Studies for Baitarani Hydro-electric project (Odisha).
 - Revision of a Chapter-V on Sediment Transport for Publication No. 204 of CBI&P, New Delhi.
 - Design of barrage floor for three dimensional seepage flow (A Basic Research Study).
 - Design of Syphon Aqueduct (A Basic Research Study).
 - Design of side training walls (A Basic Research Study).

My message, especially to young people is to have courage to think differently, courage to invent, to travel the unexplored path, courage to discover the impossible and to conquer the problems and succeed. These are great qualities that they must work towards. This is my message to the young people.

- A. P. J. Abdul Kalam



(c) Major Studies Carried Out During 2014-15 :

- Supplementary Report of Model Studies for Reservoir Flushing of Seli H.E.P. (Distt. Lahaul & Spiti, Himachal Pradesh) (3D Geometrical Similar Model on Scale 1:60).
- An Interim Report on Physical Model Studies for Head Losses in Upstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand).
- Model Studies for Inlet-Outlet of Tehri Pumped Storage Plant (Uttarakhand).
- An Interim Report on Physical Model Studies for Head Losses in Downstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand).
- Further Model Studies for Reservoir Flushing of Ratle H.E.P. (Distt. Kishtwar, J&K).
- Final Report on Physical Model Studies for Mass Oscillations in Water Conductor System of Baglihar H.E.P. Stage-II (Jammu & Kashmir).
- Further Model Studies for Water Conductor System of Kameng Hydro-Electric Project - 600 MW (Arunachal Pradesh).
- Model Studies For Road Bridge Over River Hindon in Ghaziabad(U.P).
- Hydraulic model studies for syphon aqueduct at Km. 49.500 Km., 72.300 Km., 14.600 and Km. 47.100 of Rapti Main Canal (UP).
- Compilation and Analysis of Observations Recorded at Meteorological Observatory, Hydraulics Research Unit-II, Bahadrabad.
- Model Studies for Barrage and Desilting Chamber of Naitwar Mori H.E.P. across river Tons in Distt. Uttarakashi, (Uttarakhand).
- Model Studies for Rail cum Road Bridge at Bogibill across river Brahmaputra, Assam (Post Flood 2013).
- Further Model Studies for Barrage-Intake of Lata Tapovan Hydroelectric Project in Distt. Chamoli, Uttarakhand .
- Model Studies for Reservoir Sedimentation of Naitwar Mori Hydro Electric Project across river Tones in Distt. Uttarkashi (Uttarakhand).

(d) **PUBLICATIONS**

The following are the types of publications which were issued during the year 2014-15

(i) **Annual Report** — Annual Report for the year 2013-14 was published giving the brief account of the technical activities of the institute, including the important studies carried out, papers presented, research reports and test reports issued during the year.

(ii) **Technical Papers and Research Reports** — During the year 2014-15, a total number of 48 Research Reports were issued by the Institute on the basis of studies carried out by different research units. A List of the Research Reports and Technical Papers under different titles are given in Section-B and the abstracts of the Research Reports as well as Technical Papers are given in Section-C.

(iii) **Test Reports** — Test reports are issued on the basis of field or laboratory tests carried out by the respective divisions. During the year 2014-15, 70 test reports pertaining to various projects/agencies were issued. The details are given in Section-D.

(e) **LIBRARY**

The Institute library has a rare and large collection of technical books, journals, reports and other publications. The IRI library possesses Indian and foreign publications related to the field of water resources, hydropower, ground water, mathematical modeling, geotechnical engineering,

earth sciences, rock mechanics, engineering geology etc. There are approximately 25000 books in the IRI library at Roorkee and 3000 books at Hydraulics Research Station (H.R.S), Bahadradabad.

(f) **CO-ORDINATION WITH OTHER INSTITUTIONS**

The institute is a member or represented on technical/high level committees of the following organizations:

- Indian National Committee on Hydraulic Research (INCH), New Delhi.
- Central Ground Water Board (CGWB), Faridabad.
- Central Board of Irrigation and Power (CBI&P), New Delhi.
- National Geophysical Research Institute (NGRI), Hyderabad.
- Indian National Committee on Irrigation and Drainage (INCID)
- Institution of Engineers (India).
- Bureau of Indian Standards, New Delhi.
- International Congress On Large Dams (ICOLD).
- Ganga Flood Control Commission (GFCC)

(g) **COORDINATION WITH DIFFERENT ORGANIZATIONS LOCATED AT ROORKEE.**

- (i) Indian Institute of Technology Roorkee.
 - Department of Civil Engineering.
 - Department of Water Resources Development and Management.
 - Department of Earthquake Engineering.
 - Department of Hydrology
 - Alternate Hydro Energy Centre.

- (ii) National Institute of Hydrology, Roorkee.
- (iii) Central Building Research Institute, Roorkee.
- (iv) Central Institute of Mining & Fuel Research, Regional Centre, Roorkee.

(h) REPRESENTATION AT HIGH LEVEL COMMITTEES

The Chief Engineer (Design) & Director I.R.I., Roorkee is a member of the following high level committees:

- Technical Advisory Committee (TAC) on State Flood Projects.
- Indian Road Congress.
- Chief Engineer's Committee of State.
- C.B.I.&P. Technical Committee on Management of Floods.
- Advisory Committee on Engineering Construction Technology of Council of Science & Technology, Lucknow, U.P.
- Science and Technology Advisory Committee of Ministry of Water Resources, New Delhi (STAC-MOWR).
- Governing Council of CWPRS, Pune.
- Academic Council, Indian Institute of Technology, Roorkee.
- Protective Works Committee of I.R.C., Ministry of Surface Transport, Govt. of India.
- Committee on Research and Future Development chaired by Advisor, Planning Commission, New Delhi.
- Sub-committee of the Indian National Committee on Hydraulic Research (INCH), New Delhi.
- Working Group of National Institute of Hydrology, Roorkee
- Sectional Committees of Bureau of Indian Standards (BIS), New Delhi.

To raise new questions, new possibilities, to regard old problems from a new angle, require creative imagination and marks real advance in science.

- Albert Einstein



Technical Memo No. 85

Year 2014-15

SECTION - B
LIST OF PUBLICATIONS
RESEARCH REPORTS AND TECHNICAL/RESEARCH PAPERS

(a) RESEARCH REPORTS

(i) HYDRAULIC RESEARCH UNIT – 1

Hydraulic Research Unit – 1 mainly deals with the model studies for river training and flood protection works, siting of bridges, barrages, head regulators, silt ejectors and excluders, energy dissipaters and pump canals. Its work station is situated at Bahadrabad. Important studies carried out by this division during the year are as follows:

SI. No.	R.R. No.	TITLE OF REPORT
(1)	85 RR (H ₁ -01)	Annual Report of Hydraulics Research Unit-1
(2)	85 RR (H ₁ -02)	Supplementary Report of Model Studies for Reservoir Flushing of Seli H.E.P. (Distt. Lahaul & Spiti, Himachal Pradesh)
(3)	85 RR (H ₁ -03)	An Interim Report on Physical Model Studies for Head Losses in Upstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand)
(4)	85 RR (H ₁ -04)	Model Studies for Inlet-Outlet of Tehri Pumped Storage Plant (Uttarakhand)
(5)	85 RR (H ₁ -05)	An Interim Report on Physical Model Studies for Head Losses in Downstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand)
(6)	85 RR (H ₁ -06)	Further Model Studies for Reservoir Flushing of Ratle H.E.P. (Distt. Kishtwar, J&K)
(7)	85 RR (H ₁ -07)	Further Model Studies for Reservoir Flushing of Ratle H.E.P. (Distt. Kishtwar, J&K)

(ii) HYDRAULIC RESEARCH UNIT – 2

Hydraulic Research Unit – 2, generally deals with physical hydraulic modeling of dams, spillways, energy dissipaters devices, canal structures, intake and outlet works, flushing of reservoirs, desilting chamber of power channels and siting of weirs and barrages etc. In addition to physical hydraulic modeling, the division also takes up works of mathematical modeling of desilting chambers, surge shafts, and water hammering etc. The division maintains a class “B” meteorological observatory and an automatic weather station (AWS) for observing various climatic parameters/conditions at Hydraulic Research Station Bahadrabad. Various studies carried out by this division during the year are as follows:

Sl. No.	R.R. No.	TITLE OF REPORT
(8)	85 RR (H ₂ -01)	Further Model Studies for Water Conductor System of Kameng Hydro-Electric Project - 600 MW (Arunachal Pradesh).
(9)	85 RR (H ₂ -02)	Model Studies for Road Bridge Over River Hindon in Ghaziabad (U.P).
(10)	85 RR (H ₂ -03)	Hydraulic model studies for syphon aqueduct at Km. 49.500 of Rapti Main Canal –Kharjhar Drain (UP).
(11)	85 RR (H ₂ -04)	Hydraulic model studies for syphon aqueduct at Km. 72.300 of Rapti Main Canal –Nakti Drain (UP).
(12)	85 RR (H ₂ -05)	Hydraulic model studies for syphon aqueduct at Km. 14.600 of Rapti Main Canal –Bhakhla Drain (UP).
(13)	85 RR (H ₂ -06)	Compilation and Analysis of Observations Recorded at Meteorological Observatory, Hydraulics Research Unit-2, and Bahadrabad during Year 2014.
(14)	85 RR (H ₂ -07)	Hydraulic model studies for syphon aqueduct at Km. 47.100 of Rapti Main Canal –Kachni Drain (UP).

(iii) BASIC RESEARCH UNIT – 2

The unit is actively involved with the hydraulic studies related to the medium and high head hydroelectric projects. The main thrust is towards the evolution of optimal hydraulic design for Intake structures, Spillways, Energy Dissipation Arrays, Stilling Basins, Sediment Exclusion Devices, Trench Weirs, Surge Tanks, Optimal location of Dams and Bridges and allied structures.

In addition, the division has a good facility for rating of current meters, which is unique of its kind in northern India. The division has been carrying out current meter rating work for various sponsors. The division is maintaining library and computer centre at the Hydraulic Research Station, Bahadrabad. Studies carried out during the year are as follows:

SI. No.	R.R. No.	TITLE OF REPORT
(15)	85 RR (H ₃ -01)	Annual Report Basic Research Unit-2
(16)	85 RR (H ₃ -02)	Model Studies for Desilting Chamber of Naitwar Mori H.E.P. (Uttarakhand).
(17)	85 RR (H ₃ -03)	Model Studies for Barrage of Naitwar Mori H.E.P. across river Tons in Distt. Uttarakashi, (Uttarakhand).
(18)	85 RR (H ₃ -04)	Revised model studies for Barrage of Naitwar Mori H.E.P. across river Tons in Distt. Uttarakashi, (Uttarakhand).
(19)	85 RR (H ₃ -05)	Model Studies for Rail cum Road Bridge at Bogibill across river Brahmaputra, Assam (Post Flood 2013).
(20)	85 RR (H ₃ -06)	Further Model Studies for Barrage-Intake of Lata Tapovan Hydroelectric Project in Distt. Chamoli, (Uttarakhand).
(21)	85 RR (H ₃ -07)	Model Studies for Reservoir Sedimentation of Naitwar Mori Hydro Electric Project across river Tones in Distt. Uttarkashi (Uttarakhand).

(iv) GROUND WATER RESEARCH UNIT – 1

Ground Water Research Unit – 1, generally, caters the need of groundwater physical and mathematical modeling of various hydraulic structures. The division also maintains an isotope laboratory which deals with usage of tracers in estimation of discharge in mountainous stream and also in detection of seepage/leakage from hydraulic structures. Besides this, the division also maintains a Library, which fulfills the need of the researchers of the institute as well as that of field engineers and research scholars of other organizations.

SI. No.	R.R.No.	TITLE OF REPORT
(22)	85 RR (GW ₁ -01)	Annual Report Ground Water Research Unit-1.
(23)	85 RR (GW ₁ -02)	A Compiled list of Technical Memorandum/ Research Reports of Ground Water Research Unit-I from 1955-56 to 2010-11.

(v) GROUND WATER RESEARCH UNIT – 2

This Unit has a well-established EHDA laboratory where the study based on 2-D and 3-D physical modeling of hydraulic structures is carried out to determine the uplift pressures and exit gradient beneath the hydraulic structures founded on alluvium and permeable soil. The Electro-Hydro Dynamic Analogue (EHDA) technique commonly known as Electrical Analogy technique essentially deals with the study of seepage flow below the complicated hydraulic structures of Irrigation projects. In addition to this, studies related to artificial ground water recharge, seepage losses from watercourses and minors by Ponding Method are also dealt in canal lining laboratory of this division. The report presents various studies carried out during the year are given below:

Sl. No.	R.R. No	TITLE OF REPORT
(24)	85 RR (GW ₂ -01)	Annual Report Ground Water Research Unit-2.
(25)	85 RR (GW ₂ -02)	Hydraulic performance of pressure release value.
(26)	85 RR (GW ₂ -03)	Hydraulic performance of pressure release value.(with 3:1 slope position).
(27)	85 RR (GW ₂ -04)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.80.063.
(28)	85 RR (GW ₂ -05)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.80.063.
(29)	85 RR (GW ₂ -06)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.80.063.
(30)	85 RR (GW ₂ -07)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.42.500.
(31)	85 RR (GW ₂ -08)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km. 85.565.
(32)	85 RR (GW ₂ -09)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km. 47.100.
(33)	85 RR (GW ₂ -10)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km. 120.737.
(34)	85 RR (GW ₂ -11)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km. 65.400.
(35)	85 RR (GW ₂ -12)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km. 21.530.
(36)	85 RR (GW ₂ -13)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km. 72.300.
(37)	85 RR (GW ₂ -14)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km. 111.160.
(38)	85 RR (GW ₂ -15)	3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km. 55.950.



(vi) **BASIC RESEARCH UNIT – 1**

Basic Research Unit-1, is generally, responsible for the maintenance of Computer Center of the Institute, organizing computer courses for officers and staff of Irrigation Department. In addition, the division has facility to measure discharge in lined / unlined canals. Presently Pentium computers and peripherals are available in the computer center to meet the present day challenges. The computer centre has also facilities for A₀ size digital scanner and colored printer. Digitization of old Research Reports, Research Papers & Manuals etc issued by Institute are also being done so as to help in preserving important documents in soft copy for research personnel's. Maintenance and update of the website of institutes is also done by the computer center.

The division also maintains a Remote Sensing and GIS Laboratory, which was established in 1997. Since then, the laboratory is engaged in studies using remote sensing techniques with computer aided technology. Data related to water management projects are presented in GIS data base and other studies pertaining to water resources development are being carried out. With the advent of digital computers, the photo-elastic technique is not being used for the estimation of stresses, although Photo-Elastic Laboratory of the division has got capabilities to carry out these studies. Various studies carried out by this division during the year are:-

SI.No.	R.R. No.	TITLE OF REPORT
(39)	85 RR (B - 01)	Annual Report of Basic Research Unit-1.
(40)	85 RR (B - 02)	Migration behavior of Ratmau River near by Roorkee city.

(vii) **MATERIAL TESTING UNIT – 1**

The Material Testing Unit – 1 deals with the study of design of concrete mix including roller compacted concrete, high performance concrete and fiber reinforced concrete for construction of dams and other structures. This division mainly deals in the following area :-

- (i) Design of concrete mix including roller compacted concrete, high performance concrete and fiber reinforced concrete for construction of dams and other structures.
- (ii) Statistical laboratory is engaged in performing the statistical analysis of hydro-meteorological data.
- (iii) Laboratory tests for determining the suitability of physical properties of different types of construction materials which are given below:
 - (a) Coarse and Fine aggregate i.e. sieve analysis, specific gravity, crushing value, impact value, soundness, flakiness index, elongation index and abrasion value etc.
 - (b) Tests for bricks and brick tiles i.e. compressive strength, water absorption, transverse strength etc.
 - (c) Tests for cement i.e. standard consistency, setting time, soundness, fineness, specific gravity, compressive strength etc.
 - (d) Tests for tor steel & welded joints i.e. tensile strength etc.

- (e) Test for green and hardened concrete i.e. compressive strength of c.c. cubes, transverse strength of c.c. beams, unit weight, slump test and abrasion test etc.
- (f) Tests for sheathing ducts for pre-stressed cables such as workability, tension load, transverse load and water loss.

Sl. No.	R.R. No.	TITLE OF REPORT
(41)	85 RR (MT ₁ -01)	Design of Concrete Mix for Over Head Reservoirs Under Water Supply Distribution System in Roorkee.
(42)	85 RR (MT ₁ -02)	Design of Shotcrete Mix for Slope Protection of Hill Side near Power House Site of Vyasi Project at Hathini.
(43)	85 RR (MT ₁ -03)	Design of Concrete Mixes for Ramganga Barrage, Bareilly (U.P.).
(44)	85 RR (MT ₁ -04)	Design of Concrete Mix for Pavement Work for Masi-Choukhutiya Road, Section Almora.
(45)	85 RR (MT ₁ -05)	Design of Concrete Mixes for Flood Protection Works at Right Bank of River Bhagirathi.
(46)	85 RR (MT ₁ -06)	Design of Concrete Mix for 33 MLD Capacity Sewage Treatment Plant and Sewage Pumping Station at Mahigran and Ganeshpur, Roorkee.

(viii) MATERIAL TESTING UNIT – 2


This unit deals with the determination of engineering properties of rock mass and rock samples received from different hydroelectric/river valley and irrigation projects. Besides this annual report and quarterly news letter of the Institute are also published by the division as it maintains the publication section of the Institute. The important works carried out by the division during the year are given below :-

Sl. No.	R.R. No.	TITLE OF REPORT
(47)	85 RR (MT ₂ -01)	Annual Report Material Testing Unit-2.

(ix) SOIL RESEARCH UNIT – 1

The Soil Research Unit – 1, comprises of three sub-divisions each having a well equipped Laboratory. The division is mainly working in the following area:

- (a) Laboratory testing for the determination of engineering properties of soils.

- 
- (b) Field investigations for determination of
- (i) Bearing capacity at foundation of structures.
 - (ii) In-situ Shear Parameters
 - (iii) Modulus of Subgrade Reaction
 - (iv) In-situ Permeability and Sub-Soil Strata to study the seepage behavior etc.

The laboratory and field tests of soil are generally carried out in accordance with relevant Indian Standards. Laboratory tests include soil classification, shear parameters, consolidation, permeability, maximum and minimum density etc. and special tests like, dispersability on clay materials, large size tri axial shear (200 mm dia. specimen upto a maximum pressure of 20 kg/cm²), compressibility and permeability tests on rock fill material etc are performed and field tests include standard penetration test, subgrade reaction test, block shear test, In situ dry density and permeability tests are also conducted. Various studies carried out by this division during the year are :-

SI. No.	R.R. No.	TITLE OF REPORT
(48)	85 RR (S ₁ -01)	Annual Report Soil Research Unit -1

It is the lone worker who makes the first advance in a subject; the details may be worked out by a team, but the prime idea is due to enterprise, thought, and perception of an individual.

-Alexander Fleming



SECTION- C RESEARCH REPORTS AND TECHNICAL/RESEARCH PAPERS INFORMATORY ABSTRACTS

(a) RESEARCH REPORTS

The section contains only the abstract of the Research Reports published during the year by various divisions. For detail information regarding study, the TM nos. have been mentioned.

(i) HYDRAULIC RESEARCH UNIT – 1

(1) Annual Report of Hydraulics Research Unit-1.

85RR (H₁-01)

The studies and activities undertaken by the Hydraulic Research Unit -1 during the year 2013-14 are documented in the report.

(2) Supplementary Report of Model Studies for Reservoir Flushing of Seli H.E.P. (Distt. Lahaul & Spiti, Himachal Pradesh).

85RR (H₁-02)

Hydraulic Model studies were conducted with a geometrical similar 3D comprehensive Physical model on 1:60 scale (discharge scale 1:27885) for the study of sedimentation/flushing of reservoir for proposed Seli H.E. Project, Distt. Lahaul & spiti, Himachal Pradesh. The experiments for Reservoir Flushing were carried out at our Hydraulic Research Station, Bahadradab for three different discharges (1260 cumec, 800 cumec and 400 cumec) in different conditions



of gate opening and sediment concentration i.e. 1478 ppm, 580 ppm and 280 ppm. The report containing details of experimentation, results and its analysis has been issued vide T.M. No. 84-RR (H₁-14). As desired by the sponsor (reference e-mail dated 03 April, 2014), this report deals with further model studies for two discharges of 1000 cumec and 1260 cumec under specific condition of gate opening (1 and 3) with sediment concentration of 820 ppm and 1478 ppm respectively. After flushing for two hours (15.5 hours in proto) under the both conditions, it was visually seen that channels were

developed along both river banks and the initial dressed bed depressed by maximum 0.9m (i.e. 2.9m lower than sill level of intake) in front of power intake under condition no. 4 (1260 cumec with sediment concentration 1478 PPM).

(3) An Interim Report on Physical Model Studies for Head Losses in Upstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand).

85RR (H₁-03)

The main purpose of Tehri Dam is to supply water for irrigation, domestic use and



power generation. In this project, a pumped-storage scheme having installed capacity of 1,000 MW, being a part of the 2,400 MW Tehri Hydro Power Complex, is proposed to fulfill the peak hour electricity demand. The physical model study for head losses and flow pattern in the Upstream Bifurcation of proposed Tehri Pumped Storage Plant (Uttarakhand) have been conducted under Turbine & Pump Mode for different discharges. A part physical model of u/s bifurcation was built on geometrical similar model scales of 1:20 (discharge scale 1:1788.85). The test results indicated the smooth flow and no separation of flow are observed in the upstream bifurcation of both the HRT-3 & HRT-4 in all tested conditions under turbine as well as pumping mode. In turbine mode, a maximum head loss of the order of 0.39 m and 0.86 m was observed in the upstream bifurcation of HRT-3 and HRT-4 respectively when both

units are in running condition while the head losses of the order of 0.35 m and 0.37 m were observed in pumping mode. The test results for one unit in operative condition are under examination and shall be confirmed in due course after repetition of experiments.

(4) Model Studies for Inlet-Outlet of Tehri Pumped Storage Plant (Uttarakhand).

85RR (H₁-04)

The main purpose of Tehri Dam is to supply water for irrigation, domestic use and power generation. In this project, a pumped-storage scheme having installed capacity of 1,000 MW, being a part of the 2,400 MW Tehri Hydro Power Complex, is proposed to fulfill the peak hour electricity demand. The physical model study for head losses and flow pattern in the inlet/outlet structure of proposed Tehri Pumped



Storage Plant (Uttarakhand) have been conducted under Turbine & Pump Mode for different discharges. A physical model of inlet outlet structures along with some portion of river Bhagirathi was built on geometrical similar model scales of 1:20 (discharge scale 1:1788.85). The test results indicated that no negative pressures observed in the pier of inlet outlet of TRT-3 & TRT-4 in all tested conditions under turbine as well as pump mode. Maximum head losses in different condition are given in table 11. Intermittent vortex ('vortex pulling air bubbles to intake' to 'vortex pulling floating trash') of average diameter of 1.0 m near right

bay of inlet/outlet structures of TRT 3 and TRT 4 are observed in all test conditions of pumping mode except test conditions P5 & P6.

(5) An Interim Report on Physical Model Studies for Head Losses in Downstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand).

85RR (H₁-05)

The main purpose of Tehri Dam is to supply water for irrigation, domestic use and power generation. In this project, a pumped-storage scheme having installed capacity of 1,000 MW, being a part of the 2,400 MW Tehri Hydro Power Complex, is proposed to fulfill the peak hour electricity demand. The physical model study for head losses and flow pattern in the Downstream Bifurcation of proposed Tehri Pumped Storage Plant (Uttarakhand) have been conducted under Turbine & Pump Mode for different discharges. A part physical model of d/s bifurcation was built on geometrical similar model scales of 1:20 (discharge scale 1:1788.85). The test results indicated the smooth



flow and no separation of flow are observed in the downstream bifurcation in all tested conditions under turbine as well as pumping mode. In turbine mode, a maximum head loss of the order of 0.61 m was observed in the downstream bifurcation when both units are in running condition while the head losses of the order of 0.94 m was observed in pumping mode. The test results for one unit in operative condition and P4 are under examination and

shall be confirmed in due course after repetition of experiments.

(6) Further Model Studies for Reservoir Flushing of Ratle H.E.P. (Distt. Kishtwar, J&K).

85RR (H₁-06)

Hydraulic Physical Model studies were conducted with a geometrical similar 3D model on 1:55 scale (discharge scale 1:22845) for the observations of flushing at different conditions of Ratle HEP, Distt. Kishtwar, J & K. The experiments for flushing were carried out at Hydraulic Research Station, Bahadabad for five test conditions at different discharges of 1500 cumec, 2000 cumec, 2500 cumec and



3000 cumec with sediment concentration of 1350 ppm, 1800 ppm, 2250 ppm and 3000 ppm respectively. Model test results reveal that reservoir flushing at MDDL for two hours of the model with 3000 ppm and 3000 cumec discharge gives better flushing result when compared with other test conditions. In this condition, the deposit of slit was flushed found to have away upto 9.5 m below the crest of power intake. However, for remaining test conditions it ranges from 2.9 m to 3.8 m. it was also observed that for draw down condition, significant condition takes place even in short duration of 15 minute in the model.

(7) **Final Report on Physical Model Studies for Mass Oscillations in Water Conductor System of Baglihar H.E.P. Stage-II (Jammu & Kashmir).**

85RR (H₁-07)

Physical model studies for the surge shaft and tail race system of Baglihar H.E. Project Stage-II (J&K) were conducted to determine the maximum and minimum surge levels in u/s Surge Shaft & d/s collection gallery. The physical model was built on exaggerated



model scales. The test results indicated that the maximum & minimum observed surge levels in surge shaft of 27.5 m dia under worst load transients of upsurge and down surge were El. 861.50 m and El. 825.0 m as against the computed surge levels of El. 864.61 m and El. 814.16 m respectively. The flow conditions in the surge tank, collection gallery and d/s of outfall were found to be satisfactory. The maximum & minimum surge levels in d/s Collection Gallery was found at El. 726.5 m and El. 705.50 m maintaining tail water level at El. 717.20 m. The maximum & minimum surge levels in d/s Collection Gallery was found at El. 713.8 m and El. 702.00 m maintaining tail water level equal to 706.20 m. This report has been prepared on the basis of report which has been sent earlier vide T.M. No. 84-RR (H1-14).

(ii) **HYDRAULIC RESEARCH UNIT – 2**

(8) **Further Model Studies for Water Conductor System of Kameng Hydro-Electric Project - 600 MW (Arunachal Pradesh)**

85RR (H₂-01)

The physical hydraulic model study with a provision of drop shaft arrangement (length 550 m) for water conductor system of Kameng Hydro Electric Project was conducted at our Field Research Station Bahadrad and two technical reports were issued in Dec. 2013 and Jan. 2014. The present report deals with hydraulic model studies for second proposal of drop shaft arrangement (length 96 m) which was carried out after incorporating the desired



proposal in the existing model built on distorted scales using dynamic similarity. When design discharge of 10 cumec was allowed to pass through the drop shaft, the corresponding reservoir level of 771.80m was observed in Tenga dam reservoir. However, when a reservoir level of 770.0 m (FRL) was maintained in the Tenga dam reservoir, the discharge flow of 8.43 cumec only was observed to pass through the drop shaft. Total losses of 11.10 m were observed across the entire drop shaft arrangement and a head loss of 9.15 m was observed across the orifice provided in the drop shaft. The drop shaft was observed to be free from development of any sub-atmospheric pressure. A maximum pressure of 49.80 m at piezopoint no.02 was observed at upsurge at FRL condition.

(9) Model Studies for Road Bridge Over River Hindon in Ghaziabad (U.P).

85RR (H₂-02)

The hydraulic model studies for Road Bridge across Hindon River in district Ghaziabad of Uttar Pradesh were carried out on a geometrically distorted model built to scale 1:75 (horizontal) & 1:25 (vertical). On the basis of model studies, the constructed bridge comprising six spans (2 spans @ 29.89 m & 4 spans @ 30.45 m) has been found adequate to pass the design discharge of 3681.20 cumec without any adverse hydraulic effects. Suitable



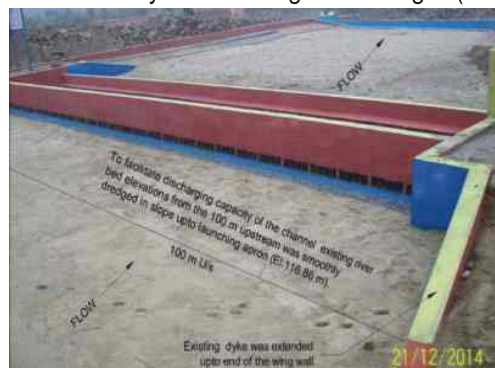
training works at right abutment & left approach embankment of the bridge are recommended wherever necessary. The maximum back water effect is 60 cm up to the devastating flood of 1978 i.e. PMF (1, 38,000 cusecs), whereas there is no significance increase in drowned floodplains. The provision of flood relief arches in approach embankments is also recommended to mitigate the effects of backwater.

(10) Hydraulic model studies for syphon aqueduct at Km. 49.500 of Rapti Main Canal (UP).

85RR (H₂-03)

The hydraulic model study for syphon aqueduct at Km. 49.50 on Rapti Main Canal has been conducted on a physical model constructed on a geometrically similar scale of

1:35 at our field research station, Bahadradab. The sponsor desired to study the hydraulic behavior, performance of the proposed syphon aqueduct, head losses through the barrels and suggestions for river training works if any. The design discharge (2920



cumec) was observed to have passed safely after dredging and the subsequent leveling of the non-perennial river (henceforth termed as Kharjhar Nala as per sponsor's information) up to 800 m u/s and 400 m d/s of the barrels. Maximum velocities in front of blocks on launching apron were observed to be of the order of 2.4 to 2.8 m/s.

A maximum head loss of 95 cm at a design discharge of 2920 cumec was observed across the barrels. The study suggested some training works which include modification in existing dykes and channelization of bed.

(11) Hydraulic model studies for syphon aqueduct at Km. 72.300 of Rapti Main Canal (UP).

85RR (H₂-04)

The hydraulic model study for syphon aqueduct at Km. 72.30 on Rapti Main Canal has been conducted on a physical model constructed on a geometrically similar scale of 1:25. The sponsor desired to study the hydraulic behavior, performance of the proposed syphon aqueduct, head losses through the barrels and suggestions for river training works if any. The passage of design discharge (2920 cumec) through the barrels was observed to be safe at an upstream water level of 115.70 m after



suitable modification in right side wing wall. Water levels against different discharges at upstream & downstream of aqueduct barrels are observed. The maximum velocity was observed as 2.20 m/s. A maximum head loss of 50.00 cm at a design discharge of 290 cumec was observed across the barrels.

(12) Hydraulic model studies for syphon aqueduct at Km. 14.600 of Rapti Main Canal (UP).

85RR (H₂-05)

The hydraulic model study for proposed syphon aqueduct to be constructed at Km. 14.600



(Bhakhla Nala/Drain) on Rapti Main Canal has been conducted on a physical model developed on a geometrically similar scale of 1:30 at our Field Research Station, Bahadrabad. It was desired to study the hydraulic behavior, performance of the proposed syphon aqueduct,

head losses through the barrels and suggestions, if any. The model study indicated the safe passage of design discharge (300 cumec) through all the 12 barrels of the syphon aqueduct with an upstream water level of 127.00 m as against theoretically computed affluxed HFL of 128.80 m. The maximum inlet velocity was observed to be 2.26 m/s at a design discharge.

(13) Compilation and Analysis of Observations Recorded at Meteorological Observatory, Bahadrabad.

85-RR (H₂-06)

Various elements of meteorological observations such as temperature, relative humidity, rainfall, wind velocity, vapor pressure,



and sediment concentration and evaporation rate were observed at Meteorological Observatory, hydraulic Division-II, and Bahadrabad in the year 2014. Maximum and Minimum temperature of the year was 42.6 on 08-06-2014 and 2.0 on 11-12-2014. Out of total of total 1065.0 mm rainfall of the year 2014, about 67.72% of total yearly rainfall was received from only July to September. The wettest month of the year was July 2014 in

which 424.7 mm rainfall was observed. Total numbers of rainy days were 67. Maximum average wind velocity was 6.5km/hr on 12-03-2014, and max. vapour pressure of 27.8 mm was observed on 17-06-2014. Max. Rate of evaporation, 9.2 mm/day, was observed on 06-06-2014. A total evaporation loss during the year was 992.1mm. Maximum sediment concentration in the feeder channel of HRS was observed as 5610 ppm on 11-09-2014.

(14) Hydraulic model studies for syphon aqueduct at Km. 47.100 of Rapti Main Canal (UP).

85-RR (H2-07)

The hydraulic model study for syphon aqueduct at Km. 47.10 on Rapti Main Canal has been conducted on a physical model constructed on a geometrically similar scale of 1:25 at our field



research station, Bahadrabad. The sponsor desired to study the hydraulic behavior, performance of the proposed syphon aqueduct, head losses through the barrels and suggestions for river training works if any. The design discharge (168 cumec) was observed to have passed safely through the 08 barrels of the syphon aqueduct at upstream water level of 125.30 m instead of theoretically computed affluxed HFL of 125.75 m. Water levels against different discharges at upstream & downstream of aqueduct barrels are observed. The maximum velocity was observed as 1.76 m/s. A

maximum head loss of 40.00 cm at a design discharge of 168 cumec was observed across the barrels.

(iii) BASIC RESEARCH UNIT- 2

(15) Annual Report of Basic Research Unit-2

85 RR (H3-01)

Basic Research Unit-2 (Formerly Hydraulics Division-III) was established in May 1965, since then model studies pertaining to various hydraulic structures such as dams, diversion structures, spillways, outlets, intake of hydro-electric projects, de-silting arrangements, canal and bypass for power houses, surge tanks are being conducted in this unit during the year 2013-14. Five Technical memorandums/ Research Reports were issued which, have been briefly summarized.

(16) Model Studies for Desilting Chamber of Naitwar-Mori.

85 RR (H3-02)

The hydraulic model studies for different proposals of desilting chamber were carried out on a geometrically similar physical model built to scale 1:15 for Naitwar-Mori HEP (Uttarakhand). Desilting chamber (196 m long



including upstream and downstream transitions) as per Drg. No. 01A to 01C was observed to be hydraulically inefficient in trapping and flushing the suspended sediments. Revised proposal

of desilting chamber was also observed to be inefficient to serve the purpose of silt removal from the flow. In experiments conducted on both the proposal, the after run conditions of the chamber (7.7 hours in proto) indicate heavy silt deposition in the power channel and transition. This deposition is an indication of the improper hydraulic design of power channel, which fails to generate enough velocity to transport suspended sediment load from power channel to the hoppers.

(17) Further Model Studies for Barrage of Naitwar Mori Hydro Electric Project across River Tons in Distt. Uttarkashi.

85 RR (H₃-03)

Hydraulic model studies for barrage of Naitwar Mori Hydro Electric Project (NMHEP) were conducted for revised barrage plan with axis of power intake aligned at an angle of 105 degree w.r.t. barrage axis, on a geometrically similar comprehensive model built to a scale of 1:30. Observations of the hydraulic test results indicated that the design discharge of power intake, 88.2 cumec, passes through it at reservoir level EI. 1261.60 m. Revised barrage plan with new



alignment of power intake was observed to be adequate to check abrupt fall from right wing wall at upstream of power intake and inducing better flow conditions as compared to previous barrage plan. Different experiments were also conducted for optimization of stilling basin, revealing that the cistern length of 40 m at floor level EI.

1248 m with 2 m high end sill gives better conditions for energy dissipation as compared to the original plan of stilling basin. It was observed that scours on river bed at downstream of the modified stilling basin reduced up to 58% than that of with the original proposal of stilling basin.

(18) Revised Model Study for Desilting Chamber of Naitwar-Mori Hydro Electric Project (Uttarakhand)

85 RR (H₃-04)

The hydraulic model studies for different proposals of desilting chamber under revised operating conditions were carried out on a



geometrically similar physical model built to scale 1:15 for Naitwar-Mori HEP (Uttarakhand), which is an extension of earlier works carried out at Hydraulics Research Station, Bahadrabad under the title "Model study for desilting chamber of Naitwar-Mori hydroelectric project" sent vide T.M. No. 85 RR(H₃-02). The revised study suggested the development of sufficient velocity for carrying suspended load in suspension in modified power channel (Drg. No.-01B). However, the velocity in transition portion is observed to be insufficient to carry the suspended silt particles to the desilting chamber. The model was run for 1 hour (equivalent to 3.87 hours in proto) and water samples were collected from H.R.T. and outlet of S.F.T. at a regular interval. The water samples were filtered and analyzed. The test results show the variation in Silt

flushing efficiency ranging from 69.1 % to 72.3 % and silt trapping efficiency (overall) ranging from 77.8 % to 79.4 % which indicates the satisfactory performance of both chambers.

(19) Model Studies for Rail cum Road Bridge at Bogibil across River Brahmaputra (Assam).

85 RR (H₃-05)

The model studies were carried out at our Field Research Station, Bahadradab to observe the behavior of manmade structure and safeguard the guide bunds of Bogibil Bridge having waterway of 4875m, across river Brahmaputra with the river bed configuration of post flood data of 2013. The studies have been conducted on the existing physical model built to horizontal scale of 1:400 and vertical scale of 1:50. The observation during hydraulic tests indicated that proper protection of both the dykes and guide bunds need to be ensured as per observed velocities. Flow pattern and behavior of manmade structures are found to



be similar at both the discharges of 73,000 and 80,000 cumec. After running the model for 12 hours at 73,000 cumec, the flow was found to be more streamlined. Also, no significant changes in flow pattern and influence on man-made structures were observed for the said discharges. No adverse effect was observed on the guide bunds, too.

(20) Further Model Studies for Barrage-Intake of Lata Tapovan HydroElectric Project in Distt. Chamoli, (Uttarakhand).

85 RR (H₃-06)

The Model studies were conducted for barrage-intake of Lata Tapovan hydroelectric project proposed to be constructed across river Dhauliganga in Distt. Chamoli, Uttarakhand on geometrically similar model built on a scale of 1:30 at HRS Bahadradab. The Observations indicated safe passage of design discharge (2000 cumec) with all gates fully opened (i.e. free flow condition) for



proposed clear water way of 132.0 m at an elevation of 2090.0 m (barrage crest) and elevation 2088.0 m (under-sluice crest). An average elevation of water surface was observed to be 2094.03 m under the above condition. The protruded rock ledge if smoothed suitably, at about 180 m u/s on the left bank of barrage (as proposed in stage-I), would be helpful in uniform distribution of discharge through the bays under free flow condition. The velocities and the maximum scour in the d/s of barrage have been observed to have reduced significantly in proposal-4 as compared to those found in proposal-3. The study further indicates that the proposed energy dissipation arrangement is working satisfactorily.

(21) Model Studies for Reservoir Sedimentation of Naitwar Mori Hydro Electric Project across river Tons in Distt. Uttarkashi (Uttarakhand).

85 RR (H₃-07)

Hydraulic model studies for proposed barrage of Naitwar Mori Hydro Electric Project (NMHEP) were conducted at Hydraulic Research station, Bahadrabad on a geometrically comprehensive model built on a scale of 1:30. This report is in continuation to earlier report sent vide T.M. No. – 84 RR (H₃-03), August, 2013 & 85 RR (H₃-03), July, 2014 covering different parameters of



barrage. The Present report essentially deals with the study of reservoir sedimentation and flushing capacity of the spillway. The model study indicated no deposition of sediment taking place above the sill of the power intake for all the conditions of tests.

The maximum flushing of sediment is achieved when right and centre bays are in operation.

(iv) GROUND WATER RESEARCH UNIT- 1

(22) Annual Report, Ground Water Research Unit-1

85 RR (GW₁-01)

Ground Water Research Unit-1, one of the Unit of Research Circle of I.R.I., Roorkee generally caters to the needs of Groundwater physical and mathematical modeling of various hydraulic structures. The unit also maintains an isotope

laboratory which deals with usage of tracers in estimation of discharge in mountainous stream and also in detection of seepage/leakage from hydraulic structures. In addition to this the unit also maintains a Library, which fulfills the needs of the researchers of the institute as well as that of field engineers and research scholars of other organizations.

(23) A Compiled List of Technical Memorandum/ Research Reports of Ground Water Research Unit-I from 1955-56 to 2010-11.

85RR (GW₁-02)

Irrigation Research Institute (IRI), a State Government organization came into existence in the year 1954 at Roorkee. The Institute undertakes problems of basic and Fundamental research and provides engineering consultancy to private sector, Government and semi government organizations in Uttarakhand and other states of India. The ground water division of IRI has a well-established Isotope Laboratory where the study based on flow rate measurement of mountainous rivers and canal seepage is carried out with the help of Radio Active Isotope Tritium. The results of all such research works are published in the form of research reports and technical memorandums. This report presents a compiled list of all research reports and technical memorandums published by ground water Unit-I from 1955-56 to 2010-11.

(v) GROUND WATER RESEARCH UNIT- 2

(24) Annual Report, Ground Water Research Unit-2.

85 RR (GW₂-01)

The studies and activities undertaken by the Ground Water Research Unit -2 during the year 2013-14 are documented in the report.

(25) Hydraulic performance of pressure release valve.

85 RR (GW₂-02)

RITWIK Project Pvt. Limited, Distt. Chamoli (Uttarakhand) provided one number PVC made Flap Type Pressure Release Valve in this sub-division for testing their hydraulic performance. The valve has been tested in horizontal position. The hydraulic performance of pressure release valve is satisfactory so the same valve can be used for the purpose.

(26) Hydraulic performance of pressure release valve.(with 3:1 slope position).

85 RR (GW₂-03)

RITWIK Project Pvt. Limited, Distt. Chamoli (Uttarakhand) provided one number PVC made Flap Type Pressure Release Valve in this sub-division for testing their hydraulic performance. The valve has been tested vertically up 15 Meter head whereas erection of PRV pipe has been done perpendicular to 3:1 slope as desired by the sponsoring authority. The hydraulic performance of pressure release valve is satisfactory so the same valve can be used for the purpose.

(27) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.80.063.

85 RR (GW₂-04)

This report deals with the 3-D EHDA model study to determine the optimal length of the canal lining from the uplift pressure and exit gradient consideration for Syphon Aqueduct on Rapti Main Canal at Km. 80.063. The safe exit gradient has been assumed as 1/6. From safe exit gradient consideration, the length of the canal lining has been found minimum at 50m for 6.67m depth of sheet piling. The hydraulic gradient (HG) line at different cross sections of the lined canal remains below of the general level of 118.312m.

(28) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.18.650.

85 RR (GW₂-05)

This report deals with the 3-D EHDA model study to determine the optimal length of the canal lining from the uplift pressure and exit gradients consideration for Syphon Aqueduct on Rapti Main Canal at Km.18.650. The safe exit gradient has been assumed as 1/6. From safe exit gradient consideration, the length of the canal lining has been found minimum at 40m for 2.825m depth of sheet piling. The hydraulic gradient (HG) line at different cross sections of the lined canal remains below of the general level of 124.555m.

(29) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.49.500.


85 RR (GW₂-06)

This report deals with the 3-D EHDA model study to determine the optimal length of the canal lining from the uplift pressure and exit gradient consideration for Syphon Aqueduct on Rapti Main Canal at Km.49.500. The safe exit gradient has been assumed as 1/6. From safe exit gradient consideration, the length of the canal lining has been found minimum at 70m for 6.74m depth of sheet piling. The hydraulic gradient (HG) line at different cross sections of the lined canal remains above of the general ground level of 116.90m. The uplift pressure seems more prominent when the Drain is at H.F.L. and the canal above is dry.

(30) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.42.500.

85 RR (GW₂-07)

This report deals with the 3-D EHDA model study to determine the optimal length of the



canal lining from the uplift pressure and exit gradient consideration for Syphon Aqueduct on Rapti Main Canal at Km.42.500. The safe exit gradient has been assumed as 1/7. From safe exit gradient consideration, the length of the canal lining has been found minimum at 70m for 3.5m depth of sheet pile. The hydraulic gradient (HG) line at different cross sections of the lined canal remains below the general ground level of 123.00m. The uplift pressure seems more prominent when the Drain is at H.F.L. and the canal above is dry.

(31) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.85.565.

85 RR (GW₂-08)

This report deals with the 3-D EHDA model study to determine the optimal length of the canal lining from the uplift pressure and exit gradients consideration for Syphon Aqueduct on Rapti Main Canal at Km.85.565. The safe exit gradient has been assumed as 1/6 to 1/7. From safe exit gradient consideration, the length of the canal lining has been found minimum at 50m for 5.40m depth of sheet pile. The hydraulic gradient (HG) line at different cross sections of the lined canal is well above of the general ground level of 111.587m. The uplift pressure seems more prominent when the Drain is at H.F.L. and the canal above is dry.

(32) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.47.100.

85 RR (GW₂-09)

This report deals with the 3-D EHDA model study to determine the optimal length of the canal lining from the uplift pressure and exit gradient consideration for Syphon Aqueduct on Rapti Main Canal at Km.47.100. The safe exit gradient has been taken as 1/6. The exit gradients observed are almost Non-predictive. The hydraulic gradient line for different length of canal impervious to a range of RL 121.76 to RL

121.86m condition I. In condition II, the range offshoots to a range of RL119.14m to RL124.08m. A better inference can be drawn with respect to ground level adjacent to structure. The uplift pressure seems more prominent when the Drain is at H.F.L. and the canal above is dry.

(33) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.120.737.

85 RR (GW₂-10)

This report deals with the 3-D EHDA model study to determine the optimal length of the canal lining from the uplift pressure and exit gradients consideration for Syphon Aqueduct on Rapti Main Canal at Km.120.737m. The safe exit gradient has been taken as 1/7. The Exit Gradient observed for condition-II is almost Non-predictive. The hydraulic gradient line for different length of canal impervious lining endorses fairly above General Ground Level of 93.612m. The uplift pressure seems more prominent when Drain is at H.F.L. and the canal above is dry.

(34) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.65.400.

85 RR (GW₂-11)

This report deals with the 3-D EHDA model study to determine the optimal length of the canal lining from the uplift pressure and exit gradients consideration for Syphon Aqueduct on Rapti Main Canal at Km.65.400m. The safe exit gradient has been provided as 1/6. From safe exit gradient consideration, the length of the lining for condition-I has been found safest at 50m for 5.69m depth of sheet pile. The hydraulic gradient (HG) line at different cross section of the lined canal is found fairly well below the general ground level of 120.850m. The uplift pressure seems more prominent when Drain is at H.F.L. and the canal above is dry.

(35) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.21.530.

85 RR (GW₂-12)

This report deals with the 3-D EHDA model study to determine the optimal length of the canal lining from the uplift pressure and exit gradients consideration for Syphon Aqueduct on Rapti Main Canal at Km.21.530m. The safe exit gradient has been provided as 1/7. From safe exit gradient consideration, the length of the lining for condition-I has been found safest at 40m for 6.947m depth of cutoff. The hydraulic gradient (HG) line at different cross section of the lined canal is found below the general ground level of 125.250m. The uplift pressure seems more prominent when Drain is at H.F.L. and the canal above is dry.

(36) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.72.300.

85 RR (GW₂-13)

This report deals with the 3-D EHDA model study to determine the optimal length of the canal lining from the uplift pressure and exit gradients consideration for Syphon Aqueduct on Rapti Main Canal at Km.72.300m. The exit gradient observed are found safe for a minimum impervious canal lining length P130 against the desired permissible exit gradient of 1in 6. The hydraulic gradient (HG) line at different length of canal impervious lining lies well below the general ground level of RL118.371m.

The uplift pressure seems more prominent when Drain is at H.F.L. and the canal above is dry.

(37) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.111.160.

85 RR (GW₂-14)

This report deals with the 3-D EHDA model study to determine the optimal length of the

canal lining from the uplift pressure and exit gradients consideration for Syphon Aqueduct on Rapti Main Canal at Km.111.160m. The exit gradient observed are found safe for a minimum impervious canal lining length 50m against the desired permissible exit gradient of 1 in 7. The hydraulic gradient (HG) line at different length of canal impervious lining lies somewhat about the general ground level of RL95.480m but is well below the service road of RL98.100m. The uplift pressure seems more prominent when Drain is at H.F.L. and the canal above is dry.

(38) 3-D EHDA Model study for Syphon Aqueduct on Rapti Main Canal at Km.35.950.

85 RR (GW₂-15)

This report deals with the 3-D EHDA model study to determine the optimal length of the canal lining from the uplift pressure and exit gradients consideration for Syphon Aqueduct on Rapti Main Canal at Km.35.950m. The exit gradient observed are found safe for a minimum impervious canal lining length P130 against the desired permissible exit gradient of 1in 6. The hydraulic gradient (HG) line at different length of canal impervious lining lies well below the general ground level of RL124.435m.

The uplift pressure seems more prominent when Drain is at H.F.L. and the canal above is dry.

(vii) BASIC RESEARCH UNIT- 1

(39) Annual Report of Basic Research Unit-1

85 RR (B-01)

The studies and activities undertaken by the Basic Research Unit -1 during the year 2014-15 are documented in the report.

(40) Migration behavior of Ratmau river near by Roorkee city.(Basic Study)

85 RR (B-02)

“Migration behavior of Ratmau river near by Roorkee city,” Remote Sensing techniques have been adopted by using Erdas Imagine software and Arc-View software.

In the present study Survey of India Toposheet-1970 and Satellite Imagery-2001 have been used to find out migration behavior of Ratmau River by creating the digital course of the two banks and one middle channel of the river. Computer aided techniques have been used for Geo-coded and digitization of satellite imagery and toposheet .

This study concludes the migration of Ratmau River during the span of 30 years as follows:-

- (i) The maximum and minimum shift observed in Right bank of Ratmau River is 1.16Km (village Belri Salahpur) and 0.73Km. (Village Hadipur) respectively.
- (ii) The maximum and minimum shift observed in Left bank of Ratmau River is 1.18Km (village Dera) and 0.30 Km. (Village Daluwala Khurd) respectively.
- (iii) The maximum and minimum shift observed in Mid-Channel of Ratmau river is 1.16Km (village Belri) and 0.38Km. (Village Sohalpur Sakrauda) respectively.

(viii) MATERIAL TESTING UNIT- 1

(41) Design of Concrete Mix for Over Head Reservoirs under Water Supply Distribution System in Roorkee.

85RR (MT₁-01)

This study was sponsored to design the concrete mix for the concrete grade A₂₀M₃₀ at slump (50±5) mm on the basis of 28 days compressive strength for construction of Over Head Reservoirs under Water Supply

Distribution System in Roorkee town by the Project Manager, Nagarjuna Construction Company Ltd., 458/10, Ramnagar, Roorkee. Study of concrete mix design for above grade of concrete has been carried out on 150mm size cube specimens. Ordinary Portland Cement-43 grade (Vikram Cement), Coarse aggregate (Crushed), Fine aggregate (Natural) and High Range Water Reducing Admixture ‘CICO PLAST SUPER’ have been used in the study.

(42) Design of Shot Crete Mix for Slope Protection of Hill Side near Power House Site of Vyasi Project at Hathini.

85RR (MT₁-02)

This study was sponsored to design the shotcrete (dry process) of grade A₁₀M₃₅ on the basis of 28 days compressive strength for slope protection of hill side near power house site of Vyasi Project at Hathini by the Executive Engineer (Civil-1), Vyasi Project, U.J.V.N. Ltd., Near St. Mary School, Tons Colony, Dakpathar, and Dehradun. Study of shotcrete mix design for above grade has been carried out on 150mm size cube specimens. Ordinary Portland Cement-43 grade (CCI Cement), Coarse aggregate (crushed), Fine aggregate (natural) and Superplasticiser ‘VITCON 9001HG’ have been used in the study of shotcrete mix design. Proper accelerator to be used in the shotcrete was not used in the study of shotcrete mix design due to its quick setting properties. So, accelerator should be used in the shotcrete at site.

(43) Design of Concrete Mixes for Ramganga Barrage, Bareilly (UP).

85RR (MT₁-03)

This study was sponsored to design the concrete mixes for the concrete grades A₂₀M₂₅, A₂₀M₃₀, A₂₀M₃₅, A₂₀M₄₀, & A₂₀M₄₅ at slump (50±10)mm on the basis of 28 days compressive strength for construction of Ramganga Barrage on river Ramganga in

Bareilly district of Uttar Pradesh by the Executive Engineer, Flood Division, 117, Civil Lines, Canal Colony, Bareilly. Study of concrete mix design for above grades of concrete has been carried out on 150mm size cube specimens. Ordinary Portland Cement-43 grade (JAY PEE Cement), Coarse aggregate (Crushed), Fine aggregate (Natural & washed) and High Range Water Reducing Admixture 'APCON ADDPLAST- GF(M)' have been used in the study.

(44) Design of Concrete Mix for Pavement Work for Masi-Choukhutiya Road, Section Almora.

85RR (MT₁-04)

This study was sponsored to design the concrete mix for the concrete grade A₂₀M₃₀ at compacting factor 0.78 to 0.80 on the basis of 28 days compressive strength for pavement work for improvement of Masi-Choukhutiya road, section Almora by the Executive Engineer, Construction Division, PWD, Ranikhet, Distt.- Almora (Uttarakhand). Study of concrete mix design for above grade of concrete has been carried out on 150mm size cube specimens. Ordinary Portland Cement-43 grade (CCI Cement), Coarse aggregate (Crushed) and Fine aggregate (Natural) has been used in the study.

(45) Design of Concrete Mixes for Flood Protection Works at Right Bank of River Bhagirathi.

85RR (MT₁-05)

This study was sponsored to design the concrete mixes for the concrete grades A₄₀M₁₀ & A₄₀M₁₅ at slump (50±5)mm on the basis of 28 days compressive strength for flood protection works at right bank of river Bhagirathi, SP house to Kandola by the Executive Engineer, Investigation and Infrastructure Division, Uttarkashi. Study of concrete mix design for above grades of concrete has been carried out on 150mm size cube specimens. Portland Pozzolana Cement (Ultratech Cement), Coarse aggregate (Crushed) and Fine aggregate (Natural) have been used in the study.

(46) Design of Concrete Mix for 33 MLD Capacity Sewage Treatment Plant and Sewage Pumping Station at Mahigran and Ganeshpur, Roorkee.

85RR (MT₁-06)

This study was sponsored to design the concrete mix for the concrete grade A₂₀M₃₀ at slump (110±10)mm on the basis of 28 days compressive strength for 33 MLD Capacity Sewage Treatment Plant and Sewage Pumping Station at Mahigran and Ganeshpur, Roorkee by M/S KEC-WATERLEAU (JV), H. No.-277/6A, 20 Civil Lines, Behind Prakash Hotel, Roorkee. Study of concrete mix design for above grade of concrete has been carried out on 150mm size cube specimens. Ordinary Portland Cement-43 grade (Jay Pee Cement), Coarse aggregate (Crushed), Fine aggregate (Crushed) and Water Reducing Concrete Admixture 'Plastiment-100' have been used in the study of concrete mix design. Sponsor desired the slump (110±10)mm at the mixing plant. As desired by the sponsor, slump of concrete also measured in the laboratory after 30 minutes. After 30 minutes the slump decreases by (30±5)mm.

(viii) MATERIAL TESTING UNIT- 2

(47) Annual Report, Material Testing Unit-2.

85RR (MT₂-01)

The report deals with activity and financial status of Material Testing Unit – 2, for the year 2013-14.

(ix) SOIL RESEARCH UNIT- 1

(48) Annual Research Report, Soil Research Unit -1.

85RR (S₁-01)

The studies and activities undertaken by the Soil Research Unit - 1 during the year 2013 -14 are documented in the report.

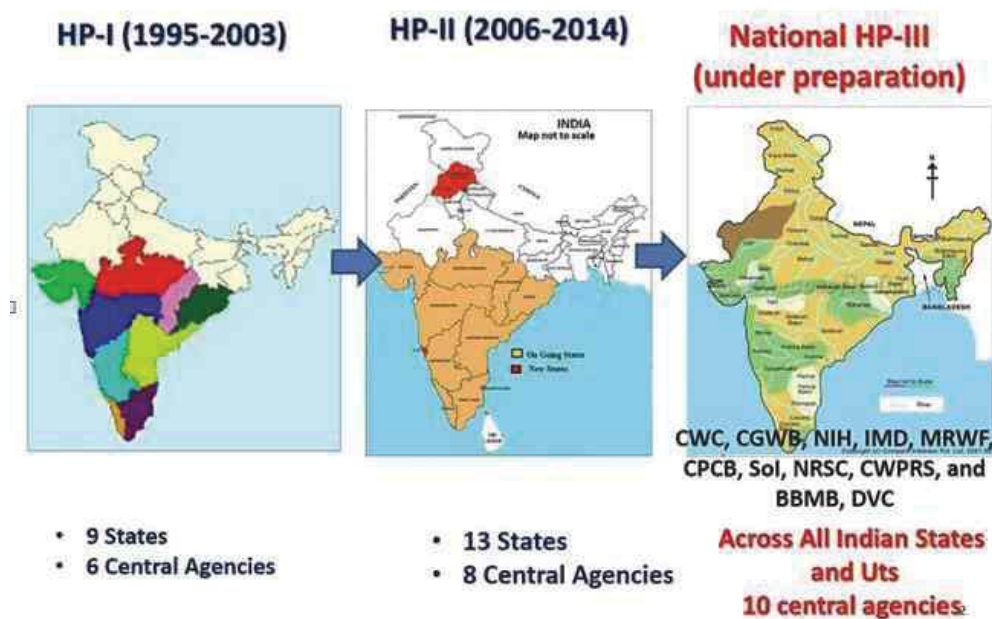
(b) NEW INITIATIVE

1. Hydrology Project-III

Hydrology Project is an ambitious joint project of Centre Government and State Governments, which was started in 1995 as Hydrology Project-I with the aim to establish an effective and sound system of Hydrological Information System (HIS), Decision Making Support System (DSS) and for establish a hydrologic database, National as well as State chapter of India-WRIS (website), National as well as State WR e-library WR Planning & Applications in 9 southern states of India. The project was implemented in four sectors viz. Hydrometeorology, Surface Water, Ground Water and Water Quality.

After completion of HP-1, HP-2 was started in 2006 in 4 more states (Punjab, H.P., Goa, Puducherry) and 2 central agencies incorporating the drawbacks addressed in HP-1 with some additional objectives and was completed in 2014.

After completion of HP-2, HP-3 has been started in 2014 in all 29 states and 7 UTs incorporating the drawbacks addressed in HP-2 with some additional objectives. The main objectives of HP-III are



Improving Water Resources Monitoring Systems (WRMS)

Appropriate financial and human resources channeled to state meteorological institutions/laboratories.

Baseline Water Resources Information Systems

An effective system of protocols for issuing alerts to various stakeholders.



Water Resources Management Applications:

Implementation of the concept of Integrated Water Resources Management (IWRM) to attain sustainable water resources development of the state.

Strengthening Institutions and Capacity Building

Technological upgradation and capacity building activities targeting government and nongovernment stakeholders at all levels.

Irrigation Research Institute, Roorkee is nominated to implement the HP-III in Uttarakhand State. In HP-III for Uttarakhand state the following issues were taken

- **Water Resources management:** Presently, surface water (streams) is the most exploited source of water for drinking and irrigation purposes in hilly regions of Uttarakhand. Most of Himalayan springs have dried up due to interference in their natural recharge caused mainly by deforestation. Therefore, only systematic hydrological studies to assess available localized water resources can provide solutions to the water scarcity problems, especially in the rural areas.
- **Flood forecasting:** The data obtained from poor network of rain gauges and lack of proper weather monitoring network in the state is unable to represent the actual rainfall distribution in Uttarakhand due to its varied topography. Absence of early warning system and a proper monitoring system is also felt in the state to deal with disaster management during extreme events like floods. Creation of an independent flood forecasting system for Uttarakhand state is the urgent need of hour to save the loss of lives and properties.
- **Sedimentation Studies:** Sedimentation affects both the useful life of a reservoir for such important purposes as flood control and water supply as well as its aesthetic quality. In response to concerns about sedimentation studies may be undertaken with objectives to: (1) estimate total sediment volume and mass, (2) estimate annual sediment deposition and yield from the basin and (3) determine the occurrence and trends of constituents, etc. in critical zones of different river basins.

The following outputs are supposed to be come out after implementation of HP-III in the state

- The development of capacity and tools within the state to support planning and decision-making in IWRM and the operation of water resources system.
- Provision of information on the latest available monitoring equipment for hydro-meteorology, as well as information on available tools and modelling software for flood forecasting and management and water resources planning and management.
- The water quality and sedimentation potential of different rivers in different critical reaches will be assessed which will become a tool for planning the water quality and sedimentation load assessment of different river basins in the state.



2. Quality assurance and Testing Works for Ardh-Kumbh Mela 2016 to be held at Haridwar (Uttarakhand)

After successful completion of Maha Kumbh mela at Haridwar in the year 2010, Ardh-Kumbh mela is proposed to be held in the year 2016 just after six years of Maha Kumbh mela at Haridwar. For successful and peacefully organizing of Kumbh Ardh-Kumbh Mela various construction works like construction of bridges, roads, buildings, stable, temporary shed, arrangement for water supply and sanitation, security structures, etc. are necessary to be done in advance. Various construction/renovation works are to be proposed for Ardh-Kumbh mela 2016 which are to be started recently. In this continuation, a meeting of High Level empowered committee was held on 27 February 2015 under the chairmanship of Chief Secretary, Government of Uttarakhand. In this meeting the work of **Third Party Quality Control Assurance** was allotted to Irrigation Research Institute, Roorkee which is an event of proud for this Institute.

3. Establishment of Highway Material Testing Laboratory at Irrigation Research Institute, Roorkee.

At present, there are various facilities available for the testing of different civil engineering materials including Ground Water and Hydraulics R&D works at Irrigation Research Institute, Roorkee (IRI) except some typical materials like bituminous items, paint, etc. As construction of roads has become a major part of the civil engineering industry after formation of NHAI, also the implementation of PMGSY, MNREGA, etc. After nomination of IRI, Roorkee as **Third Party Quality Control Assurance** agency for Ardh-Kumbh Mela 2016, it was felt necessary to establish a well-equipped Highway Materials Testing laboratory at IRI. Keeping the above in mind the management of IRI, Roorkee has decided to established a well equipped Highway Material Testing Laboratory at IRI, Roorkee. For this work preliminary works like requirement of tests, selection of instruments/equipments for the conducting the specified tests, initiation of procurement procedures, etc. were started, which is proposed to be established by end of June 2015.

Almost half of the population of the world lives in rural regions and mostly in a state of poverty. Such inequalities in human development have been one of the primary reasons for unrest and, in some parts of the world, even violence.

-A. P. J. Abdul Kalam



Technical Memo No. 85

Year 2014-15

SECTION - D TEST REPORTS

The section contains a list of Test Reports brought out during the year by various divisions. For detail information's regarding tests, the T. M. nos. have been mentioned.

(a) MATERIAL TESTING UNIT – 1

Material Testing Unit -1 essentially deals with the design of concrete mix including roller compacted concrete, high performance concrete and fiber reinforced concrete for hydraulic structures. Concrete lab carries out various lab tests for determination of suitability of physical properties of different types of construction materials such as bricks, brick tiles, cement, aggregates, steel bars etc. as per laid IS codes. Some of the tests carried out during the year are:

Sl.No.	T R No.	Title of Test Report
(1)	85 TR (MT ₁ -01)	Testing of c. c. cubes & bricks received from Tunnel & Power House Division-2, Dehradun.
(2-3)	85 TR (MT ₁ -02,37)	Testing of tor steel received from Construction Unit, U.P. Jal Nigam, Saharanpur.
(4-10)	85 TR (MT ₁ -03,13,16,33,34,36,45)	Testing of tor steel and coarse & fine aggregate received from Urban Works Unit, U.P. Jal Nigam, Muzaffarnagar.
(11)	85 TR (MT ₁ -04)	Physical properties of cement sample received from U.J.V.N. Ltd., Dakpathar.
(12)	85 TR (MT ₁ -05)	Physical properties of cement sample received from Flood Division, Bareilly.
(13-17)	85 TR (MT ₁ -06,10,24,55,56)	Testing of tor steel received from Unit-46, Construction & Design Services, U.P. Jal Nigam, Meerut.
(18-24)	84 TR (MT ₁ -07,14,15,42,43,44,51)	Physical properties of cement sample received from Urban Works Unit, U.P. Jal Nigam, Muzaffarnagar.
(25)	85 TR (MT ₁ -08)	Physical properties of cement sample received from Nagarjun Construction Company Ltd., Ramnagar, Roorkee.
(26-30)	85 TR (MT ₁ -09,21,22,28,29)	Testing of tor steel, c.c. cubes, bricks, coarse & fine aggregate received from Construction Unit, Uttarakhand Peyjal Sansadhan Vikas & Nirman Nigam, Rishikesh.
(31-34)	85 TR (MT ₁ -11,12,17,30)	Testing of tor steel, c.c. cube, bricks and coarse & fine aggregate received from Construction Unit-9, Construction & Design Services, U.P. Jal Nigam, Saharanpur.

(35) 85 TR(MT ₁ -18)	Physical properties of cement sample received from Construction Division, P.W.D., Ranikhet.
(36) 85 TR(MT ₁ -19)	Testing of c. c. cubes received from Irrigation Division, Almora.
(37) 85 TR(MT ₁ -20)	Physical properties of cement sample received from Investigation and Infrastructure Division, Uttarkashi.
(38) 85 TR(MT ₁ -23)	Testing of tor steel received from M/S SKT Buildcon Pvt. Ltd., Kashipur.
(39-42) 85 TR(MT ₁ -25,26,32,35)	Physical properties of cement sample received from Construction Unit, Uttarakhand Peyjal Sansadhan Vikas & Nirman Nigam, Rishikesh.
(43) 85 TR(MT ₁ -27)	Physical properties of cement sample received from Irrigation Division, Almora.
(44) 85 TR(MT ₁ -31)	Testing of tor steel and coarse & fine aggregate received from Construction Division, U.P. Jal Nigam, Baghpat.
(45) 85 TR(MT ₁ -38)	Testing of cement mortar & cement concrete cubes received from Irrigation Division, Uttarkashi.
(46) 85 TR(MT ₁ -39)	Testing of c. c. cubes received from Deputy Colector, Distt. Uttarkashi.
(47) 85 TR(MT ₁ -40)	Testing of c. c. cubes received from M/S Shilpi (India), 25, Civil Lines, Roorkee.
(48) 85 TR(MT ₁ -41)	Physical properties of cement sample received from Construction Division, U.P. Jal Nigam, Baghpat.
(49) 85 TR(MT ₁ -46)	Testing of c.c. cubes received from Construction Unit, Uttarakhand Peyjal Sansadhan Vikas & Nirman Nigam, Rishikesh.
(50-51) 85 TR(MT ₁ -47,53)	Testing of c.c. cubes received from M/S Govind Singh Bist, H. No.-38, Shibbu Nagar, Devi Road, Kotdwar.
(52-53) 85 TR(MT ₁ -48,49)	Testing of coarse aggregate received from Construction Division, PWD, Narendra Nagar.
(54) 85 TR(MT ₁ -50)	Physical properties of cement sample received from M/S KEC-WATERLEAU(JV), 20, Civil Lines, Roorkee.
(55) 85 TR(MT ₁ -52)	Testing of coarse and fine aggregate received from M/S KEC-WATERLEAU(JV), 20, Civil Lines, Roorkee.
(56) 85 TR(MT ₁ -54)	Testing of tor steel and coarse & fine aggregate received from Temporary Construction Division. U.P. Jal Nigam, Shamli.

To me there has never been a higher source of earthly honor or distinction than that connected with advances in science.

-Charles Darwin

(b) MATERIAL TESTING UNIT – 2

The Material Testing Unit-2 deals with in-situ tests on rock mass and laboratory tests on intact rock samples received from different project authorities for the determination of engineering properties of rock so that the same may be used for the design of structures related to Civil Engineering and River Valley Projects. In-situ tests such as Uniaxial jacking test, Flat jack test, Block shear test, Anchor pull out test, Bearing capacity test and Load test on Bridges and aqueducts etc. are carried out by this division whereas various laboratory tests viz. Unconfined Compressive Strength, Modulus of elasticity & Poisson's ratio, Dynamic modulus of elasticity, Shear parameters like Cohesion coefficient 'c' and Angle of internal friction ' ϕ ', Tensile strength, Point load strength index, Resistance to wear by abrasion, Durability / Soundness etc. are carried out in the Rock Mechanics Laboratory of this division. The division also maintains and upkeeping the various Technical Memorandums & Reports issued by various divisions of the Institute.

Sl. No.	T R No.	Title of Test Report
(57)	85 TR (MT ₂ -01)	Determination of Bearing Capacity of Ghat Netra-Salam Moter Marg Bridge Site, Lohaghat (Champawat), Uttarakhand.

(b) SOIL RESEARCH UNIT - 1

The Soil Research Unit – 1, has three well equipped Soil laboratories. The division is mainly responsible for carrying out the laboratory testing for the determination of engineering properties of soils, field investigations for determination of Bearing Capacity of foundations, in-situ shear parameters, modulus of sub grade reaction, in-situ permeability and sub-soil strata to study the seepage behavior etc.

Sl. No.	T R No.	Title of Test Report
(58)	85 TR (S ₁ -02)	Determination of silt factor of two samples received from Senior Manager (Civil) NM&JS HEPS, SJVN Mori Uttarkashi.
(59)	85 TR (S ₁ -03)	Determination of silt factor of two samples received from Executive Engineer, Avsthapna Division, Dehradun Uttarakhand.
(60)	85 TR (S ₁ -04)	Determination of silt factor of three samples received from Executive Engineer, Research Avsthapna Division, Uttarkashi (Uttarakhand)
(61)	85 TR (S ₁ -05)	Determination of silt factor of eight nos. samples received from Executive Engineer, Irrigation division Haridwar Uttarakhand.
(62)	85 TR (S ₁ -06)	Determination of silt factor of fourteen no. samples received from Executive Engineer, Irrigation division, Uttarkashi Uttarakhand.
(63)	85 TR (S ₁ -07)	Determination of silt factor of one no. soil sample received from Executive Engineer, Irrigation division Dugadda, Uttarakhand.
(64)	85 TR (S ₁ -08)	Determination of silt factor of ten no. soil samples received from Executive Engineer, Infrastructure division Uttarkashi Uttarakhand.
(65)	85 TR (S ₁ -09)	Determination of silt factor of three no. samples received from Executive Engineer, Irrigation division, Narendra Nagar, Tehri Garhwal, Uttarakhand.

(c) SOIL RESEARCH UNIT – 2

The Soil Research Unit – 2, comprises of two sub divisions viz. Chemical Laboratory (Sub division-1) and Soil Laboratory (Sub division-2)

Chemical laboratory carries out various tests viz. chemical analysis of water samples for examining its suitability for use in Irrigation, drinking and Cement Concrete test purposes. Chemical analysis of Cement Mortar/Cement Concrete samples are tested to find out mix proportions of cement, sand & ballasts and various constituents of cement by Gravimetric method. Test for Alkali reactivity test of aggregate samples, silt contents in water samples and grain size distribution of silt samples are also conducted here.

Soil laboratory of this division with tests deals soil classification, determination of engineering properties of soil samples, field investigations for determination of bearing capacity of foundation soil and in-situ permeability test of soils.

Sl.No.	T R No.	Title of Test Report
(66)	85 TR(S ₂ -02)	Chemical analyses of Cement Concrete samples.
(67)	85 TR (S ₂ -03)	Chemical analyses of Cement Mortar samples.
(68)	85 TR (S ₂ -04)	Determination of Silt factor of soil samples.
(69)	85 TR (S ₂ -05)	Determination of Silt factor of soil samples.
(70)	85 TR (S ₂ -06)	Grain Size distribution of silt samples.

There cannot be a greater mistake than that of looking superciliously upon practical applications of science. The life and soul of science is its practical application...

-William Thomson



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Year 2014-15

SECTION - E

(a) Officer In-charge during the Year 2014-15

CHIEF ENGINEER (DESIGN) & DIRECTOR IRI, ROORKEE

Er. Ajay Verma

Senior Staff Officer

Dr. Subhash Mitra

Superintending Engineer

Research Circle

Er. N.K. Sharma

Hydraulics Circle

Dr. Subhash Mitra

HYDRAULIC RESEARCH UNIT- I

Research Officer

Er. S.K.Saha

Assistant Research Officer-I

Er. Shashwat Raj

Assistant Research Officer-II

Sh. Surendra Mohan

Assistant Research Officer-III

Sh. Amarjeet Shah

Assistant Research Officer-IV

Sh. Jatin Bhardwaj

HYDRAULIC RESEARCH UNIT- II

Research Officer

Er. Ajay Kumar

Assistant Research Officer-I

Er. Sumit Malwal

Assistant Research Officer-II

Sh. Sushil Kumar

Assistant Research Officer- III

Sh. Surendra Kumar

Assistant Research Officer-IV

Ms. Salma Jahan

BASIC RESEARCH UNIT- I

Research Officer

Sh. Sushil Kumar

Assistant Research Officer- I

Sh. Sushil Kumar

Assistant Research Officer- II

Sh. Vinod Kumar

Assistant Research Officer- III

Sh. Chhatter Singh



BASIC RESEARCH UNIT– II

Research Officer	Er. B.K. Pandey
Assistant Research Officer-I	Sh. Ajay Kumar
Assistant Research Officer—II	Sh. Ram Swaroop
Assistant Research Officer III	Sh. Ram Swaroop
Assistant Research Officer—IV	Er. Arun Kumar Singh

GROUND WATER RESEARCH UNIT – I

Research Officer	Er. Kapil Kumar
Assistant Research Officer-I	Ms. Neha
Assistant Research Officer-III	Sh. Surendra Kumar

GROUND WATER RESEARCH UNIT - II

Executive Engineer	Er. Kapil Kumar
Assistant Research Officer-I	Sh. R.R. Mohan
Assistant Research Officer- II	Er. R.K. Pandey

MATERIAL TESTING UNIT – I

Executive Engineer	Sh. Bijendra Pal
Assistant Research Officer-I	Sh. Bijendra Pal
Assistant Research Officer- IV	Sh. Dheer Singh

MATERIAL TESTING UNIT – II

Executive Engineer	Sh. R.R. Mohan
Assistant Research Officer- II	Sh. Ram Ashish
Assistant Research Officer-III	Sh. Ajay Kumar



SOIL RESEARCH UNIT – 1

Research Officer

Sh. Dheer Singh

Assistant Research Officer- I

Sh. Kanwer Pal

Assistant Research Officer- III

Er. R.K. Pandey

Assistant Research Officer- IV

Sh. Sukhvir Singh

SOIL RESEARCH UNIT – 2

Research Officer

Er. S.L. Badri

Assistant Research Officer- I

Sh. Kishan Lal

Assistant Research Officer- II

Ms. Sheela Rani

ADMINISTRATIVE DIVISION

Executive Engineer

Er. Dixant Gupta

Assistant Engineer- I

Er. S.K. Mangai

Assistant Engineer- II

Er. L.M. Kuriyal

Assistant Engineer-III

Er. D.S. Rawat

Assistant Engineer-IV

Er. S.C. Pant

Assistant Engineer-V

Er. Vivek Kumar

(b) PARTICIPATION IN HIGH LEVEL MEETING / SEMINAR / WORKSHOP.

Sl. No.	Name of Seminar/ Symposium / Workshop / Training etc.	Place	Date	Name of Research Personnel who attended
1.	BIS Meeting	BIS, Manak Bhavan, New Delhi	28 Jun, 2014	Er. S. K. Saha, EE
2.	One day Workshop on Sustainable Construction for Hilly Regions	Dehradun	9 July, 2014	Dr. Subhash Mitra, SE Er. Pratibha S. Sant, AE Er. Arun K. Singh, AE
3.	Meeting of 75 th Governing Body of NIH	MoWR New Delhi	19 Jan, 2015	Er. N.K. Sharma SE
4.	Hydrology Project-3	New Delhi	24 Jan, 2015	Er. S. K. Saha, EE
5.	Hydrology Project-3	New Delhi	27 Jan, 2015	Er. N.K. Sharma SE Er. P.K. Mall, EE Er. S. K. Saha, EE Er. B.K Pandey, EE Sh. Sushil Kumar, RO
6.	Workshop on Role of Land Cover Mapping in Participatory Sustainable Resource Management conducted by IIRS Dehradun	Dehradun	30 Jan, 2015	Sh. Chhatter Singh, RO Km. Ghizala Parveen, SA
7.	Third IIRS User Interaction Meet (IUIM-2015)	IIRS, Dehradun	26-27 Feb, 2015	Sh. Sushil Kumar, RO Sh. Chhatter Singh, ARO
8.	BIS Meeting on Rock Mechanics Sub Committee	Roorkee	Feb, 2015	Dr. Subhash Mitra, SE
9.	Hydrology Project-3	New Delhi	16 Mar, 2015	Er. S. K. Saha, EE
10.	National Conference on Research and Innovations in Engineering & Technology	COER, Roorkee	28-29 March, 2015	Er. Pratibha S. Sant, AE

(c) Visitors

Sl. No.	Name / Designation & Address	Project	Date
1	Mr. Jitendera Singh, A.G.M.	Bogibil	17/06/2014
2	Mr. Neeraj Aggarwal, S.D.G.M. Mr. Vikalp Panday, A. M.	Bogibil	18/06/2014
3	Mr. G.Guyot, Expert edf France	Tehri PSP	02/07/2014 to 04/07/2014
4	Mr. Sheshmani, (Manager Engineering & Design) Hindustan Construction Company, Mumbai	Tehri PSP	02/07/2014 to 04/07/2014
5	Mr. Jitendera Singh, A.G.M. Mr. Neeraj Aggarwal, S.D.G.M	Bogibil	03/07/2014
6	Mr. R.K.Dayal, G.M. Mr. Dr.R. A.Oak (Consultant RITES) Mr. Neeraj Aggarwal, S.D.G.M Mr. Vikalp Panday, A. M.	Bogibil	15/07/2014
7	Mr. Saurabh Joshi, Engineer	Naitwar- Mori	30/07/2014
8	Mr. Saurabh Joshi, Engineer	Naitwar- Mori	31/07/2014
9	Mr. Kali Prasad, E.E., Dibrugarh Mr. Nandanwar, G.G.M., RITES Mr. R.K. Dayal, G.M., RITES Mr. J. Singh, A.G.M., RITES Mr. Neeraj Aggarwal, S.D.G.M.,RITES Mr. Vikalp Panday, A. M.	Bogibil	05/08/2014
10	Mr. Vikalp Panday, A. M.	Bogibil	12/08/2014
11	Mr. Om Jangid, Manager, L & T Dr. R. S. Varshney, Consultant L & T.	Lata-Tapovan	09/12/2014
12	Mr. Om Jangid, Manager, L & T Dr. R. S. Varshney, Consultant L & T.. Mr. B. Prasad, D.G.M., (Hydro Engg) N.T.P.C. Mr .Amar Singh, (Hydro Engg) N.T.P.C. Mr.Gunjan, (Hydro Engg) N.T.P.C. Mr. Prakash Chandra, (W.A.P.C.O.S.) Mr. Samay Singh, (W.A.P.C.O.S.) Mr. Geet Aggarwal, (W.A.P.C.O.S.) Mr. Rakesh Arora, L & T. Mr. Amarpal Singh, (Chief Engg.)	Lata-Tapovan	10/12/2014
13	Mr. Lalit Gupta, (Sr.Manager Hydro Engg) N.T.P.C., Noida Mr. Amar Singh, (Manager Hydro Engg) N.T.P.C., Noida Mr. A.K. Singh, (Manager Hydro Engg) N.T.P.C., Noida	Lata-Tapovan	30/12/2014
14	Mr. Saurabh Bhaumic, Engineer, L & T	Lata Tapovan	10/01/2015
15	Mr. Bishwanath Prashad, DGM (Hydro Engineer) Mr. Gunjan Mukherjee, Manager (Hydro Engineer) Mr. Vivekanand, Sr. Manager (Hydro Engineer)	Gadarwada STPP	20/02/2015
16	Mr. Saurabh Bhaumic, Engineer, L & T	Lata Tapovan	23/03/2015

(d) Vocational Trainings Provided by IRI, Roorkee.

Engineering Students of following Institutes took part as Group Trainees during 2014-15.

Sl. No.	Name of Institution	Period (In Weeks)
B.Tech (Civil Engineering)		
1	College of Technology, G.B.Pant University of Agriculture & Technology Pantnagar, (Uttarakhand)	04
2	College of Engineering Roorkee, Roorkee, (Uttarakhand)	04
3	G.B. Pant Engineering College, Ghurdauri, Pauri Garhwal, (Uttarakhand)	04
5	Bishambar Sahai Institute of Technology, Roorkee, (Uttarakhand)	04
6	THDC Institute of Hydro Power Engineering & Technology, Bhagirathipuram, Tehri	04
7	Phonics Group of Institutes, Roorkee (Uttarakhand)	04
8	Hindustan Institutes of Technology & Management, Ambala	04
9	Quantum School of Technology, Roorkee Dehradun Highway Roorkee (Uttarakhand)	04
10	Tula's Institution Selaqui Chakrata, Dehradun (Uttarakhand)	04
11	MKR Engineering Collehe of Information Technology, Ambedkarnagar (U.P.)	04
12	Roorkee College of Engineering, Bajuhari, Roorkee (Uttarakhand)	04
13	Bipin Tripathi Kumaun Institute of Technology Dwarahat, Almora (Uttarakhand)	04
14	UIT Dehradun and National Institute of Technology, Uttarakhand	04
15	Haryana Engg. College, Jagadhari (Haryana)	04
Diploma (Civil Engineering)		
1	Shakambbhari Institute of Higher Education & Technology, Roorkee	04
2	K.L. Polytechnic Roorkee, Uttarakhand	04
3	Uttaratech Polytechnic, Dhanauri, Roorkee, Uttarakhand	04
4	College of Advanced Technology, Roorkee, Uttarakhand	04
5	OM Institute of Technology Roorkee, Roorkee Uttarakhand	04
6	Swami Darshanand Institute of Management & Technology, Gurkul Mahavidhyalya, Jwalapur, Haridwar	04
7	B.S.M. College of Polytechnic, Roorkee, Uttarakhand	04
8	Motherhood Institute of Management & Technology, Roorkee, Uttarakhand	04
9	Ramanand Institute of Pharmacy & Management, Jwalapur, Haridwar	04
10	Govt. Polytechnic Srinagar-Garhwal (Uttarakhand)	04
11	Phonics Group of Institutions, Roorkee	04
12	IMS Institute of Technology, Roorkee	04
13	Roorkee College of Engineering, Canal Road, Roorkee	04
14	Bishamber Sahai Diploma Engineering Institute, Roorkee	04
15	Roorkee College of Polytechnic, Roorkee	04

(e) Time Schedule of Different Lab. Tests Carried Out at IRI Roorkee

(i) Soil Mechanics:

Sl.No.	Name of the Test	Days
1	Mechanical Analysis (Screen/ Sieve/ Hydrometer/ Liquid Limit)	10
2	Specific Gravity	1
3	Natural Moisture Content and Density	1
4	Compaction test	3
5	Maximum and Minimum density of cohesion less soil	1
6	Consolidation test (At Saturation)	15
7	Permeability test (At Saturation)	2
8	Direct shear test (60x60x20 mm)	4
9	Direct shear test (300x300x150 mm)	6
10	Unconfined compression test	1
11	Triaxial shear test (37.5mm Dia x 75mm high) { At OMC/NMC & Saturation }	4 - 8
12	Triaxial Compression test (100mm Dia x 200mm high)) { At OMC/NMC & Saturation }	4 - 8
13	Triaxial Shear Test (200mm Dia x 400mm) { At OMC/NMC & Saturation }	10-15
14	Large size permeability test (50 cm dia)	2
15	Dispersibility test	10

(ii) Chemical Analysis of Cement Mortar/Water Sample/Soil Sample etc.:

Sl.No.	Name of the Test	Days
1	Chemical Analysis of Cement Sample	23
2	Chemical analysis of Cement Mortar /Concrete Sample	14
3	Chemical Analysis of Water Sample	14
4	Alkali Aggregate Reacting test of Alkali Aggregate Sample	14
5	Silt content(mg/liter) in Water Sample	3
6	Determination of grain size distribution of Silt Sample	3

(iii) Rock Mechanics:

Sl.No.	Laboratory Test	Days
1	Modulus of Elasticity and Poisson Ratio	2 – 3
2	Unconfined Compressive Strength on Rock core Specimen	2 – 3
3	Shear Parameters 'C' and 'Ø'	3
4	Point Load Strength Index/Tensile Strength	1
5	Water Absorption/Porosity/Density	2 – 3
6	Cutting, Grinding and Polishing of rock cubes	2
7	Drilling, Cutting, Grinding and Polishing of rock core	2
8	Co-efficient of Permeability	2 – 3
9	Abrasion Test (by Dorry's Method)	1

(iv) **Material Testing:**

Sl.No.	Name of the Test	Days
[A] Concrete		
1	(i) Cement Concrete Mix Design (28 days basis)	70
	(ii) Cement Concrete Mix Design (90 days basis)	160
	(iii) Cement Concrete Mix Design (180 days basis)	250
	(iv) Roller Compacted concrete Mix Design	75
2	Compressive Strength of Concrete cubes as per requirement	1-28
3	Flexural Strength of Concrete beams as per requirement	1-28
[B] Bricks/ Brick Tiles		
1	Warpage	1
2	Water absorption/ Flexural Strength (only for Tiles)/ Efflorescence	3
3	Compressive Strength	6
[C] Steel/ Welded Joints (Upto 25mm dia)		
1	Tensile Strength (9 bars)	1
[D] Fine Aggregate		
1	Sieve Analysis, Unit Weight	1
2	Material finer than 75 microns	2
3	Specific gravity & Water absorption/ Organic Impurities	3
4	Soundness	6
[E] Coarse Aggregate		
1	Sieve Analysis/ Unit Weight/ Impact Value/ Crushing Value/ Abrasion Value/ Flakiness/ Elongation Index	1
2	Material finer than 75 microns	2
3	Specific gravity & Water absorption/ Organic Impurities	3
4	Soundness	6
[F] Cement		
1	Standard Consistency/ Setting time/ Fineness (Specific Surface)/ Specific Gravity	1
2	Soundness	2
3	Compressive Strength	28
[G] Pozzolana		
1	Standard Consistency/ Setting time/ Fineness (Specific Surface)/ Specific Gravity	1
2	Soundness	2
3	Compressive Strength	28-90
4	Lime Reactivity Test	28
[H] Abrasion Test		
1	By Sand Blast Method	2
2	By High Velocity Water Jet Method	3

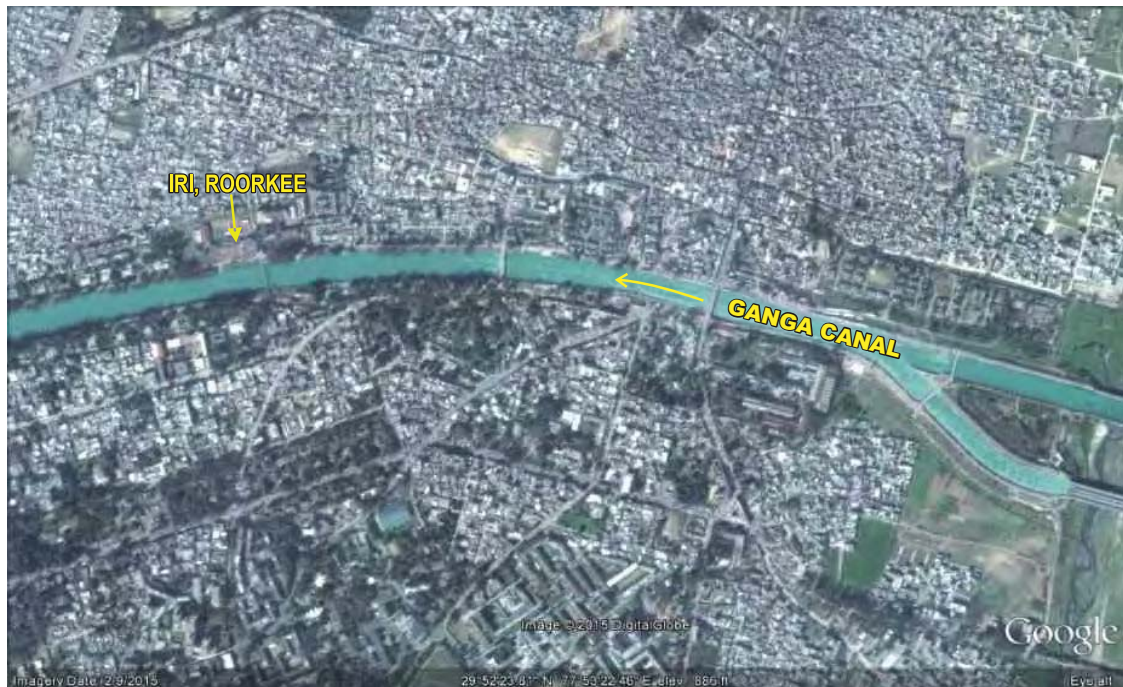
(v) Highway Testing Laboratory

Sl. No.	Name of the Test	Days
Bituminous Materials		
1	Specific Gravity Test	3
2	Water Content Test	3
3	Softening point Test	3
4	Penetration/ Penetration Ratio Test	3
5	Ductility Test	3
6	Loss on heating Test	4
7	Viscosity Test	4
8	Flash-point and Fire-point	3
9	Float Test	3
10	Distillation test	3
11	FRAASS Breaking Point Test	3

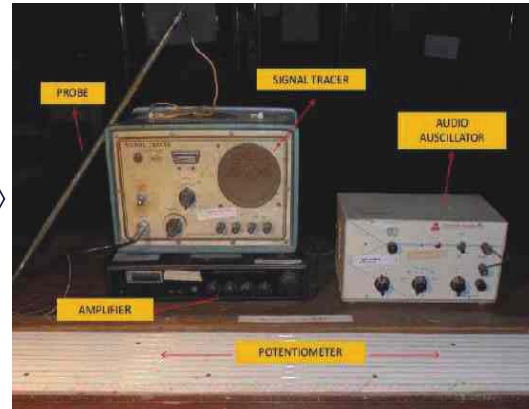
(f) PICTORIAL VIEWS OF R&D ACTIVITIES



A Panoramic View of Hydraulic Research Station, Bahadradab from Google Earth



A Panoramic View of Irrigation Research Institute, Roorkee from Google Earth



EHDA Model of Aqueduct at Km. 72.300 of Rapti Main Canal (UP) and Instrument Set-up in Ground Water Laboratory



Models for measurement of Discharge & Seepage Laboratory Losses using Tracer Technique in Isotope Laboratory



Meteorological Observatory Situated at Bahadrad



Abrasion Testing Machine in Material Testing Laboratory



Universal Testing Machine in Material Testing Laboratory



Additional Secretary Visit at Hydraulic Research Station, Bahadrabad (Haridwar)



Model Study for Vyasi Hydro Electric Project (Uttarakhand)

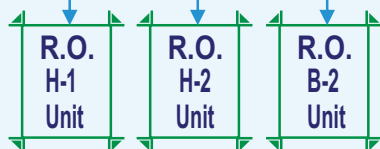


A View of Right Bank Shaft Spillway (Morning Glory) of Tehri Dam Site

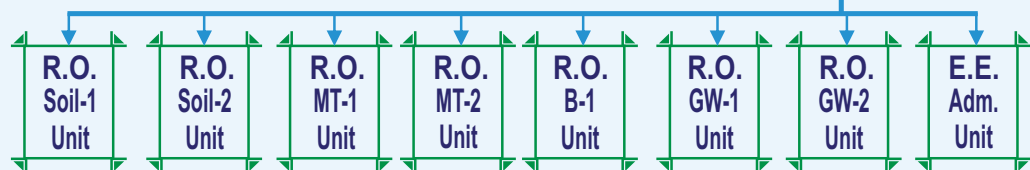
Organisational Setup of Irrigation Research Institute

Chief Engineer & Director

**Superintending Engineer
Hydraulic Circle**



**Superintending Engineer
Research Circle**



Assistant Engineer/Assistant Research Officer -33



Glimpses of Activities

Meteorological Observatory

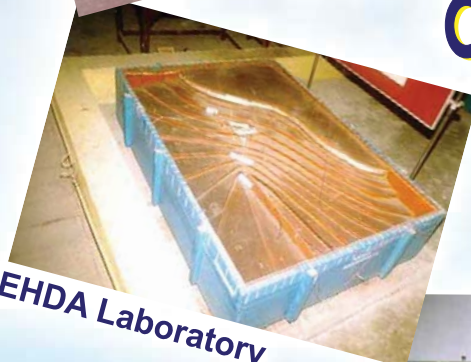


River Model



Model of Barrage

Consultancy Areas



EHDA Laboratory



Material Testing
Laboratory



Water Quality &
Chemical Laboratory

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